Qualifications Statement

QUALIFICATIONS STATEMENT
Investigation and Remediation




Loureiro Engineering Associates, Inc.
100 Northwest Drive, Plainville, CT 06062
860-747-6181
www.LoureiroEngineering.com

An Employee Owned Company

SULLIVAN & WORCESTER

Sullivan & Worcester LLP
1666 K Street, N.W.
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October 5, 2007

BY OVERNIGHT DELIVERY

Ms. Anna Krasko
U.S. Environmental Protection Agency, Region 1
One Congress Street, Suite 1100
Mail Code HBO
Boston, Massachusetts 02114-2023

Re: In the Matter of Centredale Manor Restoration Project Superfund Site
Administrative Settlement Agreement and Order on Consent

Dear Ms. Krasko:

I am enclosing, on behalf of Emhart Industries, Inc., two additional copies of the qualification statements for Loureiro Engineering Associates, Inc., AMEC Earth & Environmental, Inc., and Quantitative Environmental Analysis, LLC, the contractors who will perform the work delineated in the Statement of Work. These two copies, together with the copies previously fedexed to you (copy of our transmittal letter is also attached), bring the total number of copies we have provided you to four, pursuant to the Settlement Agreement.

Sincerely,

Jeffrey M. Karp
Attorney at Law

Direct line: 202 370-3921
jkarp@sandw.com

Enclosures

cc: Eve Vaudo, Esq. (w/out enclosures)

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October 2, 2007

BY OVERNIGHT DELIVERY

Ms. Anna Krasko
U.S. Environmental Protection Agency, Region 1
One Congress Street, Suite 1100
Mail Code HBO
Boston, Massachusetts 02114-2023

Re: In the Matter of Centredale Manor Restoration Project Superfund Site
Administrative Settlement Agreement and Order on Consent

Dear Ms. Krasko:

We are writing on behalf of Emhart Industries, Inc. ("Emhart") to identify the contractors who shall perform the work delineated in the Statement of Work, and to designate the Project Coordinator, pursuant to paragraphs 34 and 35, respectively, of the above-referenced Settlement Agreement.

Pursuant to paragraph 34, Emhart hereby notifies U.S.EPA that it has retained the following three contractors to perform the work. The requested contact information is provided below for each contractor, and its statement of qualifications is attached hereto.

1) Loureiro Engineering Associates, Inc.
100 Northwest Drive
Plainville, CT 06062

Contacts: Jeffrey Loureiro (860) 410-2915
David Scotti (860) 410-2976

2) AMEC Earth & Environmental, Inc.
15 Franklin Street
Portland, Maine 04101

Contacts: Dr. Russell Keenan (207) 879-2222
Patrick Gwinn (207) 879-2222

3) Quantitative Environmental Analysis, LLC
305 West Grand Avenue, Suite 300
Montvale, NJ 07645

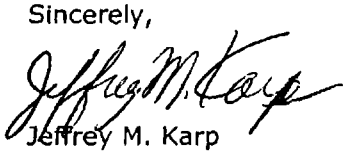
Contact: Dr. C. Kirk Ziegler (201) 930-9890, ext. 49

Pursuant to paragraph 35, Emhart hereby notifies U.S. EPA that it has designated Jeffrey Loureiro of Loureiro Engineering Associates, Inc. as its Project Coordinator. Mr.

Loureiro's contact information is provided above and his statement of qualifications is attached hereto.

Please contact the undersigned if you have any questions regarding the foregoing.

Sincerely,



Jeffrey M. Karp
Attorney at Law

Direct line: 202 370-3921
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JMK:llj

Enclosures

cc: Eve Vaudo, Esq. (w/out enclosures)

CONTENTS

Overview of Loureiro Engineering Associates

Engineering Capabilities and Services

Investigation and Remediation Qualifications

Quality Assurance and Quality Control

Customer Service

Selected Project Descriptions

Resumes

Overview of Loureiro Engineering Associates

BACKGROUND AND OVERVIEW OF LOUREIRO ENGINEERING ASSOCIATES, INC.

HISTORY AND CURRENT STATUS

Loureiro Engineering Associates, Inc. (LEA) is a Plainville, Connecticut based consulting engineering and environmental services company that has provided over 30 years of quality service to the industrial, commercial and government sectors throughout the United States and internationally. Founded in 1975, LEA provides comprehensive environmental, civil engineering, geotechnical and health and safety consulting services. Our experience ranges from small-scale designs to long-term, complex, multimillion-dollar projects. In addition to engineering services, LEA also has the capability of offering its client's turnkey design and construction services through its wholly owned construction subsidiary, Loureiro Contractors, Inc. (LCI).

Since the company's founding, LEA's management and employees have conducted their work with four guiding principles in mind:

- To provide our customers with a high level of quality service
- To provide personal attention to details and competitive pricing
- To satisfy our clients scheduled needs within their requirements
- To understand and focus on our client's goals and objectives

LEA's adherence to these principles has resulted in tremendous customer loyalty. In fact, over 90 percent of LEA's work comes from repeat business or word of mouth. Our customers know that LEA will get the job done quickly and efficiently.

Committed to ensure equal opportunity employment, LEA is an employee-owned (ESOP) company that maintains a multi-disciplinary staff of approximately 140 employees including a diverse staff of experienced licensed professionals. Our engineering staff includes civil, environmental, chemical, electrical, mechanical and structural engineers. In the area of earth sciences, our staff includes environmental scientists, geologists, hydrogeologists, and chemists. LEA's staff also includes experts in the fields of emergency planning, environmental health and safety, and drug and alcohol misuse. Our technical support services include computer-based data and information management systems, AutoCAD stations with GIS capabilities, Geoprobe™ drilling equipment, soil and environmental laboratory capabilities including a mobile laboratory, computer modeling, and survey and sampling equipment for conducting a variety of field surveys.

LEA formed its construction subsidiary in 1990 to provide site remediation and environmental clean-up services. In January 2000, LCI's services were expanded to include a variety of site work activities including demolition, site grading, roadway construction, and the installation of water, sanitary and storm sewers, and other underground utilities to complement its remediation services. At the same time, LEA began offering comprehensive design-build services to many of our clients.

In 2004, LEA acquired the talented staff and trusted experience of Barnhart, Johnson, Francis & Wild, Inc. (BJFW) of Avon, Connecticut. This acquisition has enabled LEA to now provide the highest quality structural, mechanical and electrical engineering services to our clients.

The unique One-Team unity between our design and construction staff offers many advantages to our clients. By drawing upon the combined skills and experience of our staff in both the design and construction arenas, LEA confidently incorporates innovation in design and accuracy in our project cost estimates, both of which are imperative to a successful project.

LICENSURE AND CERTIFICATIONS

LEA promotes licensure and/or certification for various disciplines for all employees within the organization. Our staff presently includes Professional Engineers (PE), Certified Hazardous Materials Managers (CHMM), Certified Professional Environmental Auditors (CPEA), Certified Safety Professionals (CSP), Certified Industrial Hygienists (CIIH), Professional Geologists (PG) and Licensed Environmental Professionals (LEP), all licensed to practice in the State of Connecticut.

ORGANIZATIONAL STRUCTURE

The organization and staffing for all work performed by LEA is managed through a project team. Depending on the size and nature of the project, selected individuals are brought together to form the project team. These individuals are chosen on the basis of their previous experience and expertise relative to the particular project and their strong management and technical abilities. The team assembled for a project usually consists of one project officer, one project manager, one or more project engineers and other technical support staff members. The project officer, manager and engineers, together, provide the nucleus of the entire staff effort throughout all phases of the project.

The primary purpose of the project team is to ensure realization of the specific objectives associated with the detailed scope of the project. The project officer is the principal-in-charge and is responsible for the overall project direction and the allocation of resources. The project manager is directly responsible to the project officer. The project manager's responsibilities include planning and monitoring the progress of the work as well as assuring its technical accuracy and timely completion. The project manager is responsible for the overall coordination of the project, the technical review of reports and documents, participation in meetings, and is often the primary contact for the client. The project engineers and/or geologists are responsible to the project manager for the technical execution of the project on a day-to-day basis. Work plans and schedules are updated in conjunction with the submittal of periodic progress reports to the client to track the status of the project. Internally, progress is monitored on a weekly basis utilizing computerized monitoring techniques and weekly project manager meetings to ensure appropriate allocation of personnel resources and time to satisfy established deadlines.

The project team members are carefully selected to provide complete continuity throughout the planning, design, bid, construction and operational phases of the program, closely integrated with ongoing quality assurance. All projects are subject to a QA/QC review at designated completion milestones by the Quality Assurance Coordinator assigned to the project. Where applicable, the QA/QC review will include a complete constructability assessment by a representative of LCI for the purpose of providing construction-oriented input to the design review process.

In order to ensure that senior management is familiar with all projects being performed by LEA, all LEA project officers and managers attend weekly project manager meetings. Staff members working on a project attend project-specific team meetings, as scheduled by the project manager, to improve the flow of communication among all project team members.

LEADERSHIP IN THE FIELD

Loureiro Engineering Associates, Inc. has worked extensively with governmental agencies, including municipal, state and federal institutions. Over the span of our 32 years of practice in the environmental field we have developed many positive relationships with individuals at the Connecticut Department of Environmental Protection (CT DEP) and the Environmental Protection Agency (EPA) Region 1 where we are well known for our high-quality work products and professionalism.

AFFIRMATIVE ACTION

LEA maintains a rigid policy of equal employment and advancement opportunity for all qualified individuals without distinction or discrimination because of race, color, sex, creed, age according to law, national origin or mental or physical handicaps.

This policy extends to all employees and all aspects of the employment relationship, and continues a full and firm commitment to recruit, hire, train, and promote in all job classifications, to ensure that the promotion process, compensation, benefits, transfers, layoff, recall, training, educational assistance and social and recreational programs will be objectively administered without regard to race, color, sex, creed, age according to law, national origin or mental or physical handicaps.

FINANCIAL STABILITY

LEA has been in business for over 30 years providing our clients with the solutions that they need. In 1999, Mr. Julio Loureiro, the founder of LEA, elected to offer the company to the employees through an employee stock ownership plan or ESOP. This transition was initiated in 2000 and the success of the company has continued ever since. In calendar year 2001, Loureiro Engineering Associates was recognized as one of the fastest growing engineering companies in the United States by Zweig-White.

As further evidence of our financial stability, we refer you to our Dunn & Bradstreet D-U-N-S number 010166403. Additional information regarding our financial stability may be provided upon request.

Engineering Capabilities and Services

OVERVIEW OF LEA ENGINEERING CAPABILITIES AND SERVICES

LEA offers a complete range of engineering and other special services. An overview of the services we offer includes those listed below.

ENVIRONMENTAL ENGINEERING SERVICES

LEA has been retained by large and small municipal and private sector clients since 1975 to provide environmental consulting services varying from conceptual and feasibility planning through detailed plans and specifications for virtually all aspects of environmental and civil activities involving phased environmental assessments, hazardous waste management, soil and groundwater investigations, hazard waste remedial action plans, industrial wastewater treatment facilities, municipal sewerage collection and treatment facilities, and stormwater drainage systems,. We offer significant advantages in combining our environmental services with our health and safety programs, since both overlap in many circumstances. We also offer design build services in conjunction with out wholly owned construction subsidiary Loureiro Contractors, Inc. (LCI).

Remedial Investigation/Feasibility Studies

LEA has been providing comprehensive investigation and feasibility study services to our clients for over 30 years. In recent years, the firm has conducted extensive soil and groundwater investigations, evaluated appropriate remedial alternatives, and implemented remedial measures to address contamination in soil and groundwater. The work has been conducted in a variety of hydrogeologic settings, and the nature of the releases has impacted soil, groundwater in both overburden and bedrock aquifers, surface water, and sediment.

To date, LEA has completed numerous site investigation/feasibility projects with a significant range in both complexity and magnitude with total fees ranging from less than $50,000 to greater than $4,000,000. These projects ranged in scope from the installation of a few soil borings and groundwater monitoring wells to the detailed hydrogeologic and contaminant delineation investigations in soil, groundwater, surface water and sediment.

LEA recently completed a large-scale sediment remediation project for United Technologies Corporation, Pratt & Whitney Division located within Willow Brook and Willow Brook Pond. This project initially involved a detailed alternatives analysis, which presented and evaluated a host of potential solutions to this contamination issue. The alternatives were evaluated based on feasibility; cost; compliance with the applicable local, state and federal regulations; the need to satisfy specific environmental standards; and the protection of human health. Based on these evaluations, a final remedy was selected, the associated permits and approvals were acquired, and the project was completed as a design-build project through the combined efforts of LEA and LCI.

Remedial Design and Remedial Action Services

In recent years, LEA has drawn on its vast engineering capabilities to address the needs of our clients in the design of appropriate and cost-effective remedial action systems to treat a variety of wastes including contaminated soils and groundwater. Through these projects, we have often been responsible for providing start-up services and have been retained to provide long-term operation and maintenance activities for active waste treatment systems.

LEA, in conjunction with LCI, has completed a number of turnkey remedial design and remedial action projects. These projects have included a number of hazardous waste site closures for a number of industrial sites owned by P&W, Raytheon Corporation, Heublein, Inc., and the Delta Rubber Company. Other projects involved the design and installation of 40 CFR 265 Subpart D containment buildings; numerous soil vapor extraction systems for the treatment of VOC contaminated soils; air-sparging systems for the treatment of contaminated groundwater; several sub-slab ventilation systems to address indoor air quality; and groundwater 'pump and treat' systems for the treatment of impacted groundwater utilizing standard wastewater treatment technologies employing chemical precipitation, chemical flocculation, air stripping, aeration, as well as a multitude of other advanced treatment technologies.

Environmental Compliance Evaluations / Audits / Permit Assistance

LEA maintains a staff of highly qualified professionals who are current in the local, state and federal regulations that actively follow regulatory developments and policies. Our staff is similarly proficient in the preparation of environmental site assessments and conducting environmental audits for both industrial and municipal facilities. The site assessments have been performed in accordance with the requirements defined by our clients, lending institutions, and the American Society for Testing and Materials (ASTM). We have helped our clients develop detailed management procedures to comply with today's complicated environmental regulations.

LEA has extensive experience in the preparation of a variety of state and federal air, water and waste permits and registrations for municipal and industrial clients. We have prepared permit applications for the following programs:

- Emergency or Temporary Discharge Authorizations.
- General Permit for the Discharge of Stormwater from Industrial Activities.
- General Permit for the Discharge of Stormwater from Construction Activities.
- General Permit for Dam Safety Repair and Alteration.
- General and Individual Permits for Diversion of Water for Consumptive Use.

- General Permit for Lake, Pond and Basin Dredging.
- General Permit for Minor Grading.
- General Permit for Utilities and Drainage.
- Individual Permit – 401 Water Quality Certification.
- Individual Permit – Department of the Army Individual Section 404 Permit.
- Individual Permit – Stream Channel Encroachment.
- Individual Permit – Flood Hazard Certification.
- Programmatic General Permit – Section 404 of the Clean Water Act.

LEA has provided permitting assistance through many of above programs to a variety of industrial and municipal clients including Farmington, Kent, New Hartford, New Milford, Plainville, Plymouth, Stafford, Stamford, and the Canaan Fire District. Industrial clients include such large corporate entities as United Technologies Corporation, The Stanley Works, and the Black & Decker Corporation. LEA has performed due diligence assessments for a broad array of facilities and operations locally and, on a less frequent basis, for facilities located throughout the United States and internationally. As examples of our international experience, LEA has performed a due diligence assessment in Mexico for P&W and with a large multi-national manufacturer in southern China.

Stormwater Management Programs

Recently, the State of Connecticut has been focused on enforcement of the existing stormwater pollution prevention program for municipalities. LEA has prepared a number of Stormwater Pollution Prevention Plans (SWPPPs) for municipal public works garages and designed various pretreatment facilities for sediment reduction for a host of municipal and industrial stormwater projects. LEA has also prepared the associated permit registration applications and performed the necessary sampling and monitoring activities on behalf of the responsible parties. In the municipal sector these services are typically provided for solid waste transfer stations, public works garages, salt storage facilities, school bus terminals and compost/volume reduction facilities. Under the Phase II Stormwater Program, LEA provided assistance to the Town of Farmington to comply with the *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems* (*MS4s*) which involves the development of a town-wide Stormwater Management Plan including annual monitoring of existing stormwater outfalls.

Spill Prevention, Control and Countermeasure Plans

In response to EPA's Final Spill Prevention Control and Countermeasure Plans (SPCC) Rule changes of August 2002, LEA has been heavily involved in updating and preparing new SPCC plans for a variety of municipal and industrial clients throughout the country. The services we provide typically include the performance of a site inspection to verify and inventory oil storage and handling areas and oil transfer and loading operations; the preparation or updating of SPCC plans in accordance with Code of Federal Regulations 40 CFR 112, the preparation of inspection forms for use by personnel for the monitoring of the SPCC plan requirements; and the SPCC

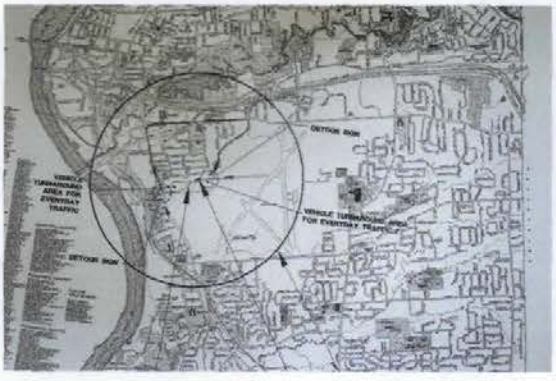
training (as required by the regulations) to key personnel, following issuance of the SPCC Plan.

Sanitary Landfill Site Closures & Certifications

LEA has completed a number of sanitary landfill closure projects which have involved conducting preliminary investigations and studies to determine the closure requirements; the preparation of detailed plans and specifications for the closure activities required by the DEP solid waste regulations for closure; assistance with the administration of the construction contract including the review and evaluation of the construction bids and periodic monitoring of the construction activities; completion of the certification of closure documentation including the as-built drawings; and post-closure activities including the necessary sampling and analyses of the groundwater and surface water samples located in the vicinity of the landfill site. We have provided many of these activities for the towns of East Granby, Farmington, Kent, Stafford and Plymouth, Connecticut and continue to provide the routine post-closure monitoring services for these towns in accordance with the solid waste closure permits and closure authorizations.

CIVIL AND SITE ENGINEERING SERVICES

For over 30 years, LEA has provided consulting engineering services in civil and site engineering. Our staff is experienced in working directly with the owners and developers of a project, its primary architects, technical support team and the applicable municipal land-use boards and commissions. We support our clients by integrating projects with site constraints, roadway construction, site grading, stormwater management, wetland mitigation and rehabilitation, drainage systems, utility services and other issues indigenous to civil and site development projects. In addition, through our wholly owned subsidiary, Loureiro Contractors, Inc. (LCI), we can also provide full construction services for such projects.



Engineering Feasibility Studies and Reports

LEA performs engineering feasibility studies as a matter of course for all of our engineering design projects, which include roadways, water main and sanitary sewer line extensions, salt storage facilities, solid waste transfer stations, and other public works facilities. These evaluations are completed via integration between our engineering staff and our construction staff to ensure that our projects are not only feasible, but also cost-effective. Construction input

is initiated from the onset of the project design to ensure value engineering is incorporated throughout the project.

LEA was retained by the Town of Stafford to conduct a detailed evaluation of the various regional alternative sewage disposal alternatives to serve the Crystal Lake area located in the adjoining Town of Ellington. Various wastewater treatment and disposal options were evaluated including: the installation of at least two sanitary sewer trunk lines with and without the need for a sewage pumping station discharging into the existing Stafford Water Pollution Control Facility; the construction of an on-site community subsurface sewage disposal system located in the vicinity of the lake with a discharge to the groundwaters; and the implementation of a sewer avoidance program for those properties located outside the designated sanitary sewer service area. The evaluation included determination of the impact of any future planned sewer facilities on the capacities of the existing town sewerage collection and treatment system, as well as considerations of unintended secondary residential growth resulting from extending the sanitary sewer service to the Crystal Lake area.

The environmental assessment and demographic analysis included a detailed analysis of existing zoning, population densities (with and without sewers), as well as an evaluation and projection of zoning changes as a result of the introduction of sewers. The study involved a detailed analysis of the existing and potential wastewater disposal problems within the planning area including the performance of a sanitary survey incorporating the preparation and distribution of wastewater questionnaires, personal interviews and attendance at public workshops to properly define the current status of pollution problems in the area. Public participation included all mandatory requirements for the basic program outlined by the U.S. EPA and the Connecticut DEP.

Conceptual and Detailed Design

For over 30 years, LEA has provided design services in the civil/site and environmental engineering arenas. Our services range in scope from the preparation of permit applications for various private development projects to the preparation of detailed design plans and specifications for different types of municipal improvement projects for a variety of clients. We have provided such design services to municipalities for the construction of public works facilities such as wastewater treatment plants, solid waste disposal and transfer stations, salt storage and truck washing facilities, roadways and related site work for public buildings such as schools and libraries as well as to a number of private clients for a variety of commercial, residential and industrial improvement projects.

LEA and our construction subsidiary, LCI, recently completed a large-scale design-build project, which included the design and reconstruction of a roadway located within the Town of East Hartford. The design elements of this project included vertical and horizontal roadway realignment, signalization, lighting, pedestrian interface, drainage and flood hazard permitting.

For more than seven years LEA provided civil engineering design services for a major urban revitalization project involving the complete demolition and reconstruction of several hundred housing units in the City of New Haven. The work included conceptual and detail design of several city streets, sanitary and stormwater drainage systems; water distribution lines/service connections; gas mains; power, telephone and cable TV services as well as demolition plans related to the various existing utility services.

LEA was retained by the Town of Mansfield, Connecticut to provide a detailed review of a proposed stormwater drainage system for a large housing project developed by the University of Connecticut. This particular project, which was designed by one of the University's consultants, involved local inland wetland and watercourse commission approvals, and a Flood Management Certification and Dam Safety Permit through the DEP. LEA's primary responsibilities included a detailed review of the permit application packages; the verification of the hydraulic computations and modeling programs used by the University's consultant; providing recommendations for best-management practices; and providing presentations at public hearings/meetings.

Construction Management/Support Services

LEA has extensive experience in contract administration and construction monitoring services for a wide variety of projects including utility installations, roadway construction, soil remediation projects, site improvements for industrial/municipal/commercial buildings and water and wastewater treatment facilities. We have a staff of experienced field technicians, which is augmented by our engineering and construction staff. The unique unity between our technical, engineering and construction staff offers many advantages to our clients in that a comprehensive understanding of all facets of the project is maintained throughout the design and construction phases.

Our contract administration experience ranges from projects that LEA has performed the engineering design services for to other projects designed by other consultants. Many of our construction monitoring services are performed on behalf of municipalities to ensure that their interests are represented throughout the performance of the construction activities. Our observation reports are comprehensive and have been useful to many of our clients in dispute resolution, and compliance demonstration.

LEA recently provided construction monitoring services for the urban revitalization project referenced above for over a four year period, involving the reconstruction of several hundred housing units in the City of New Haven. Our services included observation of the reconstruction of several city streets, sanitary and stormwater drainage systems; water distribution lines/service connections; gas mains; power, telephone and cable TV services. For a recent closure of a former sanitary landfill and the construction of a solid waste transfer station and recycle facility for the Town of Stafford, our services included obtaining bids from local contractors, material suppliers and equipment venders; recommending award of the contracts; managing all the work conducted on-site; retaining the necessary material testing services; reviewing payment requisitions; and providing status reports on a regular basis to the town. The project was highly successful in attaining the objectives of the town within their budget. LEA also assisted the town in obtaining the required permits from the Connecticut DEP.

Geotechnical and Construction Testing Services

LEA offers a wide range of field services to perform sub-surface explorations and for testing soil and concrete materials for earthwork, foundations, and environmental applications. LEA maintains its own fleet of direct-push drilling rigs used to obtain soil and groundwater samples. We also have a soils laboratory equipped to perform a variety of tests for soil classification, permeability, percent compaction and for the determination of moisture content using standard methods and procedures established by ASTM, AASHO, the U.S. Army Corp of Engineers and others. Additional geotechnical services can be provided by special sub-consultants and laboratories available to us in the area as discussed in a later section of this proposal.

STRUCTURAL, MECHANICAL AND ELECTRICAL ENGINEERING

LEA acquired Barnhart Johnson Francis and Wild, Inc. (BJFW) in March 2004. Founded in 1975, BJFW has been providing multi-disciplined civil, structural, mechanical and electrical consulting engineering services to governmental, corporate, institutional, and industrial clients. Over half the firm's professional staff members are registered Professional Engineers, and all of them have been with the firm for five or more years providing the stability and depth of experience that are hallmarks of LEA. The acquisition of BJFW has enhanced our traditional engineering capabilities at LEA and further strengthened the unique unity between our design and construction staff.

BJFW personnel have been engaged in municipal facility projects in the towns of Avon, East Granby, Farmington, Glastonbury, Harwinton, Manchester, Plainville, Simsbury, Somers, West Hartford, Westport, Windsor, and other Connecticut communities. Project types have ranged from school boiler and piping replacements in public schools, and HVAC system upgrades and replacements for libraries, public works facilities, and fire stations. Further examples of their broad range of experience include similar projects for the State of Connecticut, U.S. Navy, several private schools (Choate, Suffield Academy, Kingswood Oxford), Aetna Life & Casualty, CIGNA Corporation, The Institute of Living, Phoenix Mutual Insurance Co., and several industrial clients (Divisions of UTC, Ensign-Bickford Industries, and Stanley Works) for whom they have developed a continuing relationship for more than ten years.

Projects for these and other clients have included field investigations and surveys, special studies, and the design for alterations, expansion, renovation, rearrangement, and modifications of existing structures and process equipment as well as for new construction processes.

HEALTH & SAFETY SERVICES

Elements of our health and safety program services have included many of the Occupational Safety & Health Administration (OSHA) programs for confined space entry, machine guarding, hearing conservation, lockout/tag out (LO/TO), respiratory requirements, personal protective equipment (PPE) and industrial hygiene.

In addition to the environmental, health and safety compliance assistance and management services described above, LEA has recently been involved in the provision training programs for staff and management levels. The training programs are integral to implementation of effective management systems. LEA provides training programs in waste management, emergency response procedures, spill/discharge reporting and other pertinent categories.

SPECIAL SUPPORT SERVICES

Throughout our 30 years of service, LEA has identified a variety of specific support services needed by our municipal and industrial clients. In response to these needs, LEA has expanded our service capabilities to include many of these services. This approach allows LEA to provide comprehensive consulting and construction services with minimal outsourcing. The following support services are available through LEA.

Operation, Maintenance and Emergency Response Services

LEA in concert with LCI has also been responsible for providing assistance in the start-up and initial operation of water, wastewater and remediation systems. We have also been retained to provide long-term operation and maintenance activities for several industrial treatment systems. Our system start-up services have included: assisting operators in the initial set-up of system parameters; providing training to operators on specific system requirements; and providing On Call services during the shakedown period to assist operators in troubleshooting issues as they are identified.

We have also been called upon to provide long-term operation and maintenance services to include: routine and non-routine maintenance of remediation equipment including pumps, air strippers, carbon units, blowers, and other electrical and mechanical equipment; the performance of routine monitoring of system effluents to assess compliance with regulatory requirements; routine groundwater monitoring; and the monitoring of soil vapor extraction systems to assess system efficiency and compliance with regulatory requirements. Our O&M services division can provide the staff, equipment and training on a contract or on an as-needed basis to satisfy our client's needs.

Soil Boring and Well Installation

LEA owns and operates two Geoprobe® Model 5400 direct-push drilling rigs, which are used to sample soil, soil gas, and groundwater in an efficient and cost-effective manner. Each machine can also be used for the installation of small diameter (1-inch) monitoring wells. LEA is fully licensed by the State of Connecticut (license #00072) for the installation of groundwater monitoring wells and maintains certified drillers on staff. Use of the Geoprobe® permits rapid assessment of various types of sites to determine the likelihood that a release of contaminants to soil and/or groundwater has occurred and to evaluate cost-effective delineation of contamination and hydrogeologic assessment. The most recent addition to our subsurface investigation fleet is the Geoprobe®

Model 6610DT which is a compact and has remote control capabilities which allow us to maneuver the unit into locations previously inaccessible to conventional drilling equipment.

Mobile Environmental Laboratory

LEA also operates a mobile laboratory, which is certified by the State of Connecticut Department of Public Health for analysis of volatile organic compounds. The laboratory maintains two gas chromatographs that are portable and can be operated in the field. This capability provides rapid turn-around times for analysis of soil, soil vapor and groundwater samples. When used in the field, the data for a given sample is effectively available within approximately 20 minutes from the time that it is collected. If samples are returned to the in-house laboratory at the end of the day, the results are available within 24 hours. Such rapid analysis permits decisions regarding additional sampling requirements to be made without a break in the field activities, thus saving the cost of additional mobilizations and the time required to wait for results from a conventional laboratory.

Together, the Geoprobe® and mobile laboratory provide LEA with the tools necessary for rapid assessment of sites impacted by releases of volatile organic compounds. These tools allow LEA to conduct lower cost investigations, while still maintaining the highest of quality, by supplementing more traditional drilling or laboratory capabilities. LEA has used these tools on numerous investigation/remediation projects.

Survey Services

LEA's in-house, licensed and experienced survey team operates sophisticated surveying equipment, robotic total stations, GPS, data collectors, and modern computer-aided design and drafting (CADD) software that produces efficient, professional, high quality results. The survey team is backed by LEA's firm resources, commitment to its clients, and long track record of reliable, personalized service. Our survey services typically include topographic, site utility and roadway construction layout and as-built condition documentation surveys.

Environmental Data Management Services

LEA has a state of the art environmental data management system that is used to maintain and process analytical and field data that is collected in the course of investigation and remediation activities. The database is capable of providing our personnel and clients with a variety of tabular and graphical outputs so that a clear understanding of site conditions can be obtained. The database utilizes a variety of validation tools to ensure that the analytical data is accurate and is not compromised.

Construction Services

Loureiro Contractors, Inc. (LCI), the wholly owned subsidiary of LEA is a Connecticut based construction and remediation contractor that specializes in site development, remediation, demolition, and design/build services throughout New England. Our experience ranges from small-scale site utility projects to large multi-million dollar remediation projects. We are large enough to handle all your needs and small enough to value every customer.

LCI maintains an extensive inventory of construction equipment and vehicles as well as a staff of approximately 50 employees. Included in our heavy equipment inventory are loaders, bulldozers, excavators, rollers, trailers and heavy-duty trucks. Our competent construction staff includes project managers, superintendents, foreman, equipment operators, drivers and laborers. These resources can be made readily available to serve our client's construction needs if required for a specific project.

Lead and Asbestos Services

LEA's certified lead inspectors, licensed asbestos inspectors and project designers can assist with sorting through the regulations to determine which ones may be applicable to a situation. They can develop a cost-effective plan to inspect for and manage exposure to these potentially harmful materials. Before embarking on renovation, demolition or remodeling projects, or when considering the sale of purchase of real property, LEA can assist in determining potential liabilities associated with lead and asbestos. The LEA professionals can provide comprehensive building inspection services, assist with the development of technically sound abatement plans, and carefully oversee the abatement process.

Investigation and Remediation Qualifications

INVESTIGATION AND REMEDIATION TECHNICAL CAPABILITIES AND EXPERTISE

LEA has substantial experience in implementing all phases of investigation and remediation projects.

Remedial Investigation/Feasibility Studies

LEA has been providing comprehensive investigation and feasibility study services to our clients for over 30 years. In recent years, the firm has conducted extensive soil and groundwater investigations, evaluated appropriate remedial alternatives, and implemented remedial measures to address contamination in soil and groundwater. The work has been conducted in a variety of hydrogeologic settings, and the nature of the releases have been of varying extent in both soil, groundwater (overburden and bedrock aquifers), surface water, and sediment.

To date, LEA has completed numerous site investigation/feasibility projects with a significant range in both complexity and magnitude with total fees ranging from less than $5,000 to greater than $5,000,000. These projects ranged in scope from the installation of a few soil borings and groundwater monitoring wells to detailed hydrogeologic and contaminant delineation investigations in soil, groundwater, surface water and sediment.

Our experience in the performance of site investigations and feasibility studies includes:

- Investigations of soil, groundwater, surface water, sediment, and indoor air quality;
- Hydrogeologic and geologic investigations in support of contaminant delineation investigations for soil, groundwater, surface water and sediment;
- Contaminant fate and transport modeling;
- The assessment of the presence or absence of dense non-aqueous phase liquids (DNAPL);
- The evaluation of the fate and transport of contaminants in fractured bedrock; and
- The evaluation of remedial alternatives to address soil, groundwater, surface water, sediment, and indoor air quality. Alternatives that have been evaluated have included natural attenuation demonstrations.

Remedial Design

LEA has been providing detailed technical design services to our clients for over 30 years in the areas of water and wastewater collection, treatment and distribution systems, civil and site engineering projects, industrial wastewater treatment systems, air emissions control systems, industrial process system improvements and remedial measures. In recent years, LEA has drawn on its vast engineering capabilities to address the needs of our clients in the design of appropriate and cost effective remedial systems to treat a variety of wastes including contaminated

groundwater. Through these projects, we have also been responsible for providing start-up and initial operation of the treatment systems. In addition to these tasks, we have been retained to provide more long-term operation and maintenance activities for active treatment systems.

LEA has performed the design of:

- Three 40 CFR 265 Subpart DD containment buildings. All three of which have been constructed and successfully operated.
- Numerous soil vapor extraction systems for the treatment of VOC contaminated soils.
- Air sparging systems for the treatment of contaminated groundwater.
- The design of a bioventing remediation system to treat VOC contaminated soils.
- The design of sub-slab ventilation systems to address indoor air quality.
- The design of in-situ stabilization systems to address treatment of contaminated soils.
- The design of numerous capping systems for the closure of former surface impoundments, hazardous waste storage areas, and hazardous and non-hazardous waste landfills.
- Design of groundwater pump and treat systems for the treatment of impacted groundwater. Groundwater treatment technologies that have been employed in our designs are numerous and include, chemical precipitation, chemical flocculation, air stripping, aeration, as well as a multitude of other current treatment technologies.
- Design of free-product recovery systems for LNAPL and DNAPL.
- Design of DNAPL containment systems.

Remedial Action

Loureiro Contractors, Inc. (LCI), a wholly owned subsidiary of LEA, offers a full range of construction and remediation services. The combined services of LEA and LCI eliminate the need for engineering oversight; contractor coordination and change order issues associated with the traditional approach to design and construction projects.

LCI has been able to expand the services provided to its clients including a broad range of construction management, general contracting and construction related services. These related services include project planning and administration, and the construction, rehabilitation and repair of remedial systems, as well as the implementation of remedial measures. This integrated relationship with LEA provides clients with seamless remedial services from project planning through detailed engineering design, construction, implementation, operation of improvements, and the completion of remedial measures.

LEA, in conjunction with LCI has completed a number of turnkey remedial actions. The

following is a summary listing of the types of projects that have been completed by LCI.

- LCI has completed the closure of a 13 plus acre municipal landfill and is currently scheduled to begin the construction of a composite cap on an industrial waste landfill in New Hampshire.
- LCI has been responsible for the construction and operation and maintenance of a number of soil vapor extraction systems.
- LCI has successfully completed the construction of air sparging systems for the treatment of contaminated groundwater.
- LCI has been the general contractor for the performance of extensive soil excavation and transportation projects for the removal and offsite disposal of soils impacted with a variety of inorganic and organic contaminants.
- LCI has performed a number of underground storage tank removals. Of those projects, LCI was also responsible for the installation of aboveground or underground replacement tanks.
- LCI has performed several projects involving process equipment decommissioning. These projects included the disconnection, decontamination and removal of process equipment as well as the removal of impacted building materials and environmental media.
- LCI has performed the construction and operation and maintenance of sub slab ventilation systems.
- LCI has performed the construction and is currently performing the operation and maintenance of groundwater pump and treat systems.
- LCI has constructed, operated and maintained bioventing systems for the treatment of impacted soils.
- LCI has been retained to provide oversight and performance monitoring of three soil treatment systems.

Operations and Maintenance

Loureiro Engineering Associates, Inc. in concert with Loureiro Contractors Inc. (LCI) has also been responsible for providing assistance in the start-up and initial operation of treatment systems. We have also been retained to provide long-term operation and maintenance activities for active treatment systems.

System start-up services that have been provided include:

- Assisting operators in the initial set-up of system parameters;

- Providing training to operators on specific system requirements; and
- Providing on-call services during the shakedown period to assist operators in troubleshooting issues as they are identified.

For long-term operation and maintenance, we have been called upon to provide to the following:

- Routine and non-routine maintenance of remediation equipment including pumps, air strippers, carbon units, blowers, and other electrical and mechanical equipment;
- The performance of routine monitoring of system effluents to assess compliance with regulatory requirements;
- Routine groundwater monitoring; and
- Performance monitoring of soil vapor extraction systems to assess system efficiency and compliance with regulatory requirements.

Site Closure

LEA has completed closure activities on a number of remediation projects. The following is a subset of our relevant project experience with site closure activities:

- *Former P&W ORO facility in Southington CT* – LEA, as described in previous sections, was heavily involved in the completion of remediation activities at the former ORO site. This involved a demonstration that the requirements of the CT Remediation Standard Regulations (RSRs) were met. Given the complexity of the contaminant and hydrogeological conditions at the site, nearly all provisions (e.g. exemptions, Technical Impracticability demonstration etc.) of the RSR were exercised.
- *Closure of the Surface Impoundments at the former ORO Site* – In addition to the more comprehensive site closure described above, LEA was responsible for the closure of two former sludge lagoons at this site.
- *Airport/Klondike at P&W East Hartford* – LEA has completed remediation closure activities at over 20 Areas of Concern (AOC) at this site. These AOCs included areas of soil and groundwater contamination containing metals, VOCs, PCBs and petroleum hydrocarbons.
- *93rd Street School, Niagara Falls, NY (Love Canal)* – LEA was involved as the lead designer of the closure remedy for the former 93rd Street School site. The closure activities involved excavation, stabilization, and capping to meet the closure requirements stipulated by the New York State Department of Environmental Conservation.
- *Raytheon Corporation, Stamford, CT* – LEA completed supplemental investigation activities, the design and implementation of remedial measures, verification that the site had been remediated in accordance with the CT Remediation Standard Regulations, and

post remediation groundwater monitoring. LEA assisted in the preparation of applicable land use restrictions following the completion of remedial actions that consisted predominantly of soil excavation and offsite disposal.

- *Heublein, Inc., Hartford, CT* – LEA completed subsurface investigations, the design of remedial measures, the performance of observation activities during remedial action, and post-remediation groundwater monitoring. LEA prepared a verification that the site had been remediated in accordance with the CT Remediation Standard Regulations.

- *Delta Rubber, Inc., Moosup, CT* – LEA performed a soil and groundwater investigation to assess the degree and extent of soil and groundwater contaminated by VOCs. At the conclusion of the investigation, LEA prepared a successful petition for groundwater reclassification. No further actions were required of the client following review by the Connecticut Department of Environmental Protection (DEP) of the findings of the investigations.

Performance of EH&S Site Assessments

LEA has performed due diligence assessments for a broad array of facilities and operations locally and, on a less frequent basis, for facilities located throughout the United States and internationally. As examples of our international experience, LEA has performed a due diligence assessment in Mexico for P&W and is currently working with a large multi-national manufacturer in southern China.

These assessments have been performed in accordance with the requirements defined by our clients, lending institutions, and the American Society for Testing and Materials (ASTM).

Quality Assurance and Quality Control

QUALITY ASSURANCE AND QUALITY CONTROL

Throughout its existence, LEA has made quality of work a priority for all of its projects, yet not sacrificed responsiveness or cost efficiency in the pursuit of that objective. The result is clearly seen in the reputation for a high quality of work that LEA has maintained over the years, both with its clients and with the regulatory agencies, especially upper-level and management personnel.

Key factors in maintaining that high quality have been the implementation and maintenance of detailed Quality Control/Quality Assurance (QA/QC) programs for all phases of its operations, as well as a strong commitment from top management to follow the QA/QC programs that have been established. Such programs, which are described below, have been designed specifically to accommodate both technical and managerial aspects of projects and are continually updated and modified to reflect changes in both technical and regulatory aspects of projects.

LEA has developed and continuously maintains various types of QA/QC programs to accommodate the diversity of services it provides. These programs encompass all pertinent aspects of hydrogeological services (subsurface investigation, contaminant characterization and delineation), engineering design (remedial design and operations), health and safety, and project management.

Hydrogeological Services

Specific aspects of the QA/QC program include standard operating procedures, field audits, and/or in-house training programs and manuals, as well as substantial record-keeping requirements for each project to support and document field operations. All LEA projects are performed under either the company-wide or a project- or site-specific Quality Assurance Plan. Written standard operating procedures are used for all significant aspects of field activities. Since most of the work performed by LEA is reviewed by one or more regulatory agencies, most, if not all, of the standard operating procedures related to field activities and data evaluation have been reviewed by both the EPA and the DEP.

The extensive documentation of field operations and sample collection that is required in order to comply with the operative quality assurance plan for any project helps to ensure that sampling and associated analytical data are conducted in accordance with project-specific Data Collection Quality Assurance Plans and that the data on a project meets or exceeds the Data Quality Objectives for that project. The electronic data management capabilities described above constitute an integral part of QA/QC program by minimizing possibilities of transcription errors from field work and laboratory reports through report preparation process. The QA/QC aspect of the database capabilities is enhanced by extensive data verification/validation procedures that are incorporated at all stages of the data management process. Use of LEA's extensive and versatile electronic database provides accurate dissemination of the information and analytical data for each site in a cost-efficient and readily available manner. This reduces time spent in preparing graphical or tabular displays of data, thus enhancing the data evaluation process by making it more accurate and cost-efficient and improving the reliability of the work product.

In order to ensure that field operations are continuously conducted in a manner that is consistent

with both company policies and procedures and with project-specific requirements, the field audit program is an essential aspect of the overall QA/QC program. Audits of field activities are conducted on either a project-specific basis, to meet the requirements of a project's QA/QC needs, or as part of the company's QA/QC plan. If problems are noted during a field audit, they are brought to the attention of all parties involved, from field staff to project manager and technical director. If necessary, additional training and/or follow-up audits are conducted to ensure that field work performed meets the goals and objectives of both the company and the specific project.

Engineering Design

The QA/QC program for projects which involve engineering design and the preparation of engineering specifications focuses on the review of design documents in accordance with the Design Quality Assurance Manual that was developed specifically to ensure quality of engineering work products. This manual includes the Design Quality Assurance Plan that specifies the procedures that will be followed during engineering projects to maintain an on-going, comprehensive, quality review process for all reports, field work, site investigations, design, drawings, and specifications. Included in the Design Quality Assurance Manual are checklists to cover all appropriate aspects of an engineering design project.

All engineering projects are subject to a QA/QC review at designated completion milestones by the Quality Assurance Coordinator assigned to the project. Where applicable, the QA/QC review will include a complete constructability assessment by LEA's Construction Administrator for the purpose of providing construction-oriented input to the design review process.

Health & Safety

LEA's Health & Safety program is, in and of itself, a type of quality assurance program. Company-wide procedures are in place to address such issues as hazard communication and medical monitoring. All employees likely to perform field activities or spend time on a site hold 40-hour OSHA Health & Safety Training certificates, and requisite 8-hour training is conducted on a regular basis to ensure that employees remain current with their certification. Detailed records are kept of attendance at training and/or monitoring activities to provide assurance that all requirements are met and certifications or monitoring are current for each employee.

In addition to a generic corporate Health & Safety Plan, site-specific Health & Safety Plans are prepared for each site that take into account the specific conditions likely to be encountered on that site. To ensure that appropriate health and safety requirements are being followed at a site, the company Health & Safety Plan provides for the performance of random, unplanned health and safety audits of employees performing field activities.

Project Management

Project management at LEA is performed in accordance with guidelines provided in the LEA Project Managers Manual, which covers project management issues from the opening of a job through all phases of a project, regardless of project size or scope. Assisting in effective project management from a fiscal standpoint are the capabilities of the financial and project management electronic database described previously.

In order to ensure that upper management is familiar with all projects being performed by LEA, weekly project manager meetings are attended by all LEA project managers. Staff members working on a project attend project-specific team meetings, as scheduled by the project manager, to improve the flow of communication among all project team members.

Personnel

Quality assurance and quality control issues are considered to be the responsibility of each LEA employee, from the field personnel to the highest levels of management within the organization. It is through the commitment of all individuals to ensuring that the work performed is of the highest quality, that the company's reputation for high-quality work has been maintained over the years.

Field staff, technical task managers, and project managers are trained to have knowledge of, and to follow, the extensive number of standard operating procedures that have been developed and updated as part of the on-going QA/QC programs. Company policy also provides for continued training opportunities for all staff via attendance at university courses, technical short courses and seminars, and in-house training sessions. Through the field audit program described above, the company is also able to identify issues related to quality assurance/quality control for field activities at regular intervals and provide additional or updated training as needed, either on an individual or group basis.

In addition to the above, numerous QA/QC activities are performed during the construction of a remedial measure (e.g. soil testing, concrete testing, membrane testing, etc.). The scope and frequency of such activities are embodied within the technical specification for a construction project. The responsibilities for construction QA/QC are identified and assigned an a project-specific basis at the inception of the project.

Customer Service

CUSTOMER SERVICE

Service Commitment

As an employee-owned company, all of our employees are highly motivated to develop and maintain positive, long-term client relationships by providing unmatched service. Our clients receive the benefit of dealing with an owner at all levels of the organization. We are constantly seeking ways to make our clients jobs easier.

Project Planning and Tracking Systems

LEA maintains and utilizes a computer-based system for both the day-to-day and overall management of ongoing projects. The system is used by individual project managers for schedule development, personnel and equipment scheduling, budgeting, and cost control. The computer-based system has two types of resources, an individual project management program, and an overall company resource management program.

For individual project management, LEA has available two commercial computer programs; Microsoft Project and DELTEK Vision. LEA utilizes Microsoft Project as the fundamental project-scheduling tool. In addition, the program allows the manager to utilize Gantt Charts for graphical display of a project schedule. By utilizing the program, LEA Project Managers are able to calculate the project duration based on individual task durations and dependencies, identify critical tasks, identify resource requirements, track project costs and progress, and generate reports for internal and external distribution.

The DELTEK Vision Allegro program is utilized for overall company resource management and financial management. The program is utilized on a weekly basis by Project Managers to assess short-term and long-term employee assignments. By utilizing the described computer based system in conjunction with a weekly project manager's meeting, LEA management staff have been able to efficiently and cost effectively manage the day-to-day operations of the office. As new needs arise, it has been a company policy to modify and adapt the management systems to meet the needs of our clients.

Database Management

In order to more effectively execute projects in an efficient and cost-effective manner, LEA maintains a number of in-house support services to assist our staff in the collection, management, and evaluation of data. LEA currently maintains a comprehensive, on-site electronic database for all projects that involve sampling of environmental media. This database was developed in-house specifically to accomplish the data management requirements of a wide-range of environmental projects. Types of project data included in the database files range from project and site location information to information about the individual sampling points and samples collected. Among the data stored in the database are geologic boring logs, well logs, sample location, sampling time, depth, and field and analytical data. Direct electronic transfer of analytical data from the reporting laboratories provides efficient and accurate transfer of information. Output from the database can be made in electronic form directly to data tables and drawings, minimizing errors due to transcription.

One of the most useful aspects of the customized database system is the ability to query the database to produce output in a variety of formats and to compare data against specific criteria, such as drinking water standards, soil and groundwater criteria established in Connecticut's Remediation Standard Regulation, or any other project-specific criterion. Use of the database for all projects is essential for accurate, efficient, and detailed evaluation and reporting of data, regardless of the size of the project.

Selected Project Descriptions

SITE REMEDIATION
FORMER GASOLINE SERVICE STATION AND CAR WASH
[including pre-remedial demolition, site restoration, and post-remedial groundwater monitoring]
Municipal Library, Southwestern Connecticut

DATE/DURATION: 2004 to Present
CLIENT: Municipal Library, Southwestern Connecticut
LEA PERSONNEL: Kimberly M. Clarke., L.E.P.

The Project

The site was purchased in November 2004 with the intention of developing it with the construction of a new municipal library for a town in southwestern Connecticut. LEA was retained to conduct building demolition and remediation of soil and groundwater prior to construction of the new facility. The Site had a history of underground storage tank (UST) use associated with fuel dispensing operations, accumulation of waste oil, and consumption of heating oil. At the time demolition and remediation activities were initiated by LEA, one 4,000-gallon diesel UST and two 8,000-gallon gasoline USTs existed on the Site.

The pre-remediation activities performed by LEA that were associated with the remediation of the Site included creation of a work plan, completion of a pre-demolition asbestos survey, obtaining required permits and approvals from local agencies, waste characterization, and the establishment of a stockpile area prior to disposal of wastes at an off-site location. In addition, utilities serving the service station and car wash were disconnected prior the demolition of the structures, which in turn occurred before initiation of subsurface remediation activities.

As part of the site decommissioning prior to the initiation of demolition activities, various wastes associated with the former site activities were identified, containerized, and transported to appropriate disposal facilities in accordance with applicable state and federal regulations. Wastes at the Site included gasoline and diesel fuel present in the USTs, residual liquids and sludge present in the two underground oil/water separators on the Site, fluorescent light bulbs, mercury thermostats, batteries, grease, paint, and subsurface investigation-derived waste such as soil cuttings and monitoring well purge water.

Loureiro Contractors, Inc. (LCI), LEA's wholly-owned construction subsidiary, completed the removal of one 4,000-gallon diesel fuel UST located below the pump island, and two 8,000-gallon gasoline USTs located beneath the concrete pad to the north of the pump island. The actual capacity of the 4,000-gallon UST was determined to be 2,500-gallons at the time of excavation. Excavation of petroleum-contaminated soil located above the groundwater table was selected as the most appropriate remediation approach after a review of potentially applicable remediation technologies and an evaluation of the technical, regulatory, and economic factors of each technology. The technical criteria evaluated for the alternatives included effectiveness, cost, reliability, and the time period for completion. Due to the proximity of the road and complications associated with infiltrating groundwater, in-situ remediation technology was used to address contamination below the groundwater table and in proximity to roadways.

During the excavation of contaminated soil, every effort was made to remove soil containing concentrations above the remediation criteria as determined by field screening and confirmatory soil sampling. However, soil in the base of the excavation, which was located beneath the

groundwater table, could not be removed without the use of excavation dewatering and treatment methods. Also, field screening and sampling indicated that contaminated soil continued beyond the limits of the southeast wall of the excavation along Boston Post Road. Because of the multiple difficulties involved in excavating soil beneath a public roadway, continuing the excavation beneath Boston Post Road was not considered technically feasible for the scope of this project, especially since alternative remedial options could be employed to accomplish the remedial objectives. To address residual contamination in the base and the south/southeastern sidewalls of the excavation, in-situ chemical treatment was proposed as an alternative remedy to continued excavation. Specifically, RegenOx® and Oxygen Release Compound Advanced® (ORC®), both manufactured by Regenesis of San Clemente, California, were selected as the additives expected to accomplish the remedial objectives.

Following the completion of the excavation of contaminated soil and treatment of residual contamination with in situ chemical treatment, all areas disturbed by demolition and remedial activities were restored to a condition that prepared the site for future redevelopment (i.e. backfilled and compacted to the elevation of the planned building footing).

A post-remediation groundwater monitoring plan is currently under development for the Site and will be implemented to demonstrate the effectiveness of the remediation activities performed at the Site. This plan includes the installation of groundwater monitoring wells at upgradient and downgradient locations on the Site and at off-site downgradient locations within the inferred path of the groundwater plume.

Site Assessment & Investigation
Remedial Action Work Plan

Stamford, Connecticut

DATE/DURATION:	On-Going
CLIENT:	Antares Yale and Towne SPE, LLC
CONTACT:	Jamie Selonick, Assets Manager 203-653-6006
LEA PERSONNEL:	George F. Andrews, Jr., P.E., L.E.P., Vice President Adam M. Duskocy, Senior Project Geologist

Loureiro Engineering Associates, Inc (LEA) was retained by the client to provide an assessment of the environmental status of the Site, with regard to the applicability of the Connecticut Transfer Act Program, and to complete an evaluation of the environmental site assessment (ESA) activities conducted at the Site. LEA completed the preparation of an environmental condition assessment form (ECAF) and associated Form III filing to facilitate the transfer of the Site. Subsequent to the transfer of the Site, LEA was retained by the client to complete all necessary supplemental ESA activities to achieve compliance with the Connecticut Remediation Standard regulations (RSRs).

The Site

The Site consists of approximately 20.35 acres of commercial land located in the South End of Stamford, Connecticut. From approximately 1955 to present the Site has been utilized by a wide variety of industrial and commercial tenants. Many of the original buildings on the Site have either been razed or renovated.

Initiated in September 2006, LEA has completed supplemental subsurface investigation activities pertaining to the areas of concern (AOCs) identified at the Site, attributed to current and historical site usages, to

facilitate the three dimensional delineation of the nature and extent of the previously observed soil impacts. These supplemental investigation activities have included:

- the development of a conceptual site model
- the advancement of soil borings, including interior and exterior locations
- the installation of overburden groundwater monitoring wells, including interior and exterior locations
- the collection of soil samples
- the management and evaluation of the associated laboratory analytical reports
- the completion of groundwater monitoring activities, including groundwater gauging and sampling events
- the completion of remedial excavation activities pursuant to the Connecticut General Statues (CGS) and RSRs, and associated reporting activities
- the evaluation of groundwater gradient and apparent flow direction
- the appropriate management, handling and off-site disposal of investigation-derived waste
- the preparation of routine status reports and requisite reporting requirements pursuant to the CGS and RSRs

Based upon the results of those supplemental subsurface investigation activities, LEA developed a Remedial Action Work Plan to present the approach and strategy for the remediation of soils impacted by the applicable constituents of concern. The remedial approach was designed to integrate the future use of the property with the final remedy in a manner consistent with the RSRs. The remedial approach included:

- the excavation and disposal of impacted soils;
- the installation of an engineered control;
- the design and installation of soil vapor extraction systems;
- the design and installation of light non-aqueous phase liquid (LNAPL) recovery systems ;
- the rendering of impacted soils inaccessible, as applicable;
- the rendering of impacted soils environmentally isolated, as applicable; and
- the recording of environmental land-use restrictions (ELURs) in accordance with the provisions of the RSRs.

Based on the proposed use of an engineered control, LEA prepared and submitted an Engineered Control Variance Request to the DEP for approval. LEA prepared a Remedial Action Work Plan in accordance with specific Federal regulations for submittal and approval by the United States Environmental Protection Agency (EPA).

LEA is currently completing building materials inspections activities, surrounding building materials waste classification, asbestos-containing materials surveying, and lead paint assessment activities, in conjunction with the preparation of comprehensive demolition specifications for the applicable on-site buildings and structures.

Site Investigation / Remedial Action Permitting

Fairfield Metro Center
Fairfield, Connecticut

DATE/DURATION: On Going
CLIENT: Black Rock Realty, LLC, Town of Fairfield
CONTACT: Mark Barnhart, Director of Community and Economic Development, Town of Fairfield - (203) 256-3120
LEA PERSONNEL: Brian A. Cutler, P.E., L.E.P.

SITE DESCRIPTION: The site is comprised of 35.56 acres of land and is located on Black Rock Turnpike in Fairfield, Connecticut. During the period from 1940 to 1986, the site was owned and operated by either The Bullard Company or Best Cast, Inc. as a foundry. Portions of the site were utilized by The Bullard Company for the disposal of casting sands and other industrial wastes generated from its sand casting operations. The Bullard Company was a manufacturer of large machine tools. Prior to demolition activities conducted in late summer and fall of 2004, the site structures included a foundry building with a connected office and pattern building and storage buildings. In addition to the buildings, an abandoned wastewater treatment area with an associated clarifier and treatment building, and two former wastewater infiltration lagoons were located on the site.

REMEDIAL ACTION PERMITTING: In 2002, Loureiro Engineering Associates, Inc. (LEA) was designated by the State of Connecticut Department of Environmental Protection as the Licensed Environmental Professional responsible for the verification that the site is investigated and remediated in accordance with the requirements of the State of Connecticut Remediation Standard Regulations. At the same time, LEA was retained by the developer, Blackrock Realty, LLC to assess the environmental condition of the site, develop a remedial action plan that integrated with the proposed redevelopment and was

protective of human health and the environment, and to oversee the implementation of remedial actions. Subsequent to being retained by Blackrock Realty, LLC, the Town of Fairfield and the State of Connecticut also retained the services of LEA as the sole party responsible to each to verify that the investigation and remediation of the site was performed in accordance with all applicable local, state and federal regulatory requirements.

LEA quickly and cost effectively assimilated over 20 years of environmental investigation and remediation activities and developed a remedial action approach that integrated with the overall proposed redevelopment of the site as a mixed use commercial transportation center. From these investigations and remediation activities, it was determined that greater than 50 percent of the site is covered by casting sand, a solid waste in the State of Connecticut. Casting sand on the site contains inorganic constituents (primarily lead, chromium, and arsenic), semi-volatile organic compounds, polychlorinated biphenyls at concentrations of less than 10 milligrams per kilogram, and petroleum hydrocarbons.

The planned remediation approach involves the excavation and onsite reuse of contaminated soil and casting sand followed by the placement of an engineered control over greater than 18 acres of the site. The engineered control is integrated into the overall redevelopment design and has been designed to maximize the land area available for the creation of landscape features. The remediation approach also calls for the placement of contaminated soil and casting sand beneath parking garages located under proposed buildings. In total, the remediation approach we have developed will result in the maximum onsite reuse of casting sand and contaminated soils and a savings in excess of $19,000,000 in comparison to an excavation and offsite disposal alternative previously considered.

LEA has also been an integral member of the team and principal consultant charged with the

acquisition of a number of the myriad of regulatory authorizations necessary for the proposed development. LEA has successfully negotiated the relocation of the 100-year flood line with the Town of Fairfield and FEMA allowing for the development of an additional 5.6 acres of the site. We have presented the remediation approach in open public hearings attended by a significant number of local opponents to the project and have been instrumental in obtaining the unanimous approval of the remediation approach and the project by the Planning and Zoning and Conservation Commissions. We were successful in securing authorizations from the Army Corps of Engineers and the State of Connecticut Department of Environmental Protection to allow for the elimination of greater than 2 acres of inland wetlands. LEA is continuing to represent the developers as they seek final approvals for the single largest tidal wetland application ever presented to the agency. The tidal wetlands application addresses the restoration of over 2,200 linear feet of shoreline, the removal of contaminated river sediments, and the installation of the engineered control.

Subsurface Investigation & Quarterly Groundwater Monitoring Including Quality Assurance Project Plan

Century Brass
Waterbury, Connecticut

DATE/DURATION:	June 2005 to July 2006
CLIENT:	Connecticut Department of Environmental Protection
CONTACT:	David Ringquist, Connecticut Department of Environmental Protection – (860) 424-3573
LEA PERSONNEL:	Kimberly M. Clarke, L.E.P.

ABOUT THE PROJECT

Loureiro Engineering Associates, Inc. (LEA) was retained by the Connecticut Department of Environmental Protection (DEP) to perform a subsurface investigation and quarterly groundwater monitoring at the Former Century Brass property located in Waterbury, Connecticut. The primary objective of the subsurface investigation was to collect data on the environmental quality of various media that was deemed necessary to support completion of United States Environmental Protection Agency (EPA) Environmental Indicator Determinations (EIDs). The activities performed during this subsurface investigation included collection of soil, sediment, and groundwater samples; completion of an asbestos survey; and associated laboratory analysis of environmental media.

OUR SERVICES

Soil Sampling Activities

LEA performed a subsurface investigation at the Former Century Brass property, which was designed to provide information necessary to assess the presence of soil and/or groundwater contamination associated with historical site operations. The Former Century Brass property has an extensive industrial and environmental history. Site operations were initiated in approximately 1802 and

continued until approximately 2001 by several occupants including Roger and Brothers, International Silver, Scovill Manufacturing, and Century Brass Products. Historical operations at the Site include metal stamping, polishing, washing, plating, and annealing in support of metal-working industries that included the manufacture of copper, pewter, and tin buttons, and silver plateware. Ancillary activities at the Site include the operation of a coal gas house, a raceway system for diversion of water, and landfilling of metal hydroxide sludge.

Based on the analytical data collected during the subsurface investigation, it was determined that soil at the Site was impacted by volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), extractable petroleum hydrocarbons (ETPH), polychlorinated biphenyls (PCBs), and select inorganic constituents (metals).

Groundwater Sampling

LEA collected groundwater samples from newly installed and existing groundwater monitoring wells and submitted the samples to a state-certified analytical laboratory for analysis for the presence of VOCs, SVOCs, PCBs, ETPH, cyanide, and metals. The purpose of this sampling was to provide an understanding of the nature of groundwater contamination noted during earlier investigations completed at the Site. Additionally, the investigation indicated that groundwater at the Site has been impacted by VOCs and metals.

Communications and Reporting

As part of the site investigation activities, LEA developed and implemented a detailed Quality Assurance Project Plan (QAPP), inclusive of Data Quality Objectives (DQO) and appropriate supporting drawings and figures. The QAPP described the specific objectives and Quality Assurance/Quality Control (QA/QC) protocols that were used to achieve the DQOs established for the subsurface Site. The QAPP presented the QA/QC procedures that were implemented during performance of the subsurface investigation and completion of quarterly groundwater monitoring of the RCRA landfill cap. The QAPP ensured that decisions made on the Site were based on sound professional judgment and data of sufficient quality and quantity to allow confirmation that the subsurface investigation and quarterly groundwater monitoring objectives for the Site were achieved.

Following completion of the subsurface investigations, a report was prepared to summarize the investigations and to present our findings. The report contained detailed site plans, a groundwater contour map, a description of our field investigation activities, an evaluation of the results of the investigations, and our conclusions.

Site Investigation/Feasibility Study - Soil and Groundwater Investigation in Support of Remedial Design

The Black & Decker Corporation (Farrel Corporation)

Ansonia and Derby, Connecticut

DATE/DURATION:	1996- Present
CLIENT:	The Black & Decker Corporation (Farrel Corporation)
CONTACT:	Linda H. Biagioni, Vice President Environmental Affairs (410) 716-3545
LEA PERSONNEL:	Jeffrey J. Loureiro, P.E., L.E.P.; Margaret Averill, L.E.P.; Kimberly M. Clarke, L.E.P.; Paul W. Martell, L.E.P.

About the Project:

A subsurface investigation pursuant to a Form III filing was performed to characterize subsurface conditions at two separate facilities currently owned by Farrel Corporation. The facilities manufactured and/or repaired Banbury mixers which were used in the rubber manufacturing industry. Previous activities at each of the facilities included foundry operations and other ancillary operations associated with the manufacturing of large industrial equipment. Numerous underground storage tanks containing a variety of petroleum products were, or had been, present at each site. Potential contaminants at each of the facilities included chlorinated organic solvents, petroleum hydrocarbons, semi-volatile organic compounds, PCBs, and metals.

The subsurface investigation consisted of a variety of activities, including the performance of over 100 soil borings and the installation of at least six well clusters and at least 10 additional shallow groundwater monitoring wells at each of the two facilities. Each well cluster consisted, at a minimum, of a shallow and a deep monitoring well at each location. Where sufficient saturated thickness was present, an intermediate-depth well was also installed.

Other investigation activities included the performance of several soil vapor surveys at each facility, continuous soil sampling from each soil boring and monitoring well borehole, groundwater sampling from all existing and newly installed wells, and the evaluation of aquifer characteristics from laboratory analysis of soil samples for physical parameters and in-situ testing for hydraulic conductivity. Laboratory analysis of soil and groundwater samples was performed for a variety of potential contaminants, including volatile organic compounds, metals, semi-volatile organic compounds, total petroleum hydrocarbons, and PCBs.

After evaluation of the initial phase of the investigations, it was determined that additional investigation was needed to delineate the extent of detected contamination. Supplemental investigation activities at the one site completed to date included the advancement and sampling of over 100 additional borings and installation of over 10 additional groundwater monitoring wells. The most extensive of the supplemental investigation activities were conducted in areas where chlorinated solvents were detected, sometimes at very high concentrations. Due to the potential for dense non-aqueous phase liquid (DNAPL) to be present in the subsurface, the investigations in those areas were conducted accordingly, and the data were reviewed specifically to address that and related issued of the fate and transport of DNAPL and dissolved contamination due to volatile organic compounds.

VOLUNTARY CORRECTIVE ACTION PROGRAM
SIX INDUSTRIAL FACILITIES

Including
Remedial Action Work Plan
Quality Assurance Project Plan

United Technologies Corporation, P&W
East Hartford (3), Rocky Hill (1), Southington (1) and North Haven (1)

ABOUT THE PROJECT

The Pratt & Whitney (P&W) Voluntary Corrective Action Program (VCAP) was undertaken at six of P&W facilities in Connecticut. The Pratt & Whitney sites that were addressed under the VCAP were 1) East Hartford, 2) Colt Street, 3) Pent Road, 4) North Haven, 5) Rocky Hill and 6) Southington Manufacturing.

The three East Hartford facilities, all owned and operated by Pratt & Whitney, are the main plant; the Colt Street facility; and the Andrew Willgoos Turbine Laboratory on Pent Road.
The Main Street facility is located on approximately 1100 acres of land and has been used for the manufacture of aircraft engines and aircraft engine components since 1929. Operations at the Main Street facility include (or have included in the past) vapor degreasing, chemical etching, electroplating, machining of various metals and alloys, assembly and testing, and research operations, as well as a large area of former research and development facilities.

The Colt Street facility is located on approximately 12 acres of land on Colt Street in East Hartford, Connecticut. The site has been used since 1972 for the treatment of dilute wastewater. The facility processes dilute industrial wastewater transferred from the Main Street facility and discharges the treated water to the Connecticut River under a NPDES permit.

The Pent Road facility is located on approximately 58 acres of land on Pent Road in East Hartford, Connecticut. The facility is used for testing of jet engines under simulated flight conditions, including potential failure modes. Testing of jet engines involves simulating, in test cells, atmospheric and meteorological conditions encountered during flight, and measuring the responses and operations of the engines.

The Rocky Hill facility is located on approximately 52 acres of land at 60 Belamose Avenue in Rocky Hill, Connecticut. The site has been owned and operated by Pratt & Whitney since 1965. The site was the location of several rayon manufacturing facilities from 1927 until 1965. The Rocky Hill site is used for the manufacture and testing of various composite jet engine components. Operations at the facility include (or have included) molding, bonding, degreasing, metal finishing, electrochemical machining, and testing composite materials (such as graphite, plastics, aluminum, and titanium).

The North Haven facility is located at 4145 Washington Avenue in North Haven, Connecticut. The facility is located on approximately 160 acres of land and has been owned and operated by Pratt & Whitney since 1952. The facility manufactures jet engine components, and operations at

the facility include (or have included) chemical etching, electroplating, casting, vapor deposition, pickling, degreasing, and machining of various metals and alloys.

The Southington Manufacturing facility, is located on approximately 52 acres of land on Aircraft Road in Southington, Connecticut. The facility was owned by the US Navy, but was operated by Pratt & Whitney. The site was purchased by Pratt & Whitney in 1956 and was in continuous operations until 1995, when Pratt & Whitney closed the facility. The site was used for the manufacture of jet engine components. Operations at the site included machining of various metals and alloys, vapor degreasing, electroplating, electrochemical machining, and testing of jet engine components.

SERVICES PROVIDED

Loureiro Engineering Associates, Inc. was retained to prepare the following elements of the VCAP for each of the six facilities:

- Summary of investigation/remediation activities which occurred at the facilities
- The methodologies that the Pratt & Whitney will utilize to 1) identify specific unit releases and exposure pathways, using a land use of industrial/commercial; 2) understand the transport and fate of know and potential releases; and 3) identify all actual or potential human receptors
- Develop Conceptual Site Model
- Develop RCRA Facility Investigation Plan
- Prepare Quality Assurance Project Plan and Data Quality Objectives Plan
- Prepare Data Management Plan
- Prepare Waste Management Plan
- Prepare Public Involvement Plan
- Prepare a schedule which indicates major milestones and submittals dates.

Design/Build - Remedial Action

Stamford, CT

DATE/DURATION:	1997 - 2003
CLIENT:	Former Tube Holding Company
CONTACT:	Rick Sarnelli (781) 642-2404
LEA PERSONNEL:	George F. Andrews, P.E., L.E.P. (860) 747-6181

Photo: Today, this Stamford, CT Post Office resides on the formerly contaminated Raytheon Tube Holding Site

SITE DESCRIPTION: Tube Holding Company, Inc., formerly The Machlett Laboratories, Inc., conducted operations at the site and two other adjacent parcels from approximately 1949 until 1989 for the manufacturing of vacuum tubes, X-ray tubes, and other electronic components. Specific manufacturing processes conducted at the site included metalworking and finishing activities (degreasing, plating, and painting), and minor amounts of film developing. Petroleum products; volatile organic compounds (which may have included chlorinated solvents); acidic, caustic, and metal-plating solutions; and film developing chemicals were all potentially used on-site. The site had not been occupied since the spring of 1989. All on-site buildings were demolished in 1991.

SITE INVESTIGATION: LEA initiated a Phase III soil and groundwater investigation in April 1997. The work included soil and groundwater sampling and analysis to identify potential release areas and define the nature and extent of constituents of concern at the site, which included volatile organic compounds, metals, total petroleum hydrocarbons and polychlorinated biphenyls. The investigation activities included soil sampling from approximately 300 borings, the installation of approximately 20 wells and nearly two years of quarterly groundwater sampling and water level measurements. The investigation results were compared to the applicable Remediation Standard Regulation criteria and various remedial alternatives were derived. Data used in this comparison included a synthesis of Phase I and Phase II site assessments, in addition to the Phase

III soil and groundwater investigation. The results of the soil investigations and investigations of various subsurface structures indicated the need to remediate eight separate areas of the site. LEA acted as the environmental professional under the state's Licensed Environmental Professional (LEP) program for the verification of investigation and remediation of the site.

CONSTRUCTION REMEDIATION: Concurrent with performance of the Phase III soil and groundwater investigations, LEA along with its wholly owned construction subsidiary Loureiro Contractors, Inc. (LCI), completed several remedial projects involving primarily polychlorinated biphenyls, metals and petroleum hydrocarbons. Based on the data derived from the Phase III investigation, LEA developed a remedial action plan with technical specifications for a separate large-scale remedial effort for competitive bidding. LEA proceeded to manage the selected remedial contractor through completion of the remedial activities and prepare all of the necessary confirmatory data for the LEP verification. This remedial project entailed excavation and removal of approximately 26,000 tons of soil contaminated with polychlorinated biphenyls, metals, and petroleum hydrocarbons. The remedial activities conducted on this site were integrated with the future site development for a significant remedial cost savings.

Photos of the site investigation & remediation activities

Investigation and Remediation Project

The Black & Decker Corporation
Ansonia, Connecticut

DATE/DURATION:	1996 to Present
CLIENT:	The Black & Decker Corporation
CONTACT:	Linda H. Biagioni, Vice President Environmental Affairs,
LEA PERSONNEL:	Margaret M. Averill, L.E.P., Kimberly M. Clarke, L.E.P.

SITE HISTORY: The Black and Decker Corporation became affiliated with Farrel Corporation through a series of mergers between 1976 and 1989. The Site is located immediately east of the Naugatuck River in Ansonia, Connecticut and encompasses 13.6-acres of land. For the purposes of investigation and reporting, the Site was divided into five distinct areas, known as Potential Contaminant Source Investigation Areas (PCSIAs).

Loureiro Engineering Associates, Inc. (LEA) was retained by The Black and Decker Corporation to design and implement remediation activities at the Farrel Corporation located at 25 Main Street in Ansonia, Connecticut. LEA developed a Remedial Action Work Plan (RAWP) which included a detailed Quality Assurance Project Plan (QAPP) to support the investigation and remediation activities of the project and to assure that the samples and data collected were of sufficient quality and quantity to be suitable for their intended use. The Site is currently owned and operated by Farrel Corporation, but The Black and Decker Corporation agreed contractually to perform certain investigations and remediation at the Site. The remediation activities included the physical removal of soil contaminated with polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and various metals. The remediation activities completed at the Site were developed based on the results obtained from extensive soil and groundwater investigations completed at the Site since 1996.

SITE INVESTIGATIONS: Since 1985, several environmental investigations have taken place at the Site. These investigations have included assessments of both soil and groundwater. LEA completed a site characterization investigation during the period from August 1995 to June 1996 and a supplemental site investigation (SSI) during the period from June 1999 to March 2002. Based on the results of the site characterization and SSI, the most significant constituents of concern at the Site were determined to be volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and polychlorinated biphenyls (PCBs). Semivolatile organic compounds (SVOCs) and specific metals were also detected across the Site, but the occurrence of these constituents was determined to generally be associated with fill materials present throughout the Site. Not all constituents are of concern in all areas.

The SSI that was completed at the Site between June 1999 and March 2002. The SSI was designed to conclude a comprehensive assessment of contamination in Site soil and groundwater and provided the most inclusive evaluation of soil and groundwater conditions at the Site. Construction remediation services were provided by Loureiro Contractors, Inc.

Design/Build PCB Remediation Project
Willow Brook and Willow Brook Pond Remediation Project

East Hartford, Connecticut

DATE/DURATION: 2001 - 2004
CLIENT: United Technologies Corporation/Pratt & Whitney
CONTACT: Lauren Levine, Senior Project Manager
(860) 728-6520
LEA PERSONNEL: Brian A. Cutler, P.E., L.E.P.

ABOUT THE PROJECT:
The United Technologies Corporation/Pratt & Whitney (UTC/P&W) manufacturing facility is located at 400 Main Street in East Hartford, Connecticut. The facility encompasses approximately 1,100 acres of contiguous land. Pratt & Whitney initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. UTC/Pratt & Whitney previously used these two areas as an airport and a storage/testing area, respectively.

REMEDIAL APPROACH: UTC/P&W retained Loureiro Engineering Associates, Inc. (LEA) to design and perform the remediation of polychlorinated biphenyl (PCB) contaminated soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond at the UTC/P&W manufacturing facility in East Hartford, Connecticut. Prior to commencement of the remedial work, LEA assessed alternative courses of action as required by the Inland Water Resources Division (IWRD) of the Connecticut Department of Environmental Protection (CT DEP). LEA relied on their considerable expertise and knowledge of Environmental Land Use Restrictions (ELURs) to identify viable options compliant to the regulatory standards. After careful evaluation of all applicable alternatives, the most technically feasible, cost-effective remedy was selected. The selected remedy included excavation of the soil within wetland areas to concentrations of 1 ppm PCBs or less, excavation of the soil in the upland, stream, and pond areas to concentrations of 25 ppm PCBs or less and the installation of a geotextile-soil cap protected by rip-rap armor within the watercourse areas.

Upon completion of the project, approximately 67,000 tons (55,500 cubic yards) of contaminated soil and sediment were excavated and disposed of offsite, five buildings and associated components related to a process water facility were demolished, a former underground oil/water separator was removed, a geotextile-soil-rock cap was installed, and the entirety of the remedial site was restored including the restoration of approximately one acre of functional wetlands.

DESIGN/BUILD REMEDIATION SERVICES: As a design/build project, prior to the implementation of construction activities, LEA obtained seven permits and one temporary authorization as necessary to carry forth the project. LEA also prepared all design drawings and technical specifications necessary to support the permitting activities and direct efforts during construction activities. A Health and Safety Plan (HASP) was prepared prior to the initiation of construction, which detailed safety organization, procedure, and personal protective equipment based on an analysis of potential site-specific hazards. LEA was also responsible for the development of a variety of very specific procedures to document the adequacy of the remediation all of which were approved by EPA.

CONSTRUCTION REMEDIATION: Remediation involved various construction activities performed by LEA and Loureiro Contractors, Inc. (LCI), a wholly owned subsidiary of LEA. These activities included the installation of a temporary lined by-pass channel with inlet and outlet structures, the demolition of a process water facility including five building structures and their associated components, the removal and offsite disposal of an oil/water separator and the soil containing greater than 25 ppm PCBs surrounding the structure, the offsite disposal of all related demolition debris and the installation of an engineered control to achieve compliance with the variance provisions in the Connecticut Remediation Standard Regulations (RSR).

All soil and sediment from within and surrounding Willow Brook and Willow Brook Pond containing PCBs at a concentration greater than 25 ppm was excavated and permanently removed. The exception to this approach was the wetland down gradient of the dam and the southern portion of Willow Brook Pond where excavation and removal of PCBs at a concentration greater than 1 ppm was performed, in accordance with the Residential Direct Exposure Criteria (RDEC). All contaminated soil and sediment was transported by a licensed waste hauler to a permitted chemical or solid waste facility dependent on the waste characterization.

SITE RESTORATION: Following excavation and demolition activities, the entire site was restored. The site restoration involved the installation of three types of engineered controls over the remaining soil and sediments. The engineered controls were designed to accommodate the anticipated stream flow velocities and considered the ultimate use of the areas. The Wetland north of Willow Brook was remediated to meet the RDEC. As such, there was no need for an engineered control within this area. The restoration activities performed were focused on restoring this area to a marsh with habitat value.

Post-remediation activities for this project include monitoring and maintenance of the engineered controls, monitoring and maintenance of the wetland restoration, groundwater monitoring, recording of the necessary land use restrictions and demonstrating financial assurance for the engineered control maintenance and monitoring activities.

The remediation activities were initiated on July 2, 2001 and were completed by August 31, 2002.

Phase I, II, III Environmental Site Assessments
Subsurface Investigations & Site Remediation

Former Industrial Site
Shelton, Connecticut

DATE/DURATION:	2001 - 2003
CLIENT:	Black & Decker Corporation
CONTACT:	Linda Biagioni, Vice President Environmental Affairs (410) 716-3545
LEA PERSONNEL:	Margaret M. Averill, LEP, Vice President Kimberly M. Clarke, LEP

SCOPE OF SERVICES: Loureiro Engineering Associates, Inc. completed a Phase I, Phase II and Phase III site investigation of a former rivet manufacturer and metal finisher in Shelton, Connecticut. This work was done in support of the voluntary program and property transfer. The site is on the Superfund inventory of known or suspected hazardous waste disposal sites and was a large quantity generator of hazardous waste. The objectives of the investigations were to assess the potential for contamination in soil and groundwater and to define the extent of contamination emanating from historic site operations.

PHASE I and II ESAs: LEA documented site usage and the potential for contamination resulting from site operations in a Phase I report. Based on LEA's investigations into the documented operations conducted at the site, information was obtained indicating the activities conducted at the site could have potentially resulted in the discharge, spillage, uncontrolled loss, seepage or filtration of hazardous waste on the Site. Several areas of concern were identified for Phase II investigations based on the Phase I assessment. These areas included 38 locations on the site, including former surface disposal locations, a plating line, a capped lagoon, and numerous underground storage tank locations. The Phase II subsurface investigation activities included approximately 100 soil borings (including shallow soil sampling locations) that were advanced in numerous locations across the site for the collection and laboratory analysis of soil samples for a variety of constituents. In addition to the installation of soil borings and collection of soil samples, 8 groundwater-monitoring wells were installed at the site to provide an understanding of hydrogeologic conditions at the site and to assess the quality of groundwater beneath the site. Based on the results of the Phase II ESA, it was determined that several AOCs contained constituents at concentrations that exceeded the applicable regulatory criteria. As such, a Phase III work plan was developed to fully characterize and delineate the nature and extent of contamination resulting from releases at the site.

PHASE III ESA: The Phase III site investigation was implemented and included the installation of approximately 125 soil borings, including 11 groundwater monitoring wells, collection of 80 shallow soil samples and laboratory analysis of more than 600 soil samples. In addition, LEA conducted groundwater sampling for contaminants of concern.

SITE REMEDIATION: Following the Phase III, LEA conducted remedial activities at the site which included: traditional soil removal techniques, development of land use restrictions to prevent disturbance of soil in some locations at the site, and design and installation of an engineered control to physically isolate polluted soils at the site. Since completion of these activities, the site has been transferred to a new property owner and is currently operated as a foam manufacturing facility.

ASTM Phase I Environmental Site Assessment
Limited Subsurface Investigation
Brownfields Funding/Public Outreach Assistance

Former Woods Woolen Mill Property
Hillsborough, New Hampshire

DATE/DURATION:	September 2006 to present
CLIENT:	Town of Hillsborough, New Hampshire
CONTACT:	Matthew Taylor, Town Planner (603) 464-3877
LEA PERSONNEL:	Margaret M. Averill, LEP, Vice President Bettina E. Eames, PG

SITE DESCRIPTION: The property consists of approximately 2.6± acres of land which was the former site of an old woolen (textile) mill from circa the late 1800s up until the mid 1980s. The property is zoned as being within the town's central business district but is abutted by the Contoocook River and several residential properties. The property is also bisected by a state-owned former railroad right-of-way (ROW), which connect to a network of rail trails to the west part of the state. The original mill building was demolished (only the foundation exists) and abandoned by its former owner due to the discovery of asbestos-containing building materials (ACBM) and lead-based paint (LBP) associated with wood clapboard siding on several structures. The property, access to which is unrestricted, is strewn with building debris and litter and remaining structures are deteriorating and are subject to potential trespassing, vagrancy and vandalism.

PHASE I ENVIRONMENTAL ASSESSMENT: LEA performed a Phase I ESA in accordance with ASTM E 1527-05 which incorporates the *All Appropriate Inquiries (AAI)* Final Rule (40 CFR Part 312). The Phase I ESA included a site reconnaissance, review of local, state and federal files and an interview with the former manager of the mill. The assessment identified several *Recognized Environmental Conditions (RECs)* which indicates the presence or likely presence of hazardous substances or petroleum products could have potentially resulted in an existing release, past release, or material threat of release into structures on the property or into the subsurface associated. In total, seven Areas of Concern or AOCs were identified and which included: the former railroad ROW, warehouse building, former machine shop, former dye house, former coal bin and UST area, former transformer areas and the former mill building foundation. Auxiliary environmental issues at the property identified included: ACM and LBP in building materials and which are co-mingled, LBP, building debris related to past incomplete building demolition as well as continuing deterioration of existing structures resulting in pile up of large quantities of surface debris. LEA recommended

LIMITED SUBSURFACE INVESTIGATION: LEA conducted a limited investigation using direct-push drilling techniques to assess and collect surficial and subsurface soil samples for laboratory analysis in select AOCs identified during the Phase I ESA. Potential contaminants of concern (COCs) include: VOCs, including chlorinated compounds, SVOCs and PAHs, petroleum, PCBs and heavy metals. Laboratory analysis of soil detected TPH up to 38,000 ppm, lead up to 6,600 ppm and chromium up to 140 ppm within the top 4 feet of ground surface. PAHs detected in one boring were elevated and associated with the presence of ash, cinders and coal in fill materials. Concentrations of TPH, PAHs,

lead and few other heavy metals were above NHDES Method 1 soil standards for S-1/S-2 soils. The lead concentration of 6,600 ppm in surface soil was identified to exceed the NHDES Upper Concentration Limit (UCL) of 4,000 mg/kg. LEA concluded that comprehensive assessment of environmental conditions at the property was warranted and advised the town that select soil concentrations constituted a "discharge" that required reporting to the NHDES.

BROWNFIELDS FUNDING AND PUBLIC OUTREACH ASSISTANCE: LEA evaluated the property's eligibility for assessment and clean-up grants (funding) under the EPA Brownfields Program for Fiscal Year 2007. Because contamination at the property was likely co-mingled, LEA recommended pursuit of a hazardous assessment grant. LEA assisted the town in preparing two targeted site-specific Brownfields grant applications to EPA – one for assessment of hazardous substances and a second for clean-up. LEA provided information on site history and potential site hazards, including results of preliminary site contamination found, cost estimates for future comprehensive assessment, ACM and LBP abatement and disposal and site remediation and a thorough review of both applications. Prior to submittal of the applications, LEA led a public meeting presenting information on work conducted at the site and the planned submittal of two Brownfields grant applications to EPA. In May 2007, the EPA awarded the town a $200,000 clean-up grant for the mill site. In July 2007, following the award LEA led a second public meeting in town discussing future plans for the site.

Site Investigation/Remediation - Design/Build Services
Centredale Manor Restoration Project Superfund Site

North Providence, Rhode Island

DATE/DURATION: 2001 to Present
CLIENT: Centredale Manor Performing Parties Group
ONTACT: Jerome C. Muys, Jr., Esq., Project Coordinator
(202) 424-7547
LEA PERSONNEL: Jeffrey J. Loureiro, L.E.P., David N. Scotti

SITE HISTORY: A former industrial property situated within the 100-year floodplain of the Woonasquatucket River in North Providence, Rhode Island was used as a textile mill during the 1930s. From the 1940s until the 1970s this property was used as a chemical manufacturing and an incineration-based barrel reclamation facility. In the early 1970s a fire destroyed most of the structures on site, and in the late 1970s and early 1980s the property was developed for its current use as a residential apartment complex property.

Past operations at the property were conducted along the banks of the Woonasquatucket River and an associated drainage swale, and resulted in the release of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (dioxin) and other contaminants to these drainage features. As a result, dioxin and other contaminants were transported to downstream reaches of the Woonasquatucket River and the associated wetland system, including Allendale Pond. The transport of site contaminants further downstream to Lyman Mill Pond was aided by the breach of Allendale Dam in 1991.

DESIGN / BUILD SERVICES: In response to a USEPA-mandated CERCLA removal action, LEA designed and constructed an interim protective cap for an area of the site prone to flooding and containing elevated levels of dioxin in surface soil. Due to the proximity to the Woonasquatucket River, LEA also designed and constructed a flood control berm to prevent erosion of the cap.

To address contaminants in soil and sediment downstream of the site, LEA prepared and submitted an Implementation Work Plan (IWP) for the removal all soil and sediment containing dioxin in excess of 1 part per billion (ppb), and for the restoration of Allendale Dam. In accordance with the IWP, LEA obtained soil and sediment samples from the site and associated wetland system, as well as from

surrounding residential properties. LEA also prepared a Quality Assurance Project Plan to assure that the samples that were collected were of sufficient quality and quantity and suitable for their intended use. The samples were analyzed and the results were used to define the limits of the dioxin-impacted soil and sediment. Based on the defined limits of contamination, LEA's construction division, Loureiro Contractors, Inc. (LCI), removed the impacted soil and sediment. The removal process used an innovative approach focusing on vacuum extraction. This approach enabled the contaminated areas to be accessed with minimal impact to the adjoining residential properties. Because of our practical knowledge of the governing waste management regulations, LEA successfully identified a regulatory strategy that allowed for the disposal of the excavated soil and sediment at a non-hazardous waste landfill. As a result of not having to dispose of the soil and sediment at an off-site incineration facility, as initially mandated under the Unilateral Administrative Order, LEA identified savings to the client Group on the order of $100,000.

In accordance with the IWP, LCI also removed the remnants of the breached Allendale Dam and constructed a new dam. The new dam consists of a cast-in-place concrete structure that is anchored to the underlying bedrock surface. As a less costly alternative to placing the concrete footings upon the bedrock surface, as designed, LEA proposed and prepared design modifications that were readily approved by EPA that allowed construction of the concrete footings upon the existing till above the bedrock. The modified design resulted in a reduction in the volume of impacted sediment requiring removal, and as a result, provided additional cost savings.

As part of the design / build services provided on this project, LEA performed a Time-Critical Removal Action (TCRA) to prevent the potential for the migration of, and direct contact with, surface soils, sub-surface soils and exposed sediments impacted with dioxin, metals, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and other hazardous contaminants in the area of the former tailrace.

The TCRA involved the design and construction of a permeable protective cap over soil and sediment within the former tailrace. A drainage swale was incorporated as part of the permeable protective cap thereby moderating the impact of flood conditions and managing the stormwater runoff that discharges into this area of the Site.

The design-build services provided by LEA on this project demonstrate LEA's ability to quickly develop solutions to changed field conditions while completing the project on time and on budget.

Design/Build Construction Remediation
Brownfields Redevelopment
Derby, Connecticut

(Photo: Before)

SITE HISTORY: The subject site, located at 45 Main Street and along Route 8 in Derby, Connecticut, was formerly occupied by a manufacturing facility. Banbury mixers, used in the rubber manufacturing industry, and other large industrial equipment were manufactured and repaired at the facility. The historical processes associated with manufacturing and repairing the large industrial equipment involved the use of chlorinated solvents. Historical operations at this facility included the use of an on-site foundry. In addition, facility operations included the storage of a variety of petroleum products in numerous underground storage tanks. Operations at the facility ceased in the late 1997/early 1998 timeframe. At that time, the site was vacated; several vacant industrial buildings, underground storage tanks, and associated improvements remained at the property.

PROPOSED SITE USE: Due to its favorable location along Route 8 in the Naugatuck River Valley, the site became the proposed location of a new Home Depot retail facility. The proposed site development plan included the construction of a 116,000± square-foot commercial building located near the southern portion of the parcel, with paved parking lots and driveways covering the majority of the remaining site area. Based on the manufacturing history and potential contaminants of concern, subsurface site investigations were deemed necessary.

SITE INVESTIGATIONS: Contaminants preliminarily identified as potentially impacting site soil and groundwater included chlorinated volatile organic compounds (VOCs) (tetrachloroethylene; trichloroethylene; 1,1,1-trichloroethane, and associated degradation products), semi-volatile organic compounds, (SVOCs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), and metals. Loureiro Engineering Associates, Inc. (LEA) developed and implemented work plans to assess the nature and three-dimensional extent of site contaminants. In implementing

these plans, over several-hundred soil borings were advanced and over 35 monitoring wells were installed at the site. The soil borings and monitoring wells were sampled for chemical analyses. Other investigative activities included several soil vapor surveys, and the laboratory analysis of soil samples for physical parameters. Based on the findings of these site investigations, VOCs, SVOCs, TPH, and metals were identified as contaminants of concern in soil and groundwater.

REMEDIATION ALTERNATIVES ANALYSIS: In evaluating appropriate remedies for the site, LEA relied upon its considerable expertise and knowledge of Environmental Land Use Restrictions (ELURs) to identify viable options compliant with the Connecticut Remediation Standard Regulations (RSRs). The remedial alternatives evaluation included an assessment of the affects of ELURs on property values, future development, and human health risk issues, in addition to technical compliance with the RSRs. LEA worked closely with the client and the Developer to ensure that a technically feasible, cost-effective alternative was selected that is protective of human health and the environment. The selected remedy included excavation and consolidation of contaminated soil beneath an on-site cap and within the area of an engineered control. The remedy also included the installation of a soil vapor extraction/sub-slab ventilation (SVE/SSV) system.

REMEDIATION APPROACH: The remediation approach was designed to include the integration of the future site development plan with the necessary excavation and/or relocation of contaminated soil. Generally speaking, the proposed remediation included the construction of an "engineered control" (e.g., a polyethylene liner overlain with several inches of bituminous pavement) along the eastern property line, with the relocation of contaminated soil from other areas of the Site to this location. By consolidating contaminated soil beneath the engineered control, significant cost savings were recognized by the former site owner, client as well as by the developer. ELURs were necessary throughout the Site to restrict the future use to commercial/industrial activities and to restrict future disturbance and/or building construction within specific areas.

CONSTRUCTION REMEDIATION:LEA performed site remediation activities through its construction division Loureiro Contractors, Inc. (LCI). In general, these activities included the construction of the engineered control (cap) and placement of contaminated soil beneath the cap. These activities also included the installation of a SVE/SSV system. As designed, the remediation activities were performed concurrently with activities associated with the development and construction of the Home Depot retail outlet and related site improvements. The integration of remediation, site development, and construction required the critical coordination of various activities between LCI and the developer's contractors.

(Photo: During)

During the excavation of contaminated soil by LCI, LEA obtained soil samples to fill data gaps in delineating the extent of contamination, and to guide soil relocation efforts. The soil samples were screened in the field to provide "real-time" data providing immediate decision-making ability to assess the need to excavate and remove additional soil. Once all of the contaminated soil appeared to have been removed based on this screening characterization, additional samples were obtained and analyzed to confirm the limits of contamination. The samples were analyzed under a rapid turn-around-time. The laboratory results were used to rapidly and efficiently guide characterization efforts by means of an adaptive sampling strategy, in which the results of the samples were fed into the decision-making process to direct the excavation and collection of the next round of samples. This dynamic process enabled the soil relocation efforts to proceed without the unnecessary excavation and relocation of soil to limited space within the area of the engineered control. This process was also used to quickly identify when enough data were obtained to verify that the soil remaining on-site is compliant with the RSRs.

The eastern portion of the Site included the largest area of contamination, primarily consisting of SVOCs and VOCs that exhibited concentrations exceeding the applicable tabulated direct exposure and pollutant mobility criteria presented in the RSR. The majority of this contamination was located between the proposed building and the eastern property line. This portion of the Site was equipped with the engineered control and an ELUR was recorded in this area to restrict disturbance to the engineered control.

Soil located adjacent to the above referenced contaminated area which do not exceed any of the applicable criteria, were excavated and relocated to another portion of the Site to provide a consolidated location for the relocation of other contaminated soils (within the engineered control). Smaller pockets of contaminated soil necessitating remediation due to exceedances of the pollutant mobility criteria, which are located throughout the proposed parking and landscaped areas of the Site, were excavated and relocated to the engineered control area. The contaminated materials over the direct exposure criteria were removed by excavation to an adequate depth to render the remaining materials "inaccessible" as defined in the RSR. The excavated materials were similarly deposited below the proposed engineered control. ELURs were recorded in these areas to restrict any future disturbance to the inaccessible soil.

Soil that exhibited contamination levels exceeding the applicable tabulated criteria in the RSRs which were located below the proposed building were remediated to a depth adequate to facilitate construction of the building slab, footings, and related subsurface components. Contaminated soil located below this critical elevation was left in place and considered "inaccessible" and "environmentally isolated" upon construction of the proposed building. An

ELUR was recorded for the area extending throughout the building footprint to restrict any future disturbance.

To address groundwater contamination below the proposed building footprint, LCI constructed a sub-slab ventilation system to prevent the migration of VOCs to the interior of the building. ELURs were recorded for this area to restrict the land use to industrial activity and to prevent the construction of a building over the impacted areas without acceptable measures to prevent the migration of vapors into the building(s).

By utilizing our experience in providing turnkey design/build remedies, this project exemplifies how LEA/LCI is able to work with developers to concurrently perform remediation and development / construction activities.

ASTM Phase I Environmental Site Assessment
Subsurface Site Investigation
Voluntary Clean-Up and Site Remediation

Commercial Property
New Haven, Connecticut

DATE/DURATION:	July 2004 to present (on-going)
CLIENT:	Crosby Realty, Inc.
CONTACT:	Richard Smith (203) 467-1997
LEA PERSONNEL:	Margaret M. Averill, LEP, Vice President Mark A. Welsh, PE, LSP Bettina E. Eames, P.G.

SITE DESCRIPTION: The property consists of approximately 2.3± acres of improved commercial land located along the Quinnipiac River in New Haven County, Connecticut. The property has a long history of petroleum use and storage, including: as a lumber storage area and wood working shop (early 1900s), as an above-ground and under-ground storage tank (AST and UST) farm, fuel depot and asphalt batch plant (early 1900s up until the 1970s) and most recently as a Treatment Storage and Disposal Facility (TSDF) for state-regulated and hazardous waste through the late 1990s. The property, which is being redeveloped for commercial reuse, is currently being used as docking facility for ships and other marine vessels.

PHASE I ENVIRONMENTAL ASSESSMENT AND SUBSURFACE INVESTIGATION: LEA performed a Phase I ESA in accordance with ASTM E 1527-05 and the *All Appropriate Inquiries (AAI)* Final Rule (40 CFR Part 312). The Phase I ESA included a site reconnaissance, review of local, state, federal files and review of various environmental databases. The assessment identified several *Recognized Environmental Conditions (RECs)* which indicates the presence or likely presence of hazardous substances or petroleum products could have potentially resulted in an existing release, past release, or material threat of release into structures on the property or into the subsurface in eight potential release areas of Areas of Concern (AOCs).

In July 2004 and February 2005, LEA conducted a subsurface investigation in the eight AOCs identified as part of the Phase I ESA. The investigation included: the advancement of 41 soil borings, including 10 monitoring wells, and the collection of approximately 200 soil samples and three rounds of groundwater samples over a two-year period. Potential contaminants of concern (COCs) identified in soil included: petroleum hydrocarbons, VOCs, SVOCs, PAHs and metals, primarily lead and arsenic. Concentrations in soil were identified to exceed Connecticut Residential and Industrial/Commercial Direct Exposure Criteria (I/CDEC and RDEC) and the Pollutant Mobility Criteria (PMC) for a GB Area. Potential COCs identified in

groundwater included: petroleum hydrocarbons, PAHs and several metals. Groundwater concentrations were identified to exceed Connecticut Residential and Industrial/Commercial Volatilization Criteria and potentially Surface Water Criteria. Sources of petroleum included releases from the asphaltic material (which was found in subsurface materials) from former AST and USTs

VOLUNTARY CLEAN-UP AND SITE REMEDIATION: In July 2005, under the direction of state licensed environmental professional (LEP), LEA directed soil removal activities in three separate areas of the property. Soil excavation activities were designed to meet the Connecticut Remediation Standard Regulations (RSRs) for future industrial/commercial use. Approximately 1900 cubic yards of petroleum and metals contaminated soil was removed and disposed off-site for asphalt-batch recycling. The top 2 feet of soil was removed in most locations. For various reasons (i.e. presence of widespread polluted-fill, subsurface obstructions and some confirmatory sample results were above the required RSRs in some areas), all areas were not fully excavated and thus further response actions will be required to prevent future exposures. Surface restoration activities consisted of a "customized" cap of a layer of new asphalt pavement overlying a layer of clean fill. Due to site constraints, flooding issues and nature of contamination remaining in place relative to the asphalt cover (which is similar), the "customized" cap was not required to meet the minimum 2-foot thickness in all locations as per state requirements. Based on the data collected as part of the Phase I ESA, the subsurface investigation and soil remediation, LEA prepared and submitted an Environmental Condition Assessment Form (ECAF) for the property under the state's Voluntary Remediation Program (VRP). The ECAF will be used by the DEP to determine whether continued assessment and remediation of the property will require oversight by the DEP or can be taken over by a state-licensed LEP.

ON-GOING MONITORING AND IMPLEMENTATION OF INSTIUTIONAL CONTROLS: LEA continues to perform semiannual monitoring of groundwater at the property. Because concentrations of COCs in soil do not meet residential RSRs, residential use of the property will be restricted via implementation of an Environmental Land Use Restriction (ELUR), which will be attached to the property deed and recorded at the local land office. LEA is in the process of preparing the decision document for the Environmental Land Use Restriction (ELUR), which is expected to be recorded in the near future.

Resumes

Jeffrey J. Loureiro, P.E., L.E.P.
President and Chief Executive Officer

Education

Bachelor of Science; Civil Engineering – Northeastern University – 1978

Professional Certifications

Professional Engineer, Connecticut and Maine

Licensed Environmental Professional, Connecticut

Summary Biography

Mr. Loureiro has developed a broad range of experience in the planning, design, supervision, review, and management of projects in civil and environmental engineering throughout his career. This experience includes investigations related to soil and groundwater contamination, evaluation of remedial options, development and implementation of remedial action plans, hazardous waste management, closure of RCRA-regulated units and facilities, preparation of RCRA Part B and NPDES permit applications, and design of industrial and municipal wastewater collection and treatment systems. He also provides litigation support for cases involving RCRA compliance and site remediation issues.

Highlights of Accomplishments and Experience

Investigation & Remediation

- Directs and administers the activities of the firm in the areas of subsurface investigation of soil and groundwater contamination, remediation of contaminated media, RCRA compliance, site assessment, and multi-media Environmental Health and Safety Management Systems Audits, and underground storage tank management.
- Evaluates behavior, fate, and transport of dense nonaqueous phase liquid (DNAPL) chemicals in the subsurface and the development of effective remedial strategies for DNAPL sites.
- Responsible for the development and implementation of "state-of-the-art" and innovative remedial solutions for a variety of situations, such as *in situ* bioventing system for remediation of jet fuel-contaminated soil and design and operation of a "containment building" for *ex situ remediation* of soils contaminated with chlorinated solvents from RCRA-listed waste.

RCRA Facility Investigation (RFI):

- Participated in extensive subsurface investigation to delineate the nature and extent of contamination primarily from heavy metals and chlorinated volatile organic compounds.
- Installed hundreds of soil borings and a groundwater monitoring network of over 100 wells. Project included a specific investigation to evaluate the potential occurrence of dense nonaqueous phase liquids (DNAPL) in the subsurface, as well as several pumping tests to evaluate aquifer characteristics.

RCRA Corrective Measures Study/Corrective Measures Implementation (CMS/CMI):

- Participated in evaluation and implementation of corrective measures, performed concurrently with the RCRA Facility Investigation to address contamination primarily from heavy metals and chlorinated volatile organic compounds.
- Performed remedial activities at the site that included soil removal in several areas of

the facility, vapor extraction to address vadose zone contamination from solvents, limited groundwater extraction and treatment (primarily to lower the water table and expose more soils to vapor extraction), and ex-situ treatment of solvent-contaminated soils in a temporary "containment building".

Design and operation of a "containment building" for remediation of solvent-contaminated soil:

- Participated in the design and operation of a temporary "containment building" for the ex-situ treatment through volatilization of solvents from a RCRA-listed waste resulted in a significant cost-savings for the client due to the innovative approach.
- Project activities included detailed design and plans and specifications for construction and operation of the building, as well as the performance of treatability studies and constant performance evaluations.

Evaluation of aquifer restoration potential:

- Evaluated data following completion of the RFI and CMS/CMI to determine whether or not it was technically infeasible to restore a portion of the aquifer contaminated with chlorinated volatile organic compounds to drinking water quality due to the documented, as well as calculated, occurrence of dense nonaqueous phase liquids (DNAPL) in the subsurface.
- Used batch flush calculations and plume lengths and an extensive literature review on the subject of aquifer restoration when DNAPL chemicals are present in the saturated zone to estimate potential remediation times for various portions of the aquifer, based on site-specific aquifer and contaminant characteristics.

Design and implementation of in-situ bioventing system

- Performed pilot study for the site of a former 500,000 gallon above ground jet fuel storage tank to determine the effectiveness of bioventing as a remediation technique.
- Conceptual development, design, installation and operation of the system for 60 days.
- Performed continuous monitoring and testing to determine process operating parameters, radius of influence, air permeability and respiration rate, which were used to optimize the system operation. The objective was to evaluate the extent to which microbial activity in the contaminated soil could be enhanced by increased oxygen supply.

Environmental Management & Pollution Prevention

- Participated in sampling and analysis of soil and groundwater to determine the nature and extent of contamination resulting from leaking gasoline underground storage tanks and hydrogeological characteristics of the site.
- Developed a remedial action plan, which included soil vapor extraction, groundwater extraction and treatment, bioremediation, and continued groundwater monitoring.

RCRA Part B and Part B Post-Closure Permit applications

- Prepared Part B and/or Part B Post-Closure Permit Applications for individual facilities in accordance with the Resource Conservation and Recovery Act (RCRA).
- Tasks included compilation, review, and evaluation of all available data relating to hazardous waste management, process operations, preparation and/or documentation of waste analysis plans, contingency plans, inspection plans, personnel training, closure plans, groundwater monitoring programs, and process descriptions.
- Identified hazardous waste management units as waste piles, landfills, surface impoundments, container storage areas, and tank storage facilities.
- Delineated areas of non-compliance, development of groundwater monitoring plans and compliance schedules.

- Prepared plans and specifications for initial improvements, and cost estimates.

Closure plan for RCRA-permitted hazardous waste landfill:

- Developed Closure Plan prior to completion of the landfill.
- Prepared detailed design, plans, and specifications for construction of a multi-layered cap.
- Supervised construction.
- Certified closure.
- Utilized innovative cap design to consider the steep slopes of the landfill and construction methodology that would prevent the release of contaminated particulates through wind dispersal and storm water runoff.

Civil & Site

Tank removal and installation/replacement projects

- Prepared detailed plans and specifications for the removal and replacement of tanks, appurtenant piping, heating and piping equipment (including as-built drawings).
- Evaluated viable replacement alternatives.
- Prepared plans for construction sequencing.
- Performed construction services for numerous projects involving the removal and/or installation of underground storage tanks. (Tanks have generally been used for the storage of a variety of petroleum products, and have had capacities as large as 45,000 gallons.)

Groundwater treatment system design:

- Participated in conceptual design and treatability studies for removal of iron. manganese, and several chlorinated solvents for a 2500-gallon per minute potable water supply delivered via three high-capacity production wells, as well as detailed design.
- Prepared plans and specifications for construction.
- Supervised construction.

Brian A. Cutler, P.E., L.E.P.
Senior Vice President

Education

Bachelor of Science, Civil Engineering – Northeastern University – 1991, with honors

Professional Certifications

Professional Engineer, Connecticut, #19470
Licensed Environmental Professional, Connecticut, #359

Summary Biography

Since joining Loureiro Engineering Associates, Inc. in 1991, Mr. Cutler has been involved in the development, planning, engineering, evaluation, design and construction administration of various civil and environmental projects for government and private-sector clients. As Senior Vice President, Mr. Cutler is responsible for the day-to-day operation of the consulting practice of Loureiro Engineering Associates, Inc. and is active in projects that call upon the combined resources of the consulting practice and Loureiro Contractors, Inc., the construction subsidiary of Loureiro Engineering Associates, Inc. Specific responsibilities as Senior Vice President include scheduling and supervision of technical personnel, budget evaluation, preparation of progress reports, and interaction with clients and regulatory agencies. The breadth of Mr. Cutler's experience in the environmental consulting field has resulted in proficiency with the state and federal environmental regulations and in the development and integration of computer based applications to provide solutions to management, cost tracking, data evaluation, and engineering analyses.

Throughout his career, Mr. Cutler has been directly responsible for environmental investigations, remediation, and permitting conducted in conformance with numerous regulatory programs and voluntary situations for a number of large industrial entities in the State of Connecticut, as well as for smaller commercial and industrial entities. Specific site investigation experience includes a wide range of expertise from Phase I environmental site assessments and underground storage tank removals to complex investigations of soil, groundwater, surface water and sediment contaminated with multiple contaminants in a range of environmental settings. He has performed evaluations of remedial alternatives, developed and designed remedial strategies, and provided managerial oversight of numerous remediation projects for a variety of contaminated media.

In addition to activities related to investigation and remediation, Mr. Cutler's expertise includes civil and geotechnical engineering design and a range of environmental permitting issues. His civil engineering and design experience has focused on planning and design for sanitary and storm sewer systems, design of municipal landfill closure systems and RCRA Closure Caps, and construction administration. Environmental permit and reporting activities have included preparation of such documents as SARA Title III, Tier II and Form R reports; NPDES Wastewater and Storm Water Discharge Permit applications; diversion permit applications; solid waste facility construction and operation permit applications; Spill Control and Best Management Practice Plans, Solvent Management Plans, and Spill Prevention Control and Countermeasures Plans. He has also participated extensively in participation in multi-media Environmental Health and Safety Management Systems Audits at large manufacturing facilities.

Highlights of Accomplishments and Experience

Site Investigation and Remediation

- Management of numerous Phase I, Phase II, Phase III Environmental Site Assessments
- Management and supervision of field and office personnel during the performance of soil and groundwater investigations.
- Development, implementation, and management of numerous, complex soil and groundwater investigations for a variety of contaminants and a range of geologic settings
- Project manager for a mandatory soil, groundwater, surface water, and sediment investigation for inorganic, volatile and semi-volatile organic compounds, and petroleum hydrocarbons. Activities included identification of potential contaminant source areas, preparation of a Work Plan, installation of soil borings, monitoring wells, stream gauges, collection of soil, groundwater, surface water, sediment, and soil vapor samples, data evaluation, and evaluation of appropriate remedial alternatives.
- Project officer for a mandatory remediation of soil and sediment contaminated with polychlorinated biphenyls. Remediation was performed on a design/build basis. Activities included preparation of local, state and federal wetlands applications, negotiations with local, state and federal regulatory agencies, and preparation of a Work Plan. The project resulted in the approval of the first sub aqueous "cap" for polychlorinated biphenyls in the State of Connecticut. Remediation activities involved the excavation and offsite disposal of over 66,000 tons of contaminated soils and sediment and restoration of two ponds, a wetland, and 1,200 feet of stream channel.
- Project officer for a mandatory remediation of soil and sediment contaminated with polychlorinated biphenyls. Remediation was performed on a design/build basis. Activities included preparation of local, state and federal wetlands applications, negotiations with local, state and federal regulatory agencies, and preparation of a Work Plan. Remediation activities involved the excavation and offsite disposal of over 23,000 tons of contaminated soils and sediment and restoration the embankment of two ponds and the construction of 500 feet of 4-lane road through an active manufacturing complex.
- Project officer for a mandatory remediation of soil, groundwater, and sediment contaminated with volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls, and metals. Activities included the development of a remediation plan integrated with a future use that included a hotel, train station, commercial office a residential tower, the negotiation of a soil and sediment remediation plan with state agencies, and the preparation of various local, state and federal environmental permit applications. Project will involve the onsite relocation of over 150,000 cubic yards of contaminated soils, installation of engineered controls, and the restoration of over 2,000 feet of shoreline in a tidally influenced environment.

Preparation of Storm Water Discharge Permit Registrations and Pollution Prevention Plans

- Compilation of information and submitted registration documents to State Agencies for the discharge of "Stormwater Associated with Industrial Activities" for several private industrial clients. Authored Stormwater Pollution Prevention Plans for each in accordance with applicable State regulations.
- Coordination of in-house and sub-contracted sampling teams.

Municipal Landfill Closure

- Project engineer for design and preparation of plans and specifications for the closure of a landfill in accordance with current Federal and State requirements. Additional services included the design of a salt dome storage foundation, authoring a site specific Stormwater Pollution Control Plan, and construction administration activities including: weekly progress meetings, client/contractor relations, and the development of a

computer based comprehensive project cost management system.

NPDES Permit Application

- Preparation of NPDES Permit Applications for several Connecticut based manufacturing facilities. Responsibilities included facility and State record research, coordination of sampling activities, compilation and analysis of process information, authoring site specific Spill Control, Solvent Management, Spill Prevention Control and Countermeasure Plans, and Operation and Maintenance Manuals for process wastewater treatment systems, and performed site compliance investigations for Spill Prevention Control and Countermeasure Plans.

Superfund Amendments and Reauthorization Act Title III Reporting

- Preparation of Tier II and Form R facility reporting documents in accordance with Sections 312 and 313 of SARA Title III for two Connecticut based industrial facilities. Responsibilities included data acquisition, review, compilation, reporting form completion, agency notifications, and the completion and submittal of documentation packages for the client's records.

George F. Andrews Jr., P.E., L.E.P.
Vice President

Education

Master of Science; Environmental Engineering – University of New Haven – 1993

Bachelor of Science; Agricultural/Soil and Water Engineering – Univ. of Connecticut – 1986

Professional Certifications

Professional Engineer - Connecticut 1995

Licensed Environmental Professional – Connecticut 2004

Summary Biography

Mr. Andrews has over 18 years of experience in the planning, engineering, design, supervision, inspection, administration and management of civil and environmental projects for government and private sector clients. This experience includes taking a project from the conceptual stage through the permitting, planning and design phases to the final stage of construction supervision, administration and management.

Mr. Andrews has a wide variety of experience in the civil and environmental fields. His civil engineering experience includes roadway design for residential and commercial/industrial development; large industrial and small-scale site development; innovative stormwater management; wetland mitigation; utility improvements including water, sewer, power/communications and gas; sewage pump station design; infiltration/inflow evaluations; potable water provision and distribution; evaluation and design of wastewater treatment facilities; and design of large and small subsurface sewage disposal facilities.

His contamination remediation experience includes investigation and characterization of contaminated sites; UST removal/replacement; design of various groundwater and soil vapor recovery systems; and design and management of excavation/disposal and on-site capping activities for large-scale contaminated soil remediation projects for a number of large industrial entities.

Highlights of Accomplishments and Experience

Investigation and Remediation:

- Prepared process design schematics and installed several soil vapor extraction systems (SVE) for remediation of VOC contaminated soil. Long-term performance monitoring and maintenance services were provided throughout operation. One system integrated air sparging technology with the SVE.
- Managed all activities associated with several soil contamination remediation projects at large industrial facilities. Projects ranged in size with soil volumes up to 30,000 cubic yards. Post remediation activities included preparation of all closure documentation and post-closure monitoring. Contaminants of concern included PCBs, VOCs, metals, petroleum hydrocarbons, and SVOCs. Projects also included closure of solid and/or special waste disposal areas.
- Managed and actively participated in all field activities associated with an emergency spill response for a 50,000 gallon fuel release at an industrial site. Responsibilities included around-the-clock participation in the remedial activities, communications and negotiations with regulatory agencies and management of the immediate and long-term remediation of

the site. Remedial approach included installation of a barrier well system with an internal vacuum enhanced product recovery system.

- Prepared remedial alternatives evaluations for several soil and groundwater remediation projects. Contaminants of concern included PCBs, VOCs, metals, petroleum hydrocarbons and SVOCs.
- Prepared detailed construction plans and specifications for various groundwater contamination remediation systems. Projects ranged in size from 350 gpm up to 2,500 gpm. Technologies implemented include separation, filtration, air stripping, chemical treatment with settling and carbon adsorption. Provided construction administration services throughout the construction period and performance monitoring for numerous groundwater remediation projects.
- Participated in the completion of a RCRA facility investigation for a large industrial facility. Primary focus of activity was related to investigations and evaluation of the potential for the presence of DNAPL in soil and groundwater.

Civil & Site:

- Managed a 160 acre residential subdivision including land acquisitions, financial modeling, site layout, land surveys, design of 6,600 linear feet of roadway with utilities, traffic studies, local permitting, Army Corp of Engineers and Connecticut Department of Environmental Protection permitting, archeological surveys and coordination of all legal issues.
- Managed numerous infrastructure and site improvement construction projects for Loureiro Contractors, Inc. including scheduling, budgeting, contracts and logistical coordination for industrial and private sector clients.
- Managed and prepared local land use permit applications and construction drawings/specifications for numerous site development projects in Connecticut, Rhode Island and Massachusetts. Projects included industrial developments, residential subdivisions, large residential condominium developments, commercial developments and municipal roadway projects.
- Managed and prepared detailed hydrological studies for various residential, commercial and industrial developments throughout Connecticut, Rhode Island and Massachusetts.
- Prepared numerous environmental reports and permit applications through the Connecticut Department of Environmental Protection, Rhode Island Department of Environmental Management, Army Corp of Engineers, Coastal Resource Management Commission and other state, local and federal agencies for various site improvement projects.
- Managed and prepared construction drawings/specifications for numerous municipal roadway improvement projects including utility extensions, drainage and power/communications.
- Provided construction administration and resident inspection services for numerous site development projects.
- Prepared design plans and related permit applications for coastal marina developments and private dock facilities throughout Connecticut and Rhode Island.

Water & Wastewater:

- Completed detailed evaluations of water and wastewater facilities for a number of municipalities and provided recommendations for improvements and new facilities to upgrade their water supply, distribution and wastewater treatment and collection systems.
- Prepared detailed construction plans and specifications for plant-wide wastewater treatment facility upgrades at various activated sludge and filter bed water pollution control facilities. Unit processes designed include settling, aeration, clarification, miscellaneous chemical feed, sludge stabilization, disinfection and filtration. Provided construction administration services throughout the construction period.

- Completed sludge treatment and disposal/reuse studies for various municipal water pollution control facilities with detailed cost/benefit evaluations and recommendations.
- Prepared detailed construction plans and specifications for numerous municipal and private sanitary sewer extensions including medium and small sewage pump stations.
- Prepared detailed construction plans and specifications for various water supply systems for municipalities and private developments.

Thomas J. Salimeno, P.E., L.E.P.
Vice President

Education

Master of Science; Environmental Engineering – University of New Haven – 1993

Bachelor of Science; Chemical Engineering – University of Connecticut – 1986

Professional Certifications

Professional Engineer – Connecticut 1993
Licensed Environmental Professional – Connecticut 2001

Summary Biography

Mr. Salimeno is experienced in the evaluation, engineering and design of air, chemical, environmental and hazardous waste projects for healthcare, industrial and governmental clients. This experience includes taking a project from the initial planning phase through the survey, investigation, permitting and design phases, to the construction, implementation and operation phases.

Mr. Salimeno has been directly responsible for soil and groundwater investigations conducted in conformance with the voluntary provisions of Public Act 95-183 for large industrial entities in the State of Connecticut; Transfer Act Site Assessments for commercial and industrial entities; RCRA Closures; EPA's Voluntary Corrective Action Program and CERCLIS (including voluntary response actions under the EPA "comfort letter" program). As a Vice President, his responsibilities include scheduling and supervision of technical personnel, budget evaluation, project tracking, and interaction with clients and regulatory agencies.

Mr. Salimeno has a proficiency with the state and federal environmental regulations and is experienced in the preparation of RCRA permit applications, compliance programs and plans, and EH&S procedures. Mr. Salimeno's regulatory compliance experience includes a broad range of regulatory programs, including RCRA, CERCLA, SARA, TSCA, and NPDES. His environmental and hazardous waste experience includes regulatory compliance audits, and the preparation of environmental documents including spill prevention control and countermeasure plans, wastewater discharge permits, hazardous waste closure plans, and SARA Tier II and Form R's.

His engineering and design experiences include: site investigation and design of environmental remedial measures; wastewater treatment systems; solid waste landfill capping, and; waste management and chemical/fuel storage and processing systems. The remedial measures include soil vapor extraction systems, groundwater extraction systems, bioventing systems, underground storage tank and contaminated soil removal, and cap installation.

He evaluates design criteria and alternatives, prepares reports, contract documents, drawings and specifications, develops opinions of costs, and provides client representation through all phases of project award and construction. His process design experience includes the preparation of heat and material balances, process engineering and utility flow diagrams, piping and instrument diagrams and detailed process equipment specifications.

His air engineering experience includes solvent emission studies including the estimation of solvent emissions and the identification and implementation of emission reduction alternatives.

He is also experienced in the preparation of permit applications and the completion of preinspection questionnaires for various manufactures.

Highlights of Accomplishments and Experience

Soil Vapor Extraction Systems

- Participated in soil investigations to determine the degree and extent of solvent contamination
- Designed, implemented, and operated several area-specific soil vapor extraction systems installed as part of a corrective measures program at a large manufacturing facility.
- Designed, implemented, and operated in situ remedial measures including soil vapor extraction systems, high vacuum extraction systems, air sparging and groundwater extraction and treatment system.

EH&S Management Systems and Compliance

- Served as both a team leader and team member for over 15 multi-media Environmental, Health and Safety Management Systems Audits in the U.S. and Canada over the last 3 years.
- Performed multi-media compliance audits to determine regulatory compliance with hazardous and solid waste regulations, air compliance regulations, wastewater discharge regulations, PCB management regulations, OSHA hazard communication regulations and SARA community right-to-know regulations. Audited facilities have included hospitals, aerospace manufacturers, and tool manufacturers.
- Prepared RCRA Part B Permit Applications, closure plans, contingency plans, inspection plans, personnel training, and waste analysis plans for a variety of hazardous waste management units.
- Prepared state and NPDES wastewater discharge permits including effluent sampling plans, spill control plan preparation, best management plans, and solvent management plans.
- Evaluation and assistance on the applicability and implementation of the July 1998 PCB regulations as they pertain to an area formerly used for hydraulic presses containing PCBs. Identified and evaluated various options for the reuse of the manufacturing area while considering future uses, costs, and necessary modifications.

In-Situ Bioventing System for Jet Fuel Remediation Pratt & Whitney, East Hartford, CT

- Senior project engineer for a pilot study performed at the site of a former 500,000 gallon aboveground jet fuel storage tank to determine the effectiveness of bioventing as a remediation technique for this site.
  Activities included :
  - the conceptual development, design, installation and operation of the system
  - continuous monitoring and testing was performed to determine process operating parameters, radius of influence, air permeability and respiration rate, which were used to optimize the system operation.

Multi-Media Compliance Audits for Industrial Facilities in Connecticut

- Participated in investigation and inspection of facility operations to determine regulatory compliance with hazardous and solid waste regulations, air compliance regulations, wastewater discharge regulations, PCB management regulations, OSHA hazard communication regulations and SARA community right-to-know regulations.
- Prepared audit reports to note audit findings, identification of applicable regulatory requirements and provide recommendations for remedial actions.

Waste Analysis and Management

- Preparation of RCRA Part B Permit Applications, closure plans, contingency plans, inspection plans, personnel training, and waste analysis plans for a variety of hazardous waste management units.
- Investigated and studied the feasibility of excavating and recycling an electrochemical machining sludge from a landfill. The study included an evaluation of the chemical composition, identification of recycling options and a determination of the regulatory requirements for all the recycling options.

Engineering Report for Solvent Emissions, Pharmaceutical Manufacturing, Groton, CT

- Investigation and study to identify and quantify solvent emissions from a pharmaceutical manufacturing process, and to identify and complete the conceptual design of emission reduction alternatives to minimize solvent losses and waste generation and promote solvent reuse.

Air Compliance Studies and Reports for Industrial Facilities in Connecticut

- Prepared permit application for a wet scrubber for a chrome plater.
- Compled preinspection questionnaires for various manufacturers.
- Completed solvent emission studies including the determination of emissions and the identification and conceptual design of emission reduction alternatives.

OSHA Compliance Reports and Training for Industrial Facilities in Connecticut

- Preparation of hazard communication programs including training and documentation for various manufacturers.

Water and Wastewater

- Preparation of state and NPDES wastewater discharge permits including effluent sampling plans, spill control plan preparation, best management plans, and solvent management plans
- Investigation and design of groundwater extraction systems for the remediation of solvent-contaminated groundwater.
- Designed, implemented and operated several area-specific Groundwater Extraction Systems installed as part of a Corrective Measures Program at a large manufacturing facility.
- Investigated, studied and designed a compact system to treat and reuse washwaters generated by a cleaning process
- Investigation and study of wastewater characteristics and development of the preliminary design of wastewater treatment alternatives.
- *Did studies and reports on the following:*
    - Design of mass metering and sampling systems for solvent and wastewater streams being oxidized in thermal oxidizers.
    - Design of jet mixing systems for large wastewater storage tanks.
    - Specification of heat exchangers to reduce solvent emissions from underground solvent storage tanks.
    - Design of various modifications to pharmaceutical reactor systems including condensers, sampling equipment, piping and transfer pumps

Kimberly M. Clarke, L.E.P.
Senior Project Manager

Education

Master of Science; Environmental Science/Geoscience – University of New Haven - 2000

Bachelor of Science; Environmental Science – Charter Oak State College – 1997

Professional Certifications

Licensed Environmental Professional – Connecticut, #465
40-Hour Health and Safety Training for Hazardous Waste Site Activities – OSHA 29 CFR 1910.120
8-Hour Annual Refresher Health and Safety Training – OSHA 29 1910.120
Licensed Asbestos Inspector, 000580
Certified Lead Inspector, 002118
RCRA Compliant Hazardous Waste Handler Program – 40 CFR 262.34(a), 262.34(d), 264.16, and 265.16
DOT Compliant Hazardous Waste Handler Program – 40 CFR 172.704
Women and Management Training, Simmons College, 2000

Summary Biography

Ms. Clarke is a Senior Project Manager for Loureiro Engineering Associates, Inc. (LEA) with a broad range of experience in assessment, evaluation, administration, coordination and management of environmental and hazardous waste projects for commercial, industrial and municipal clients. This experience includes site assessment and evaluation, development and implementation of subsurface investigation plans, preparation of health and safety plans, coordination and supervision of subsurface investigation activities and construction oversight.

Ms. Clarke has extensive field experience including a variety of soil and groundwater sampling methods, site surveys, soil gas surveys, geophysical surveys, hydrogeologic evaluations (slug tests, short- and long-term pump tests), and analysis of groundwater flow and contaminant migration. Her field experience pertaining to remedial activities includes removal of underground storage tanks ranging in capacity from 500-gallons to 40,000-gallons, development, implementation and maintenance of a pump and treat groundwater treatment system, and a variety of contaminated-soil removal activities.

Ms. Clarke's reporting and regulatory interfacing experience includes development of Phase I, Phase II and Phase III site assessments, environmental impact statements, RCRA Closure reports, remedial action plans, site conceptual models, groundwater reclassification requests, and transfer act documents (i.e. ECAF and Form filings).

Highlights of Accomplishments and Experience

Contaminated Site Investigation and Remediation

- Participated in a Small Business Innovation Research project, conducted evaluations of proposed methodologies for heavy metal extraction from contaminated soils, specifically, designed and conducted soil column leaching tests to evaluate in-situ remediation of chromium contamination.

- Conducted extensive subsurface investigations at an historic aerosol paint manufacturing facility that included hydrogeologic flow regimes and evaluation of aquifer properties from geochemical data, pump testing and regional data.
- Conducted and managed Phase I, II and III soil and groundwater investigations, including hydrogeologic studies, geophysical surveys, and soil gas studies.
- Oversight of solid waste removal and hazardous waste areas contaminated with heavy metals and petroleum hydrocarbons.
- Supervised subsurface investigations at several properties in Connecticut, New York, New Hampshire, and Massachusetts for Exxon Corporation to evaluate potential and known releases of gasoline, fuel oil, and waste oil.

Civil/Site Engineering

- Coordination, oversight, inspection and reporting of underground storage tank removals ranging in size from 500-gallons to 40,000-gallons containing gasoline, fuel oil, spent solvent and diesel fuel.
- Development, implementation and maintenance of a groundwater pump and treat system at a former Connecticut aerosol manufacturer.

Hydrogeologic Investigations

- Conducted an evaluation of the hydrogeology of karst island environment to determine characteristics of a freshwater lens, the presence or absence of subsurface conduits, and the effect of well-pumping on the well field freshwater supply. The research area included a 140-well water supply field.
- The research included application of the Ghyben-Herzberg model to the characteristics of the hydrogeology of the well field and determination of applicability of long-term use of the wells for a fresh water supply.
- Conducted slug tests to evaluate aquifer properties and aid in development of a site-specific remediation scheme for a chlorinated solvent contaminated site in Bridgeport, Connecticut.

Environmental Site Assessments

- Conducted hazardous waste site assessments involving field reconnaissance, regulatory and historical research and report preparation. Site assessments have been completed in Connecticut, Florida Illinois, Kentucky, Maine, Massachusetts, New Hampshire, New York, New Jersey, Rhode Island, Washington, and Ontario, Canada.

Water and Wastewater

- Manager and Site Safety Officer for an aquatic toxicity laboratory.
- Conducted acute and chronic bioassays and toxicity identification/reduction evaluations (TIE/TRE) on industrial and municipal effluents utilizing the following fresh- and saltwater organisms: *Ceriodaphnia dubia, Cyprinidon variegates, Daphnia magna, Daphnia pulex, Menidia beryllina, Mysidopsis bahia,* and *Pimephales promelas.*
- Conducted surface water quality assessments detailing the effects of upstream landfill runoff influence and deposition.
- Performed textile dye removal efficiency studies on wastewater samples, implementing activated sludge from POTW facilities.
- Performed ongoing compliance testing for a non-community, non-transient water system and acted as liaison between the facility and the Connecticut Department of Environmental Protection.

David Fiereck, P.E.
Project Manager

Education

Master of Engineering; Environmental Engineering - University of Hartford - 2003
Bachelor of Science; Environmental Science - University of Connecticut - 1999

Professional Certifications

Professional Engineer, Connecticut
40-hour HAZWOPER certified
Annual 8 Hour Refresher Training - OSHA 29 CFR 1910.120
RCRA Compliant Hazardous Waste Handler Program - 40 CFR 262.34(a), 262.34(d), 264.16, and 265.16
DOT Compliant Hazardous Waste Handler Program - 49 CFR 172.704

Summary Biography

David Fiereck, who has over seven years experience in the environmental field, is a project manager at Loureiro Engineering Associates, Inc. (LEA). Mr. Fiereck is experienced in the planning, engineering, design, and operation of environmental projects for government and private sector clients.

His remediation experience includes: the development of remedial action plans and reports, remedial alternatives evaluations for contaminated soil and groundwater, design and supervision of disposal/excavation and on-site capping activities for soil remediation projects, and design and operation and maintenance of various contaminated groundwater and soil vapor recovery systems.

His environmental investigation experience includes: Phase I site assessments, contaminated soil, groundwater, surface water and sediment investigations, underground storage tank removals, and the development of complex mathematical groundwater flow and contaminant transport models.

His environmental permit and report preparation experience includes: transfer act documents (i.e. ECAF and Form filings); Inland Water Resources Division Stream Encroachment Line Permit application preparation; Emergency Authorization permit application preparation; General Permit application and Discharge Monitoring Report preparation, and variance request report preparation.

Highlights of Accomplishments and Experience

Remediation

- Designed and managed operation and maintenance of several groundwater and soil vapor remediation systems including pump and treat, dual phase extraction, bioventing, soil vapor extraction, and sub-slab ventilation systems to address LNAPL, VOCs, metals and petroleum contaminated media.

- Designed and prepared bid specifications for a remediation system for the removal of 1,4-dioxane in groundwater. Design combined ART Intra-well Technology® with ozone injection and UV enhancement.
- Managed several in-situ injection projects for the remediation of saturated soil and groundwater contaminated with VOCs including the use of chemical oxidants, emulsified oils, and lactate-based bioremedial additives.
- Designed and prepared bid specifications for concrete and soil remediation associated with a CCA wood treatment operation in North Carolina.
- Managed Brownfields remediation project for the renovation of a historic textile mill in North Carolina to an up-scale condominium complex. Project included the excavation and off-site disposal of more than 40,000 CY of contaminated soil, the demolition and off-site disposal hazardous waste materials associated with former hexavalent chromium plating pits and plating process equipment, the design and installation of a concrete subsurface cap, and several UST removals.
- Conducted several remediation alternatives evaluations for VOCs and metals contaminated groundwater, subsurface fuel releases, and unpermitted solid waste disposal areas. Prepared remediation action work plans and remedial action closeout reports for soil remediation projects.

Site Investigation

- Conducted and managed Phase I, II and III soil and groundwater investigations, including hydrogeologic studies, geophysical surveys, and soil gas studies. Contaminants of concern included PCBs, VOCs, metals, petroleum hydrocarbons and SVOCs.
- Supervised removal of USTs and contaminated soil. Sampled in-place soils to confirm remediation and prepared reports documenting the removal of USTs and contaminated soil.

Groundwater Flow and Contaminant Transport Modeling

- Developed and utilized a three dimensional groundwater flow and contaminant transport finite difference model to evaluate zinc impacted groundwater in an aquifer influenced by a tidal river. The model was used to predict the fate and transport of zinc in groundwater and to evaluate a groundwater remediation system for the site.
- Developed and utilized a three dimensional groundwater flow and contaminant transport finite difference model to evaluate chromium and VOCs impacted groundwater emanating from an industrial facility. The model was used to predict the fate and transport of contaminants in groundwater to target locations for additional subsurface field investigations.

Compliance and Permit Preparation

- Prepared USACE JARPA and several local permit applications for the replacement of a floating walkway for a logging export facility in Tacoma, WA. Negotiated with the USACE, USFWS, NOAA, and the WDFW to obtain approval to replace the walkway after the fish window date for the Puget Sound.
- Prepared several variance request reports for the construction of an engineered control over contaminated soils as an alternative to excavation and off-site disposal.
- Performed waste characterization for hazardous and non-hazardous process wastes including initial waste characterization requirements and sampling matrices, as well as procedures to perform and update the waste determinations for the waste streams generated at a large manufacturing facility to ensure proper waste management and/or disposal.

- Prepared Emergency Authorization Permit to discharge treated effluent wastewater from a groundwater remediation system in response to a subsurface fuel spill.
- Prepared municipal and state permit applications to close a landfill located within the boundaries of the Connecticut River Stream Encroachment Line.
- Prepared property transfer Form III and Form IV filings and Environmental Condition Assessment Forms for several industrial and commercial properties.
- Prepared Environmental Land-use Restriction (ELUR) documentation for several large-scale industrial facilities in Connecticut.
- Performance of routine monitoring and preparation of discharge monitoring reports in conformance with the terms and conditions of individual and/or general permits.

Civil and Site

- Managed and prepared bid specifications for the demolition and closure of a former CCA wood treating operation in North Carolina. Project included the removal of a 120-foot pressure cylinder and several CCA process tanks, the demolition of multiple buildings, concrete structures and process equipment associated with the former operation, and the renovation of a former drip pad to a wood storage facility.
- Part-time site supervisor for a Superfund remediation site, including treatment of liquid solvent waste-contaminated soil via low temperature thermal/mechanical treatment system.
- Compiled cost estimations and prepared construction specifications for non-permitted waste disposal areas in Connecticut.

David N. Scotti, P.G.
Project Manager

Education

Bachelor of Science; Geology – Allegheny College – 1984

Professional Certifications

Licensed Professional Geologist, Commonwealth of Pennsylvania, License Number 479

Certified Professional Geologist, State of Indiana, License Number 1341

Summary Biography

Mr. Scotti provides expertise in remedial investigation, feasibility study, remedial design, and remedial action projects. With 20 years of experience in characterizing subsurface geology and hydrogeology in association with environmental, geotechnical, and engineering evaluations, Mr. Scotti has demonstrated experience in conducting a wide variety of projects within UST, RCRA, and CERCLA regulatory programs. He has also conducted remedial investigations within a number of state voluntary cleanup programs (Brownfields).

Mr. Scotti has provided hazardous waste site investigation and cleanup services to commercial, industrial, and government clients. His site investigation and cleanup services include the preparation and implementation of remedial investigation/feasibility study work plans, the preparation of hydrogeologic reports and technical memoranda, evaluations of feasibility study pilot test data as well as analyses of remedial alternatives for short-term and long-term resolution, and the design of conceptual remedies and detailed remedial action plans. Mr. Scotti draws upon his extensive field experience, his strong knowledge of geology, hydrogeology, and the scientific method, and his detailed knowledge of regulations and standard technical practices to negotiate innovative remedial strategies that result in documented savings to his clients. Mr. Scotti's experience also includes environmental investigations and corrective actions performed as a State Regulator.

Highlights of Accomplishments and Experience

CERCLA/State Superfund:

- For a former lead recycling and secondary lead smelting facility, implemented pre-remedial design investigation activities. These activities included the preparation and implementation of the Remedial Design Work Plan (RDWP), Sampling, Analysis, and Monitoring Plan (SAMP), Quality Assurance Project Plan (QAPP), and site-specific Health and Safety Plan (HASP). Based on the results of the investigation activities, prepared technical memoranda in support of a ROD amendment to the groundwater remedy. The proposed ROD amendment involved a change in the groundwater remedy from a costly pump and treat system to monitored natural attenuation of groundwater contaminated with metals.
- Conducted soil and groundwater investigations at a number of Federal and State Superfund sites contaminated with VOCs, SVOCs, TPH, PCBs, and metals.

Environmental Site Assessments, Surveys, and Evaluations:

- Performed numerous ASTM Phase I Site Screening Evaluations, Phase II Site Assessments, and due diligence surveys for commercial clients.

- Completed numerous and comprehensive Sensitive Receptor Surveys as part of Phase I Site Assessments for industrial clients.
- Completed a Hazardous Waste Site Screening Evaluation (HRE Screening Evaluation) at a former solid waste management facility, in which the toxicity, mobility, and persistence of constituents were evaluated. The results of the evaluation were used to keep the property off of the USEPA list of Superfund sites, and to facilitate the sale of the property.

RCRA Facility Assessments:

- Provided technical support on a number of RCRA facility assessments conducted at a variety of solid waste management units for private sector and government clients.

Hydrocarbon Investigation and Remediation:

- From initial investigation through closure, managed the investigation and remediation of numerous leaking USTs at major oil marketing facilities. Remedies were designed to treat soil, vadose zone, and groundwater contaminated with gasoline and diesel fuel hydrocarbons. Remedies included groundwater extraction, total fluids extraction, soil vapor extraction, and free-product recovery systems. Remedies also included natural attenuation programs utilizing sentinel wells and supported by solute transport modeling and risk exposure.
- Developed and implemented incident prioritization and management programs for private and public sector clients.

Brownfields Development:

- Prepared a Phase IV Site Remediation report for the remediation and redevelopment of a former industrial facility. Soil and groundwater at the site were contaminated with VOCs, SVOCs, TPH, and metals. The remediation activities included the placement of contaminated soil and the construction of a soil vapor extraction system within the area of an engineered control. Remediation and redevelopment of the site were completed in accordance with the Property Transfer Act of the Connecticut General Statutes and the Licensed Environmental Professional (LEP) verification program.
- Analyzed regulatory program alternatives that enabled a state regulatory agency to approve the disturbance of a former solid waste landfill that was closed prior to the enactment of existing state regulations. The analysis generated a state-approved plan under the voluntary cleanup program that involved the excavation and screening of waste to reclaim recyclable materials. The plan was implemented at the feasibility study-level only.
- Under a state voluntary cleanup program, performed preliminary site investigations at a former chromium pigment manufacturing facility to support a comprehensive remedial investigation work plan. The investigations included off-site groundwater investigations; wetlands delineation; AST removal activities; wastewater treatment plant (WWTP) closure; NPDES permit termination; and plant decommissioning activities.

Solid Waste Management:

- Designed and implemented groundwater and landfill gas monitoring plans for a number of solid waste management facilities. These plans incorporated sensible, cost-effective approaches that were scientifically defensible and compliant with RCRA Subtitle D. Often, the implementation of these plans resulted in significant cost savings to clients.
- Performed a contaminant fate and transport study at a solid waste landfill to evaluate the likely extent of future groundwater contamination threatening sensitive receptors.
- Provided technical support in the analysis of a catastrophic failure of a solid waste landfill. Field support included the installation of vibrating-wire piezometers and inclinometers, and recording of piezometric surface and slope measurements.

- Provided technical support on a landfill siting evaluation for a major solid waste management firm. As part of this siting evaluation, directed subsurface evaluations using continuous core as well as cone penetrometer testing (CPT) drilling techniques, and performed slug testing for aquifer characterization purposes.

Litigation Support:

- Served as technical project manager responsible for preparing outside counsel for litigation involving the recovery of funds expended in assessing and cleaning up soil and groundwater contamination under RCRA Subtitle I.

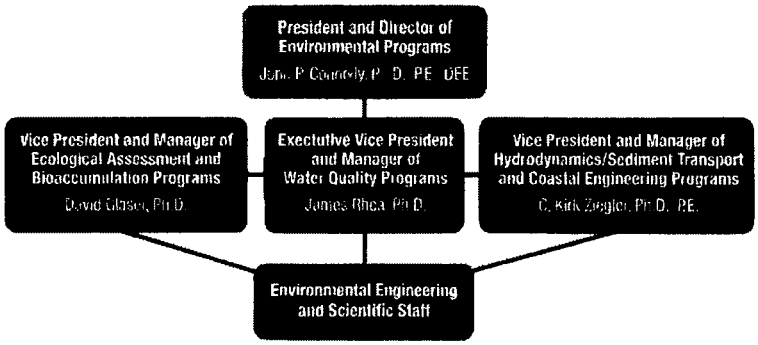
QUANTITATIVE ENVIRONMENTAL ANALYSIS, LLC (QEA) STATEMENT OF QUALIFICATIONS

About Us

Quantitative Environmental Analysis, LLC (QEA) is an environmental consulting firm offering the scientific and engineering expertise and experience necessary to develop insightful, technically-sound, and cost-effective solutions to environmental problems facing our public and private sector clients. QEA's quantitative analyses, computer modeling, and superior communication skills, support decision-making for a diverse array of simple and complex surface water, groundwater, and ecological problems. We consistently surpass our clients' expectations by delivering products and services that are of the highest possible value, quality and reliability. This client-focused service is a consequence of QEA's leadership, people, and values.

Leadership

QEA was founded in 1998 by Drs. John P. Connolly, David Glaser, James R. Rhea, and C. Kirk Ziegler. Each contributes unique expertise, developed from the application of their knowledge to a diverse array of environmental problems.



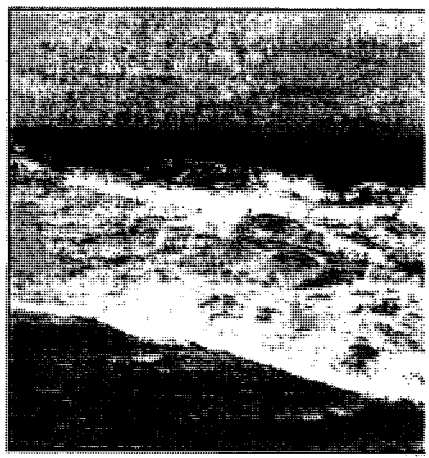
People

QEA employs highly-motivated technical and professional personnel trained in state-of-the-science quantitative data analysis, modeling, field data collection and laboratory experimentation. QEA recognizes its people are its most valuable resource and recruits the highest quality personnel from a diversity of science and engineering disciplines. QEA has offices in Montvale, NJ, Syracuse, NY, Glens Falls, NY, and Austin, TX.

Values

QEA is committed to making a contribution to society through objective, rigorous and technically superior evaluations of significant environmental problems. QEA continually strives to maintain this focus by:

- pursuing technological leadership in all areas of specialization;
- providing products and services that are of the highest possible value, quality and reliability;
- exercising irreproachable ethical standards in all aspects of our work;
- fostering a collegial work environment that encourages initiative, innovation, open communication and teamwork; and
- providing the opportunity for all employees to develop professionally and share in the company's success.



Together, these values define and embody the philosophy of the company and people at QEA.

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Experience

Rivers

Clinch River, MI
Columbia River, OR
Detroit River, MI
Fox River, WI
Genesee River, NY
Grasse River, NY
Hudson River, NY
Housatonic River, MA
James River, VA
Kalamazoo River, MI
Kelsey Creek, NY
Milwaukee River, WI
Mississippi River, MN
Pawtuxet River, RI
Penobscot River, ME
Saginaw River, MI
Seneca River, NY
Tennessee River, TN
Toms River, NJ
Rio Lerma, Mexico
Pariaba River, Brazil

Groundwater Sites

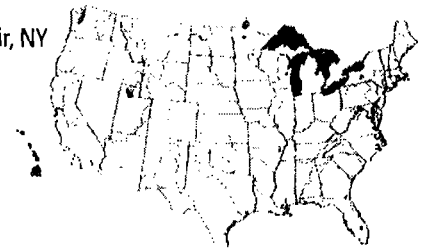
Heleva Landfill, NJ
IBM, NY
MW Manufacturing, PA
Nassau Metals, NY
Stanton Foundry, NY

Coastal And Estuarine Environments

Delaware River Estuary, DE
Hudson Estuary, NY
Lavaca Bay, TX
Long Island Sound, NY
Mamala Bay, HI
New Bedford Harbor, MA
New York Bight, NY
Santa Barbara Channel, CA
Southern California Bight, CA
Tar Pamlico Estuary, NC
Venice Lagoon, Italy
Yellow Sea, China

Lakes And Reservoirs

Cannonsville Reservoir, NY
Lake Erie, MI
Lake Michigan, MI
Lake Ontario, NY
Little Simon Pond, NY
Onondaga Lake, NY
Silver Lake, MA
Watts Bar Reservoir, TN
Waukegan Harbor, WI
Woods Lake, NY



Environmental Services

- Contaminated Sediment Evaluation
- Water Quality and Eutrophication Analysis
- TMDLs/Wasteload Allocation Development
- Plumes and Thermal Discharge Studies
- Ecological Risk Assessment
- Natural Resource Damage Assessment
- Habitat Assessment
- Contaminated Groundwater Investigation
- Pathogen Fate and Transport Modeling
- Coastal Engineering
- Water Resources

Science and Engineering Expertise

- Hydrodynamics and Hydrology
- Sediment Transport
- Environmental Chemistry
- Environmental Modeling
- Fisheries Biology
- Ecology and Ecotoxicology
- Contaminant Bioaccumulation
- Groundwater/Surface Water Interactions
- Watershed Analysis

What We Provide:

- Field Programs
- Data Integration
- Modeling
- Regulatory Support
- Applied Research

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Syracuse, NY: 290 Elwood Davis Road, Suite 230, Liverpool, NY 13088, Tel: 315.453.9009, Fax: 315.453.9010
Austin, TX: 800 Brazos Street, Suite 1040, Austin, TX 78701, Tel: 512.707.0090, Fax: 512.275.0915
Glens Falls, NY: 80 Glen Street, Suite 2, Glens Falls, NY 12801, Tel: 518.792.3709, Fax: 518.792.3719

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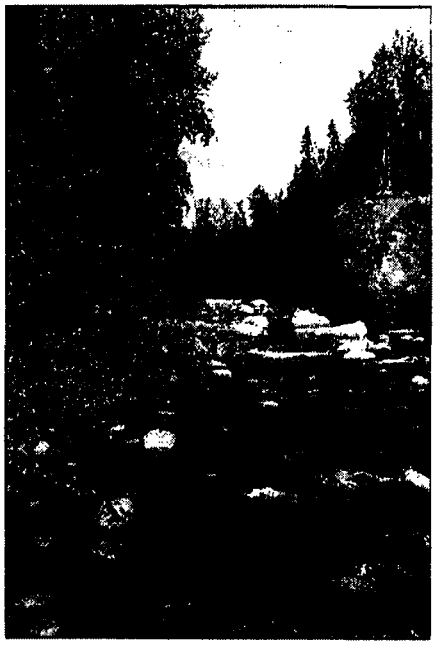
Hydrodynamics and Hydrology

The quantification of hydrodynamic processes, which determines flow pathways, volumes, and velocities is critical to understanding the fate and transport of pollutants in surface water systems. QEA applies computer simulations to predict velocities, water depths (stage height), and mixing rates for time periods ranging from individual storm events to decade-long continuous simulations. Hydrodynamic models provide the foundation for solving problems such as solids transport and sediment erosion in rivers and coastal waters, the assimilative capacity of aquatic systems, and the fate of hydrophobic organic compounds in complex estuaries.

QEA has developed and applied a variety of hydrodynamic and hydrologic models to a wide range of water bodies and water quality issues. The rigor applied by QEA to the understanding of a system's hydrodynamics/hydrology depends upon the nature of the problem, the time and space scales of importance, and the level of accuracy required. In some instances, simple water routing is sufficient to meet project needs without the consideration of the physics of water movement. Other problems may require one-, two-, or three-dimensional representation of the hydrodynamics of water movement.



Hydrodynamic Modeling

The flow of water is a basic process controlling water quality. State-of-the-science hydrodynamic models can predict the current velocity, water surface elevation, and mass transport: requirements for many water quality simulations. QEA's hydrodynamic model applications have addressed flow in rivers, lakes, estuaries and coastal waters, providing the foundation for the modeling of sediment transport, chemical fate, and eutrophication.

QEA's coastal engineering applications focus on the effects of tides, residual currents, stratified flow, storm surges, and other coastal hydrodynamic processes on shoreline stability, sediment transport and structural designs.

Mixing zone analyses are performed to assess when and where a plume reaches far-field conditions, as well as the effluent concentration as the plume migrates. Entrainment of ambient water surrounding the plume is a key process that must be evaluated in a mixing zone analysis. QEA has expertise in both simple and complex plume models. Reliable hydrodynamic modeling of an aquatic system requires both data analysis and model development and application expertise. QEA has extensive experience in analyzing and integrating hydrodynamic data collected in rivers, lakes, reservoirs, estuaries, and ocean coastal zones. Data are used to develop a detailed understanding of the primary hydrodynamic processes, and inform the selection and application of a computer model. For example, a three- dimensional hydrodynamic model is often needed to accurately simulate density-driven circulation in an estuary, whereas a one-dimensional model may be entirely adequate for a small river.

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Hydrodynamic Modeling (cont'd)

QEA possesses experience with a suite of publicly-available hydrodynamic models that can be applied to a range of water quality and coastal engineering problems. Depending on the type of aquatic system and the requirements of the project, QEA expertly develops and applies one-, two-, or three-dimensional hydrodynamic models. In addition, QEA has extensive experience in the analysis of plumes, including development and application of near-field mixing zone models.

Hydrologic Modeling

QEA's expertise in hydrologic modeling ranges from the application of relatively simple, lumped analyses that estimate steady-state loads from the land surface, to complex, distributed models with fully time-variable inputs and outputs. Our experience includes the use and customization of a number of publicly-available watershed models. QEA has educated fellow professionals on the use of these models for the Total Maximum Daily Load (TMDL) process. Our personnel have also published critical reviews of available watershed models. With this diversity and depth of experience, we have the expertise needed to develop and apply effective hydrologic tools.

Communication

Effective presentation and communication is a key component of any hydrodynamic or hydrologic modeling application. Hydrodynamics often form the basis for water quality and sediment transport assessments. Consequently, model results require quick, efficient, and comprehensive evaluation during model development. High-quality graphical presentations of model results are used to aid in the interpretation of hydrodynamic processes, particularly in estuarine and coastal regions. Our personnel possess exceptional skills in preparing graphical presentations of hydrodynamics/hydrologic data and modeling results using GIS, as well as higher-order programming environments. Animations of model results are used to support model development and to clearly communicate results to clients and stakeholders.

Relevant Experience

- Delaware River, DE: Estuary water quality model
- Lavaca Bay, TX: Impact of hurricane forces on sediments and mercury fate and transport
- Gulf of Mexico, LA: Development of an oil/gas blowout model
- Tar Pamlico River, NC: Estuary water quality model
- Mamala Bay, HI: Pathogen fate model
- Seneca River, NY: Water quality model

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Austin, TX: 800 Brazos Street, Suite 1040, Austin, TX 78701, Tel: 512.707.0090, Fax: 512.275.0915
Glens Falls, NY: 80 Glen Street, Suite 2, Glens Falls, NY 12801, Tel: 518.792.3709, Fax: 518.792.3719

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Quantitative Environmental Analysis, LLC

C. KIRK ZIEGLER, Ph.D.

PROFESSIONAL HISTORY

Quantitative Environmental Analysis, LLC, Vice President and Senior Managing Engineer, February 1998 to present
HydroQual, Inc., Associate, 1990 to January 1998
U. of California, Santa Barbara, Post-Doctoral Researcher, 1986 to 1990
Hewlett-Packard Company, Development Engineer, 1981 to 1984

EDUCATION

University of California, Santa Barbara, Ph.D., Mechanical Engineering, 1986
California Institute of Technology, M.S., Applied Mechanics, 1981
University of California, Santa Barbara, B.S., Mechanical Engineering, 1980

EXPERIENCE SUMMARY

Dr. Ziegler's primary expertise is in the area of contaminant fate and transport with an emphasis on the analysis of cohesive and non-cohesive sediment transport. He has developed a state-of-the-science sediment transport model (SEDZL) which is of importance in the study of waterborne pollutants in lakes, rivers and coastal waters. Development of the sediment transport model was funded by the EPA and the model has been used by EPA on several contaminated sediment studies. In addition, he has collaborated with UCSB researchers on development of the SEDZLJ model. Dr. Ziegler is a nationally recognized expert in the area of sediment stability and was an organizer of the Sediment Stability Workshop held in New Orleans in January 2002.

As the result of managing over 20 studies involving riverine transport processes, Dr. Ziegler has acquired extensive experience in this area. He has developed, calibrated and applied one, two and three-dimensional models (hydrodynamic, sediment transport, and contaminant fate and transport) to aquatic systems ranging from small streams to large rivers and impoundments. Associated with the modeling work, Dr. Ziegler has also designed and conducted field studies to meet the requirements of the modeling efforts.

MAJOR PROJECTS

Contaminated Sediments Assessment and Management

Sediment Stability Analysis for the Lower Duwamish Waterway
Client: Windward Environmental/Lower Duwamish Waterway Group
Managed large-scale project to investigate stability of PCB-contaminated sediment in the Lower Duwamish Waterway, which is a salt-wedge estuary located near Seattle. Combined data-based and hydrodynamic modeling analyses to evaluate stability of contaminated sediment in the study area.

Analysis of Ice-Jam-Related Bed Scour in the Grasse River
Client: Alcoa
Managed study to evaluate bed scour due to an ice jam on the Grasse River. Used combination of stratigraphic, geomorphologic and modeling analyses to investigate impacts of ice jam on bed scour. Applied a sophisticated hydrodynamic model to study turbulent flow under an ice jam for use in designing an armored cap.

Analysis of Dredging Resuspension in the Upper Hudson River
Client: General Electric Company
Managed study to evaluate fate and transport of PCB-contaminated sediment resuspended during dredging in the Upper Hudson River. Participated in development of a hydrodynamic, sediment transport and PCB transport modeling framework that is used to simulate a dredge plume in the river for a variety of flow conditions.

Kalamazoo River PCB Fate and Bioaccumulation Modeling and Analysis
Client: CH2M HILL/U.S. Environmental Protection Agency
Managed large-scale project to develop, calibrate and apply PCB fate and bioaccumulation modeling framework for the Kalamazoo River. Model will be used as a management tool to evaluate various remedial alternatives.

Sediment Stability Analysis for the Woonasquatucket River

Client: Battelle/U.S. Army Corps of Engineers/U.S. Enivironmental Protection Agency

Managed project to investigate sediment stability at the Centredale Manor dioxin site located on the Woonasquatucket River, Rhode Island. Combined data-based and hydrodynamic modeling analyses to evaluate stability of dioxin-contaminated sediment in the study area.

PCB Fate and Transport in the Kalamazoo River

Client: Michigan Department of Environmental Quality

Managed project to perform detailed review and analysis of PCB fate and transport model developed by PRP consultant. Data analyses were completed to develop general understanding of PCB transport processes in the study area.

Analysis of the Fate of PCBs in the Housatonic River

Client: General Electric Company

Managed watershed, hydrodynamic and sediment transport studies in the Housatonic River. Extensive data analysis and modeling studies will be used to develop management tools to evaluate the appropriate remedial solution for the contaminated sediments. An important aspect of this project is the evaluation of the impact of river flooding on the transport of sediment and PCBs.

Analysis of the Fate of PCBs in the Grasse River

Client: Alcoa

Managed hydrodynamic and sediment transport modeling studies in the Grasse River. Field sampling and data analysis were incorporated into the development, calibration and validation of hydrodynamic and sediment transport models. These models were linked to a PCB fate and transport model, and the modeling framework was used to evaluate the efficacy of various remedial alternatives.

Analysis of the Fate of PCBs in the Hudson River

Client: General Electric Company

Managed hydrodynamic and sediment transport (cohesive and non-cohesive sediments) modeling studies in the Upper Hudson River. This project involved field sampling, data analysis and model development/ calibration. The hydrodynamic and sediment transport models were linked to a PCB fate and transport model to predict the impacts of various remedial alternatives.

Development of PCB Fate and Transport Model for Lower Fox River

Client: Stratus Consulting (Boulder, CO) for U.S. Fish and Wildlife Service

As part of the Fox River/Green Bay Natural Resource Damage Assessment, managed development of hydrodynamic and sediment transport models in the Lower Fox River. These models were linked to a PCB fate model for potential use in evaluating impacts of remediation activities.

Investigation of Mercury Fate and Transport in Lavaca Bay

Client: Aluminum Company of America

Managed sediment transport modeling project in Lavaca/Matagorda Bay, which is a large, shallow estuary on the Texas Gulf Coast. Calibrated model, which includes the effects of wind wave resuspension, has been coupled to a mercury transport model to predict the fate of contaminated sediments in this system. A primary goal of this project is to evaluate the impact of hurricanes and other rare storms on buried mercury.

Modeling of Contaminant Fate in the Pawtuxet River

Client: Ciba-Geigy Corporation, Ardsley, New York

Developed and calibrated a fine-grained sediment transport model of the Pawtuxet River (Rhode Island) for use in determining the fate of contaminated sediments. The sediment transport model was calibrated and validated during a period which included two high flow events, each of which approximately correspond to the annual flood. The successful calibration exercise indicated that the model can be confidently used as a predictive tool.

PCB Fate and Transport in Watts Bar Reservoir

Client: McKenna & Cuneo, Washington, D.C. (representing Union Carbide)

Managed project to conduct technical analyses and prepare expert witness testimony for defendants (Union Carbide and Martin Marietta, past and present managers of Oak Ridge National Laboratory) in a lawsuit which alleged that past ORNL discharges of PCBs into Watts Bar Reservoir were the primary source of PCB body

burden in present day fish. Developed and successfully calibrated a model of fine-grained sediment transport in the reservoir over a 30 year period. Results of the sediment transport model were coupled with a PCB fate and transport model to determine the impact of ORNL PCB discharges during this period on current catfish body burden in the reservoir.

Sediment Bed Contaminant Sampling in the Toms River

Client: Ciba Corporation, Toms River, New Jersey

Managed a sediment bed sampling program in the Toms River, which is a small river in the Pine Barren region of New Jersey. Designed and conducted sampling program to evaluate the extent of bed contamination, due to organic chemicals and metals, in a 2-mile reach of the river. Directed data analysis effort to investigate possible contaminant sources and determine aquatic biota impacts.

Preparation and Presentation of Expert Witness Testimony for L.A. County 301(h) Appeal

Client: U.S. Environmental Protection Agency, Region IX, San Francisco, California

Managed project to analyze the impacts of the L.A. County sewage outfall on benthic biota. Developed and calibrated deposition model used to simulate sediment bed fluxes of organic carbon, DDT and heavy metals in vicinity of outfall from 1950 to 1990. Model results were used in conjunction with benthic biota data to determine current environmental impacts of solids discharges from the outfall.

Assessment of the Fate of Bentonite Clay Discharged from a Cooling Tower Outfall to Lake Erie

Client: Lonza, Inc.

The SEDZL sediment transport model was used to estimate the impact of bentonite clay release into Lake Erie following its discharge in association with controlling zebra mussels in cooling tower outfalls.

Yellow Sea Sediment Transport Modeling

Client: U.S. Navy, Naval Research Laboratory

Developed and documented three-dimensional sediment transport model for use in studying cohesive and non-cohesive sediment transport processes in coastal ocean areas. Developed interface between sediment transport and wind wave models so that effects of wave-induced resuspension can be realistically simulated. Applied modeling framework to the Yellow Sea.

Water Quality/Eutrophication Assessment

Water Quality Model of the Seneca River

Client: Onondaga County Department of Water Environment Protection

Managed development, calibration and validation of hydrodynamic model for the Seneca River. Water quality modeling framework includes separate submodels describing: 1) time-variable hydrodynamics, 2) phytoplankton, nutrient, and dissolved oxygen dynamics, 3) sediment oxygen demand and nutrient fluxes, and 4) zebra mussel filtering and respiration activity. The model is being applied to assess the diversion of effluent from an 85 MGD wastewater treatment plant from Onondaga Lake to the Seneca River. The model will also be applied by the NYSDEC to assess TMDLs for the river.

Upper Mississippi River Eutrophication Modeling Study

Client: Metropolitan Council Environmental Services, Minneapolis/St. Paul, Minnesota

Managed hydrodynamic and sediment transport modeling study of the Upper Mississippi River. Developed and calibrated three-dimensional hydrodynamic/sediment transport model which was coupled to an eutrophication model so that the impacts of various phosphorus sources on water quality in this riverine system could be evaluated.

Delaware River Water Quality Modeling Study

Client: Delaware River Basin Commission

Managed project to develop and calibrate a three-dimensional hydrodynamic model of the Delaware River estuary. The hydrodynamic model was coupled to a water quality model so that the impacts of wastewater treatment plants on water quality in the estuary could be evaluated.

Estuarine Circulation Modeling in the Tar Pamlico River

Client: Tar Pamlico Basin Association, North Carolina

Applied a laterally-averaged hydrodynamic model to the Tar Pamlico River estuary. Good agreement was obtained between measured and predicted water elevations and salinity distributions during the one year long

(1991) model calibration/validation period. The hydrodynamic model was directly coupled to a water quality model to examine dissolved oxygen effects on bottom layer hypoxia.

Water Resources/Watershed Assessments

The Fate of Water Filtration Plant Solids Discharges in the Potomac River

Client: Washington Suburban Sanitary Commission

Managed project to evaluate the impact of various solids discharge scenarios on downstream deposition patterns in the Potomac River. A large water filtration plant near Washington, D.C. discharges residual solids back into the freshwater portion of the Potomac River. To evaluate the efficacy of different filtration process modifications, which were necessary to meet new state requirements on solids discharge rates, a sediment transport model of a 5 km reach of the river was developed, calibrated and applied.

Pathogen Fate and Transport

The Transport and Fate of Pathogens in Mamala Bay (Oahu, Hawaii)

Client: Mamala Bay Study Commission

Managed the hydrodynamic modeling effort associated with a large-scale project to model the transport and fate of pathogens discharged from point and non-point sources in Mamala Bay, which is the offshore region near Honolulu. The hydrodynamic model developed for this study was quite complex, involving a three-dimensional model that encircled the island of Oahu. As part of this study, Dr. Ziegler worked with researchers at MIT and Georgia Tech to develop methodologies, including an innovative particle tracking model, to accurately couple the near-field model of an ocean outfall with the far-field hydrodynamic model.

Erie Wastewater Treatment Plant Outfall Study

Client: Consoer Townsend and Associates, Inc.

Analyzed the impacts of current and proposed sewer outfall locations on bathing beach water quality in the vicinity of Erie, Pennsylvania. A risk analysis was completed, using the results of a coupled hydrodynamic/water quality model in conjunction with historical data, to statistically examine the effects of outfall discharges on beach fecal coliform concentrations.

Coastal Engineering

Modeling Study for Naval War College Breakwall Design

Client: U.S. Navy

Managed modeling study to investigate impacts of a proposed breakwall offshore of the Naval War College in Narragansett Bay, Rhode Island. Developed and applied hydrodynamic, sediment transport and wave models of the bay and study area. Used models to investigate impacts of proposed breakwall on circulation and sediment transport in the study area; examined impacts of extreme storms, including a hurricane. Determined wave climate in study area during rare storms which was used for breakwall design.

Sediment Stability Study for Former Nansemond Ordnance Depot, James River Estuary

Client: U.S. Army Corps of Engineers

Managed study to investigate sediment stability in nearshore area adjacent to Former Nansemond Ordnance Depot, located on the James River Estuary in Virginia. Hydrodynamic, sediment transport and wave models were developed and applied to the nearshore study area. The models were used to evaluate sediment stability during several extreme storm scenarios.

Expert Testimony

Contaminant Transport in the Ohio River

Client: U.S. Department of Justice

Principal investigator for analyzing contaminant transport in the Ohio River. Hydrodynamic, sediment transport and contaminant transport models for a 30-mile reach of the Ohio River were used to investigate the fate of effluent discharged into the river during summer 1999. This work is being used to provide litigation support through expert testimony.

Natural Recovery and Mercury Fate in Penobscot River Estuary. Maine Peoples' Alliance and Natural Resources Defense Council, Inc. vs. HoltraChem Manufacturing Company, LLC and Mallinckrodt, Inc.
Client: Mallinckrodt, Inc.
Principal investigator for evaluating mercury fate and transport processes in this estuary located in Maine. This study involved analyzing hydrodynamic, sediment transport and mercury concentration data to determine if natural recovery is occurring in this estuary and, if so, to estimate the rate of recovery. This work was used to provide litigation support through expert testimony.

Dr. Ziegler has also managed contaminated sediment studies of three rivers for confidential clients.

PROFESSIONAL ACTIVITIES

Affiliations

Association of Coastal Engineers
ASCE Coasts, Oceans, Ports & Rivers Institute (COPRI)
American Society of Civil Engineers
International Association for Hydraulic Research

Committee Membership

Sediment Stability Subcommittee, Sediment Management Work Group
ASCE Contaminated Sediments Task Committee

Invited Participation in Technical Workshops

Second Iowa Workshop on Large Rivers: Contaminated Sediments, Fairport, IA, October 7-9, 2004.

Sediment Stability Workshop, New Orleans, LA, January 22-24, 2002.

Modeling and Management of Emerging Environmental Issues – Expert Workshop 2000, Malvern, PA, July 25-27, 2000.

PRESENTATIONS

Application of Predictive Models for Assessment of Sediment Stability. Ziegler, C.K., 3rd International Conference on Remediation of Contaminated Sediments, New Orleans, LA, 2005.

Use of Bounding Estimates to Reduce Uncertainty in Sediment Stability Analyses. Ziegler, C.K., 3rd International Conference on Remediation of Contaminated Sediments, New Orleans, LA, 2005.

Understanding, Predicting and Monitoring Contaminant Releases During Dredging. Ziegler, C.K. and P. Schroeder, Assessing Uncertainty and Managing Risk at Contaminated Sediment Sites, USACE/USEPA/SMWG Joint Sediment Conference, St. Louis, MO, 2004.

Sedflume Data Are Collected at My Site: So How Do I Use These Data? Ziegler, C.K., 2nd Iowa Workshop on Large Rivers, Fairport, IA.

Conducting Sediment TMDL Studies: Lessons Learned from Large-Scale Contaminated Sediment Studies. Ziegler, C.K. and J. Benaman, 5th International Symposium on Sediment Quality Assessment, Chicago, IL, 2002.

Improvement of Sediment Transport Dynamics in HSPF. Ziegler, C.K. and C.F. Owen, WEF Watershed 2002 Conference, Fort Lauderdale, FL, 2002.

Minimal Requirements for Developing a Credible Sediment Transport Model. Ziegler, C.K., 44th Conference on Great Lakes Research, IAGLR, Green Bay, WI, 2002.

Sediment Stability at Contaminated Sediment Sites. Ziegler, C.K., 16th Annual International Conference on Contaminated Soils, Sediment and Water, Amherst, MA, 2000.

An Empirical Method for Estimating Suspended Sediment Loads in River. Ziegler, C.K. and J.P. Connolly, WEF Watershed 2000 Conference, Vancouver, BC, 2000.

Use of Models and the Scientific Method for the Evaluation of Remedial Alternatives for PCBs in the Upper Hudson River. Ziegler, C.K. and J.P. Connolly, 32nd Mid-Atlantic Industrial and Hazardous Waste Conference, Troy, NY, 2000.

Evaluating Sediment Stability at Sites with Historic Contamination. Ziegler C.K., SETAC 20th Annual Meeting, Philadelphia, PA, November 14-18, 1999.

The Impact of Sediment Transport Processes on the Fate of Hydrophobic Organic Chemicals in Surface Water Systems. Ziegler, C.K. and J.P. Connolly, Proceedings of WEF Toxic Substances in Water Environments Conference, pp. 1-13 to 1-24, 1995.

Effects of Flocculation on Particle Transport. Lick, W., C.K. Ziegler, J. Lick and A. Joshi, Estuarine and Coastal Modeling III, Proceedings of the 3rd International Conference, pp. 172-186, 1994.

A Comparative Analysis of Estuarine Circulation Simulation Using Laterally Averaged and Vertically Averaged Hydrodynamic Models. Ziegler, C.K., J.D. Bales, J.C. Robbins and A.F. Blumberg, Estuarine and Coastal Modeling III, Proceedings of the 3rd International Conference, pp. 447-460, 1994.

Transport of Sediments in the Venice Lagoon. Ziegler, C.K., C.H. Tsai and W. Lick, Proceedings of the Third International Conference on Environmental Contamination, Venice, 1988.

Resuspension, Deposition and Transport of Fine-Grained Sediments. Ziegler, C.K. and W. Lick, Proceedings of the International Conference on Fluid Mechanics, Beijing, 1987.

PUBLICATIONS

The Role of Modeling in Managing Contaminated Sediments. Jensen R.H., S.J. Bentley, M.B. Dannel, J.V. DePinto, J.A. Dyer, K.J. Farley, M.H. Garcia, D. Glaser, J.M. Hamrick, W.J. Lick, R.A. Pastorok, R.F. Schwer, C.K. Ziegler, Chapter 2 In: *Environmental Modeling and Management Theory, Practice and Future Directions,* Chien, C.C., M.A. Medina, Jr., G.F. Pinder, D.R. Reible, B.E. Sleep, C. Zheng., eds. Today Media, Inc. 2002.

Evaluating Sediment Stability at Sites with Historic Contamination. Ziegler, C.K., *Environmental Management*, 29(3):409-427, 2002.

Modeling Sediment Transport Dynamics in Thompson Island Pool, Upper Hudson River. Ziegler. C.K., P.H. Israelsson and J.P. Connolly, *Water Quality and Ecosystem Modeling*, 1:193-222, 2000.

A Model of PCB Fate in the Upper Hudson River. Connolly, J.P., H.A. Zahakos, J. Benaman, C.K. Ziegler, J.R. Rhea and K. Russell, *Envir. Sci. & Tech.*, 34(19):4076-4087, 2000.

Numerical Modeling of the Transport and Fate of Hydrophobic Contaminants and Fine-Grained Sediments in Surface Waters. Ziegler, C.K. and W. Lick, In: *Next Generation Environmental Models and Computational Methods*, Ch. 14, pp. 129-138, 1997.

Development and Calibration of a Fine-Grained Sediment Transport Model for the Buffalo River. Gailani, J., W. Lick, C.K. Ziegler and D. Endicott, *J. of Great Lakes Res.*, 22(3): 765-778, 1996.

Modeling Outfall Plume Behavior Using a Far Field Circulation Model. Blumberg, A.F., Z.G. Ji and C.K. Ziegler, ASCE *J. Hyd. Engr.*, 122(11): 610-616, 1996.

Long-Term Simulation of Fine-Grained Sediment Transport in a Large Reservoir. Ziegler, C.K. and B.S. Nisbet, *ASCE J. Hyd. Engr.*, 121(11): 773-781, 1995.

Sediment Transport in the Lower Saginaw River. Cardenas, M., J. Gailani, C.K. Ziegler and W. Lick, *Mar. Freshwater Res.*, 46:337-347, 1995.

The Resuspension and Transport of Fine-Grained Sediments in Lake Erie. Lick, W., J. Lick and C.K. Ziegler, *J. Great Lakes Res.*, 20(4): 599-612, 1994.

Fine-Grained Sediment Transport in Pawtuxet River, Rhode Island. Ziegler, C.K. and B. Nisbet, *ASCE J. Hyd. Engr.*, 120(5): 561-576, 1994.

The Transport of Fine-Grained Sediments in the Trenton Channel of the Detroit River. Ziegler, C.K., W. Lick and J. Lick, In: *Transport and Transformation of Contaminants Near the Sediment-Water Interface*, Chap. 12, pp. 225-252, 1994.

Flocculation and Its Effect on the Vertical Transport of Fine-Grained Sediments. Lick, W., J. Lick and C.K. Ziegler, *Hydrobiologia*, 235/236: 1-16, 1992.

The Transport of Suspended Solids in the Lower Fox River. Gailani, J., C.K. Ziegler and W. Lick, *J. Great Lakes Res.*, 17(4): 479-494, 1991.

SEDZL: A User-Friendly Numerical Model for Determining the Transport and Fate of Fine- Grained, Cohesive Sediments. Ziegler, C.K., J. Lick and W. Lick, *UCSB Report*, 1990.

A Numerical Analysis of the Fluid Dynamics and Chemical Transport in a CVD Reactor: Planar Coordinate Model. Ziegler, C.K., W.L. Ahlgren and W. Lick, *UCSB Report* ME-90-6, 1990.

Metalorganic Chemical Vapor Deposition Growth of Cd_{1-y}-Zn_y-Te Epitaxial Layers on GaAs/Si Substrates. Ahlgren, W.L., S.M. Johnson, E.J. Smith, R.P. Ruth, B.C. Johnston, M.H. Kalisher, T.W. James, D.L. Arney, C.K. Ziegler and W. Lick, *J. Vac. Sci. Technol.* A, 7(2): 331-337, 1989.

The Transport of Fine-Grained Sediments in Shallow Waters. Ziegler, C.K. and W. Lick, *Environmental Geology and Water Sciences*, 11:123-132, 1988.

The Resuspension, Deposition and Transport of Sediments in the Venice Lagoon. Ziegler, C.K., C.H. Tsai and W. Lick, *UCSB Report* ME-87-3, 1987.

Open Boundary Conditions for Hyperbolic Equations. Lick, W., C.K. Ziegler and J. Lick, *Numerical Methods for Partial Differential Equations*, 3:101-115, 1987.

Interior and Boundary Difference Equations for Hyperbolic Equations. Lick, W., C.K. Ziegler and J. Lick, *Numerical Methods for Partial Differential Equations*, 2:157-172, 1986.

A Numerical Model of the Resuspension, Deposition and Transport of Fine-Grained Sediments in Shallow Water. Ziegler, C.K. and W. Lick, *UCSB Report* ME-86-3, 1986.

DALEEL NANGJU

CONTACT INFORMATION

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(201) 930-9805 *fax*
dnangju@qeallc.com

PROFESSIONAL HISTORY

Quantitative Environmental Analysis, LLC, Senior Project Engineer, January 2007 to present
Quantitative Environmental Analysis, LLC, Project Engineer, January 2004 to December 2006
Quantitative Environmental Analysis, LLC, Engineer, November 2000 to December 2003
Rensselaer Polytechnic Institute, Teaching Assistant, 1998
United Nations Environment Programme, Research Assistant, 1997
SGV & Co., a member firm of Arthur Andersen, Trainee, summer 1996

EDUCATION

8 Hour OSHA Hazardous Waste Site Operations, 2003
40 Hour OSHA Hazardous Waste Site Operations Course, 2002
Rensselaer Polytechnic Institute, M.S., Environmental Engineering, 1999
University of California, Berkeley, B.S., Chemical Engineering, 1996

REGISTRATION

Engineer in Training (New York), 2003

EXPERIENCE SUMMARY

Mr. Nangju's responsibilities at QEA involve assisting in the preparation and analysis of the in-house hydrodynamic, sediment transport, and PCB fate models. He has also been tasked with the creation and maintenance of extensive Geographical Information Systems (GIS) databases to visualize and analyze environmental data and model output.

Mr. Nangju is proficient in the FORTRAN and IDL programming languages and has used these complementary tools to customize off-the-shelf models and to build fully custom models to meet the needs of a variety of clients. These efforts have included the evaluation of spatial and temporal trends in data from statistical packages within these programs and through a GIS framework.

Before coming to QEA, Mr. Nangju conducted his graduate studies at RPI where his research focused on the hydrodynamic calibration of the Lower Hudson River using the U.S. Army Corps of Engineer's CE-QUAL-W2 model. Simulations of water motion and the longitudinal and vertical distributions of important water quality parameters such as salinity and water temperature were made to determine trends in a one-year simulation. Prior to attending graduate school, Mr. Nangju has worked with the United Nations Environment Programme, assisting in the analysis of air and water chemical parameters for the State of the Environment reports. He has also participated in the Environmental Impact Assessment process for a semiconductor plant in the Philippines at SGV.

MAJOR PROJECTS

Characterization of PCB Sources and Fate in the Lower Grasse River (2001 - 2004)

Client: Aluminum Company of America

Assisted in the development of a 2-D depth-averaged hydrodynamic, sediment transport and PCB fate model for the Grasse River near Massena, NY. Responsibilities included model projection and validation of several remedial alternatives, supporting data analyses, and dissemination of results. Responsible for the compilation and management of extensive project databases during various field sampling programs, including pre-engineering design studies conducted to assess potential implementability issues associated with the application of an in-situ cap over the river sediments. Assisted in the development of a 1-D PCB sediment bed transport model to evaluate the long-term effects of a cap placement. Involved in understanding the effects of ice-related processes on the stability of river sediments through the use of a modified sediment transport and PCB fate model. Developed techniques to interpolate multi-beam bathymetric data into a current sediment surface map of the entire river and techniques to estimate long-term deposition and erosion by comparison to historical single-beam data.

Assessment of the Contribution of PCBs to the Kalamazoo River from Eaton Corporation (2001)

Client: Eaton Corporation

Compiled and analyzed historical PCB data to determine the contribution of PCBs by Eaton to the Kalamazoo River.

Analysis of Sediment and PCB fate in the Upper Hudson River (2001 – present)

Client: General Electric Company

Assist in the development of a predictive dredge plume model for the Hudson River using an enhanced version of Hydrodynamics (EFDC) and a sediment transport (SEDZL) models. The analysis is to provide technical support for the design of dredge operations. Used GIS and interpolation methods to convert multi-beam bathymetric data into a surface map of sediment bed elevation for the entire river, in support of delineating the areas targeted for dredging. Assist in the development of a hydrodynamic flood plain model to predict long-term inundation of flood plain areas, to guide the PCB sampling effort in those areas.

Centredale Manor Sediment Stability Study (2004)

Client: Battelle

Project Engineer for estimating the potential impacts of rare floods on bed stability in Allendale and Lyman Mill Ponds of Woonasquatucket River, Rhode Island. The analysis was accomplished by using a hydrodynamic model (EFDC) to predict current velocity and bottom shear stress during rare floods and estimate areas of potential erosion in the ponds and approximate scour depths within those areas.

Contaminant Transport in the Ohio River (2004 - 2005)

Client: U.S. Department of Justice

Assisted in the investigation of contaminant transport of metal complexes in the Ohio River. Hydrodynamic, sediment transport and contaminant transport models for a 30-mile reach of the Ohio River were used to investigate the fate of effluent discharged into the river during summer 1999. This work was used to provide litigation support through expert testimony. Developed movie simulation capabilities through GIS, to show the growth of the contaminant plume over various flood conditions.

Sediment Stability Analysis for the Lower Duwamish Waterway (2004 - present)

Client: Windward Environmental/Lower Duwamish Waterway Group

Supported the investigation of the stability of PCB-contaminated sediment in the Lower Duwamish Waterway, which is a salt-wedge estuary located near Seattle. Combined data-based and hydrodynamic modeling analyses to evaluate stability of contaminated sediment in the study area.

PCB Fate and Transport in the Kalamazoo River (2005)

Client: Michigan Department of Environmental Quality

Project to perform detailed review and analysis of PCB fate and transport model developed by PRP consultant. Data analyses were completed to develop general understanding of PCB transport processes in the study area. Initial development of a hydrodynamic model which includes flood plain areas.

Matagorda Bay Hydrodynamic Model Development (2006)

Client: Lower Colorado River Authority

Constructed a numerical model of Matagorda Bay using EFDC. Calibrated salinity and water surface elevation during 7-day period in 2003.

Mercury Fate and Transport in the Holston River (2006 - present)

Client: MACTEC

Developed a conceptual site model for the fate and transport of mercury in contaminated sediment from the North Fork of the Holston River to the Cherokee Reservoir. Conducted grain size analysis of river sediments. Applied EFDC hydrodynamic model to the John Sevier Detention Dam and Cherokee Reservoirs to estimate bed shear stresses in the river during high-flow events.

Bed Stability Analysis in Patrick Bayou (2006 - present)

Client: Anchor Environmental, LLC

Determined fate and transport of PCBs, Mercury, total PAHs and total TCDD in the estuary-driven system. Applied EFDC hydrodynamic model and grain size distribution data to determine bed shear stresses in the bayou during high-flow events. Presently expanding the model to include portion of the Houston Ship Channel.

Bed Armoring Analysis in the Merrimack River (2007)

Client: Anchor Environmental, LLC

Using EFDC in a two-dimensional, vertically-averaged mode, calibrated the model using stage height and current velocity data collected during September and October 2006. Conducted flood frequency analysis to determine river flows in the study area for four flow conditions: average flow and 2-, 10-, and 100-year floods. The model was used to predicted current velocities and bed shear stresses for use in designing bed armoring in critical areas in the channel. In addition, the effects of turbidity control structures on current velocities were evaluated during a proposed dredging operation in the river.

PROFESSIONAL ACTIVITIES

Affiliations

American Institute of Chemical Engineers
Society of Environmental Toxicology and Chemistry

PRESENTATIONS

Characterizing Uncertainty in Fluvial Chemical Spill Models. North Atlantic Chapter, Society of Environmental Toxicology and Chemistry, 4th Annual Meeting. May 29-30, 1998

AMEC EARTH & ENVIRONMENTAL, INC.
STATEMENT OF QUALIFICATIONS

Aquatic Ecology Services

Fulfilling client expectations with a complete range of services and innovative solutions

AMEC offers a very deep pool of capabilities and experience in the aquatic sciences from offices coast to coast in North America. Our marine and freshwater biologists, toxicologists, environmental engineers and other professionals serve varied public and private sector clients in the United States and Canada including:

- Agricultural
- Forestry
- Harbors and Ports
- Military
- Mining
- Municipal Planning and Infrastructure
- Oil and Gas Pipelines
- Transportation

Environmental Impact Assessment

- Design and Implementation of Benthic Invertebrate, Periphyton, Fish, Kelp and Other Types of Aquatic Vegetation and Water/ Sediment Quality Survey Programs
- Assessment of Industrial, Commercial, Municipal, Resource and Coastal Development Related Impacts
- Environmental Impact Assessments, Sceenings and Reports
- Mitigation Strategy Development and Design
- Compliance Monitoring of Environmental Protection Programs and Effluent Discharges

Risk Assessment

- Contaminant Mapping and Pathways Analyses
- Risk Identification and Evaluation
- Industrial Pollutant and Agri-chemical Toxicity Studies and Determination of Lethal and Sublethal Chemical Impacts
- Design of Reclamation Detoxification Programs
- Remedial Alternatives Analyses and Remedial Design

Wetlands

- Delineation, Evaluation/Classification and Monitoring
- Biophysical and Hydrological Assessment
- Protection, Restoration and Enhancement Planning
- Assessment, Siting and Design for Water Quality Improvement, Surface Runoff Retention and Habitat Function

Aquatic Habitat Protection Planning and Restoration

- Description of Aquatic Habitats and Fisheries
- Assessment of Habitat Limitations and Potential Disruption/Destruction
- Liaison with Regulatory Agencies for Permits and Approvals
- Design of Mitigation Measures and Habitat Compensation Programs
- Contracting and Oversight of Project Construction
- Design and Implementation of Monitoring Programs

Fisheries Resource and Watershed Management

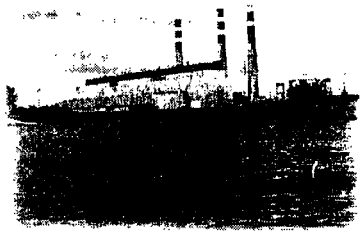
- Watershed Assessment Programs
- Inventory and Assessment of Upland, Riparian, Stream and Lake Habitats
- Fisheries Population Assessment
- Analysis of Essential Fish Habitat (EFH)
- Fish Spawning, Migration and Life-History Studies
- Creel Census and Angler Harvest Surveys
- Fish Population Management Strategies

Water Quality

- Review and Development of Criteria and Guidelines
- Priority Pollutant and Agri-chemical Fate-and-Effect Studies
- Computer Modeling
- Data Collection, Interpretation, Management
- Effluent Discharge Analysis and Mixed Zone Delineation
- Chlorinated Organics Studies and Nutrient Budget Analysis and Bio-evaluation

Sediment Studies

- Sediment Sampling and Analysis Plan Preparation
- Dredged Material Testing
- Risk-Based Sediment Characterization Studies
- Dredging and Disposal Site Assessment, Modeling and Monitoring



Marine Ecology

- Diving Surveys
- Coastal Processes and Impact on Sensitive Marine Resources
- Habitat Mapping and Conservation Planning
- Biological Oceanography

U.S. Based Programs

- National Pollutant Discharge Elimination System (NPDES)
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/ Superfund)
- Clean Water Act
- Endangered Species Act
- Marine Protection Research and Sanctuaries Act

Canadian Based Programs

- Canadian Environmental Assessment Act (CEAA)
- Federal Fisheries Act
- Environmental Effects Monitoring (EEM) for Metal Mining and Pulp and Paper

For a list of office locations, company contacts and other services refer to:
www.amec.com/earthandenvironmental

AMEC37
01/10/02

Russell E. Keenan, Ph.D.

Vice President – Technical Director

Risk Assessment Services

AMEC Earth & Environmental, Inc.

Professional Summary

Dr. Keenan is Vice President and Technical Director for human health and ecological risk assessment services and has over 20 years of experience as a biologist and toxicologist. He is regarded as an expert in the risk assessment of PCBs, dioxins, furans, chromium, and mercury and for the development of time-dependent probabilistic risk assessment methods. Dr. Keenan managed the first private sector Cooperative Research and Development Agreement (CRADA) with U.S. EPA in the field of regulatory toxicology and risk assessment. As a result of this work, he was selected to serve as one of eight independent experts in the congressionally mandated review of U.S. EPA's process for handling toxicological uncertainty in IRIS (Integrated Risk Information Service). Dr. Keenan is also noted for his work in evaluating the ecological and human health risks associated with contaminated riverine environments, including the Hudson River PCB Superfund Site, the Housatonic River in Massachusetts and Connecticut, the Fox River in Wisconsin, the Columbia River in Oregon and Washington, the Penobscot River in Maine, tributaries of the Delaware, and the Hackensack River in New Jersey. He has conducted over 100 human health and wildlife risk assessments for CERCLA and RCRA sites and has evaluated the risks associated with exposure to environmental emissions, effluents, and soil contaminants from industrial activities. He has testified before U.S. Congressional panels and various state and federal agencies during regulatory proceedings on environmental issues. This has led to the withdrawal of a proposed federal rule in one case, a decision not-to-promulgate in another matter, and to the establishment of alternative ambient water quality criteria in nine states that were ultimately approved by EPA. He is an active member in the Society of Toxicology, receiving two best paper awards, and in the Society for Risk Analysis, the National Council for Air & Stream Improvement, and the Maine Pulp and Paper Association.

Education

B.S., Biology, Bates College

Ph.D., Environmental Biology, Duke University

Memberships

Society of Toxicology

Society for Risk Analysis

Society of the Sigma Xi - The Scientific Research Society

National Council for Air & Stream Improvement

Maine Pulp and Paper Association

Awards and Honors

Society of Toxicology, Award for the Outstanding Published Paper in Risk Assessment in 1997

Society of Toxicology, Award for the Outstanding Presented Paper in Risk Assessment at the 1996 Annual Meeting

Technical Association of the Pulp and Paper Industry (TAPPI), Russell O. Blosser Memorial Award for the Best Paper Presented at the 1991 Environmental Conference

Sandoz Corporation, Board of Directors Award for Outstanding Technical Excellence in 1990

Languages

English

Location

Portland, Maine

Employment History

2000 – Present: AMEC Earth & Environmental (formerly Ogden Environmental and Energy Services)

1998 – 2000: Ogden Environmental and Energy Services Co., Inc.

1989 – 1998: ChemRisk Division of McLaren/Hart Environmental Engineering Corporation

1984 – 1989: Envirologic Data, Inc.

1983 – 1984: Independent Environmental Consultant

1981 – 1983: Maine Audubon Society

1975 – 1981: Duke University Teaching/Research Assistant

Detailed Skills by Representative Project

Dioxin Reassessment and Implications for PCBs. On behalf of the American Chemistry Council (Polychlorinated Biphenyls Panel), Utility Solid Waste Activities Group, and National Electrical Manufacturers Association, Dr. Keenan conducted an analysis and wrote an expert report demonstrating that U.S. EPA's recently proposed application of dioxin toxic equivalency factors to evaluate the risks posed by PCB mixtures over-predicts the cancer potency of PCB Aroclor 1254 by at least 30-fold. Presented these findings in public hearing to the U.S. EPA Science Advisory Board, Dioxin Reassessment Review Committee in 2000 and again before the Executive Committee of the U.S. EPA Science Advisory Board in 2001. In 2003 – 2005, Dr. Keenan and co-workers refined their analyses, prepared five papers for submission to peer-reviewed journals, and presented their findings to members of the Federal Interagency Work Group charged by the U.S. Congress with reviewing and evaluating the merits of the EPA's draft Dioxin Reassessment. Along with other scientific critiques of the EPA reassessment, these analyses and presentations served as compelling evidence in support of a congressional mandate for a National Academy of Sciences review of the draft Dioxin Reassessment. *In March 2005, Dr. Keenan and Dr. Silkworth of the General Electric Company were invited by NAS to present their research showing that EPA's toxic equivalency approach ignores empirical evidence regarding PCB toxicity and substantially over-predicts risks.*

Site-specific Human Health and Ecological Risk Assessments of 20 Chromium Sites in NJ and Interactions with Regulatory Agencies, Honeywell, NJ. Characterized the potential human health and ecological risks associated with exposure to chromite ore processing residue (COPR) on behalf of Honeywell (formerly AlliedSignal). COPR had been used historically to fill wetlands and low-lying areas in Hudson Co., New Jersey. Several of these sites are located in close proximity to the

Hackensack River, many are currently the location of commercial or industrial enterprises, and a few are residential properties. Prior to conducting the site-specific risk assessments, AMEC developed detailed protocols and methods for submission to NJDEP. Prepared technical white papers on the following topics: Evaluating potential inhalation exposures to COPR, characterizing the risks of allergic contact dermatitis, evaluating nature and extent of deep groundwater contamination, evaluating compliance with ambient surface water quality criteria for hexavalent chromium, and characterizing potential ecological risks from chromium in a heavily industrialized waterway. These white papers were presented verbally and in written form to NJDEP staff and have been the subject of monthly meetings and informal discussions with the Department.

Critique of EPA PCB Risk Assessment for the Hudson River and Development of Alternative Probabilistic Analyses. Critically evaluated an EPA risk assessment of PCB-contaminated sediments in the Hudson River. During this evaluation, directed the development of an alternative site-specific risk assessment based on regional fish consumption rates and other exposure factors using a Microexposure Monte Carlo analysis. Achieved consensus with EPA and its contractors that a Monte Carlo approach should be used for the Hudson River risk assessment. Critically evaluated the basis of proposed toxicological criteria for PCB mixtures and presented these findings before EPA work groups and in public comments.

Site-specific Probabilistic Human Health Risk Assessment for PCBs and Consultation on Ecological Risk and Natural Resource Damages concerning the Fox River. On behalf of the Fox River PRPs, provided consultation, third party review, and analysis of agency and trustee claims on human health, ecological risk, and natural resource damages (NRD) issues in conjunction with the Fox River PCB investigation and remedial action program. Developed a revised Microexposure Event Monte Carlo model for evaluating the potential human health risks associated with ingesting fish from the river and prepared comments for submission to the administrative record.

U.S. EPA, National Center for Environmental Assessment Peer Review. Selected to serve as one of eight independent experts in the congressionally mandated review of U.S. EPA's process for handling toxicological uncertainty in the Agency's IRIS (Integrated Risk Information Service) listing of chemicals. Evaluated and commented on EPA's characterization of data uncertainty and variability for a subset of IRIS assessments. Results of this peer review were submitted to the U.S. EPA Science Advisory Board and in a report to the U.S. Congress.

Comprehensive Evaluation of the Environmental Aspects of Mercury. Reports highlighting the concentration of mercury in freshwater fish in otherwise pristine environments have increased public interest and discussion concerning those anthropomorphic activities that may have contributed mercury to the environment. In response to proposed regulatory actions, developed and authored a comprehensive report that examined the scientific issues pertinent to the various public policy initiatives. This evaluation included a characterization of the relative contribution of 1) the natural and anthropogenic sources of mercury; 2) current levels in air, surface water, soil, sediment, and biota; 3) potential implications of the Great Lakes Water Quality Initiative and other regulatory programs related to the regulation of mercury in the environment; and 4) an evaluation of inputs and outputs of mercury from various industrial processes. The goal of the project was to identify how mercury enters the environment, how it cycles through it, and how various changes in certain industrial processes and raw materials can reduce discharges to the environment and ensure regulatory compliance.

Comprehensive Ecological Risk Assessment in PCB-Contaminated Floodplain. Developed a comprehensive ecological assessment for evaluating the reproductive success of insectivorous song birds nesting in the vicinity of a PCB-contaminated floodplain. This analysis was conducted using

"top-down" retrospective techniques in which study area populations were compared to reference populations remote to the influence of PCBs.

Comprehensive Multi-site Human Health Risk Assessment of PCB-Contaminated River. Directed a comprehensive multi-site human health and ecological risk assessment of a PCB-contaminated river and its environs under RCRA and a state Superfund program. Evaluated potential exposures to soils, air, sediments, groundwater, and surface waters, including the design and implementation of fish consumption, land use, and recreational use surveys. Evaluated the need to implement emergency response measures by directing the development of a property-by-property risk assessment of floodplain land use.

Ecological Risk Assessment for the BROS Superfund Site located in a Coastal Swamp, NJ. Principal-in-charge of an ecological risk assessment of wetland communities, including a red maple swamp impacted by an historical release from an adjoining waste oil lagoon. The risk assessment work plan was prepared in accordance with EPA ERAGs guidance, under EPA Region II. Principal chemicals of potential ecological concern included PCBs, PAHs, and certain heavy metals. Portions of the swamp are tidally-influenced, while other areas are influenced by local hydrology. A wide variety of assessment and measurement endpoints were used, due to the large areal extent (400+ acres) of the swamp. Receptors included vegetation, small mammals, aquatic birds and raptors, and large mammals. Results were used to support the RI/FS for the site.

Health-Based Remediation and Remediation Plan Negotiation. Selected a health-based remedial option and negotiated a remediation plan with an EPA regional office for a hazardous waste site. The plan was based on a risk assessment of groundwater and industrial soils contaminated with PCBs, dioxins, furans, and chlorobenzenes from leaking electrical transformers. The results of the risk assessment were used as the basis for establishing cleanup criteria at the facility.

RI Endangerment Assessment of PCB-Contaminated Site. Managed an RI Endangerment Assessment of a PCB-contaminated railyard and drainage basin. This assessment was prepared on behalf of the PRPs under a consent decree with Region 3 EPA and Pennsylvania Department of Natural Resources.

Development of Alternative Ambient Water Quality Standards for Dioxin. Developed the basis for establishing alternative ambient water quality standards for dioxin in eight states, receiving state and EPA approval. These standards differed by a factor of 90 from the national default criteria that were originally proposed by EPA. Submitted and presented these analyses before various state and federal regulatory agencies for the purpose of negotiating scientifically defensible effluent limits. Testified as an expert witness in regulatory hearings and adjudicatory proceedings in ten states.

Dioxin and Furan Risk Assessments for Numerous Pulp and Paper Companies. Represented numerous pulp and paper companies in addressing the risks associated with dioxins and furans. Presented testimony on the hazards posed by dioxins to a congressional subcommittee and before the U.S. Congress Office of Technology Assessment. Conducted the most comprehensive risk assessment to date of the hazards posed by trace levels of dioxins and furans in paper products. U.S. and Canadian federal agencies used these assessments as the basis for concluding that health risks were *de minimis* and these products did not require immediate regulation.

Risk Assessment of Dioxins and Furans in Wastewater Treatment Plant Sludge. Directed the most comprehensive set of published risk assessments on the hazards posed to humans and wildlife by dioxins and furans in wastewater treatment plant sludge applied to farmland, forestland, and abandoned strip mine sites. Testified as an expert witness in regulatory proceedings at the state and

federal level. Assessments have resulted in establishment of the first state dioxin standard for agricultural soils and agency approval of permit applications for land application of sludge and residuals in a number of states.

Evaluation of EPA's Cancer Slope Factor for Dioxin. Evaluated the scientific basis for the EPA's cancer slope factor for dioxin by critically examining the rodent bioassay data. Proposed and obtained funding for an independent re-read of the rat liver pathology data through the formation of a pathology working group (PWG) of expert pathologists. Based on the PWG results, derived a scientifically defensible cancer slope factor through the use of EPA's own model, resulting in a value 16 times less restrictive, and published this analysis in the peer-reviewed literature.

Risk Assessment Workplan and Final Report for Stringfellow Superfund Site, Riverside, CA. Prepared and negotiated with U.S. EPA Region IX, the acceptance of a risk assessment work plan and final report for the Supplemental Human Health Risk Assessment for the Stringfellow Superfund Site in Riverside, CA. This EPA-approved risk assessment included the use of a microexposure Monte Carlo analysis for evaluating potential risk to a changing population based on site demographics. It became the first EPA-approved work plan in Region IX for a PRP-generated risk assessment after the agency's moratorium was lifted and the first risk assessment to gain EPA Region IX approval for the use of a Monte Carlo exposure analysis.

First EPA Cooperative Research and Development Agreement (CRADA) in Risk Assessment. Established the first Cooperative Research and Development Agreement (CRADA) under the Federal Technology and Transfer Act with U.S. EPA in the field of risk assessment. This CRADA was established to provide the framework for a cooperative research project between the private sector and a federal agency to develop Monte Carlo-based models that will quantitatively characterize the uncertainty in reference dose estimates used in noncancer risk assessment. By reducing uncertainty in the reference dose, unnecessary conservatism can be minimized in setting environmental cleanup levels, thus enhancing cost-effective environmental restoration.

Comprehensive State-wide Fish Consumption Survey, ME. Directed the development and implementation of a statistically valid statewide survey to assess the rate of freshwater fish consumption by anglers and their families. The results of this survey provided a full distribution of ingestion rates for use in a Monte Carlo exposure assessment. Performed in cooperation with resource economists at the University of Maine and with representatives of the Maine Department of Inland Fisheries and Wildlife, the Maine Angler Survey became the most definitive study of its type to assess the rate of fish ingestion among freshwater anglers in North America.

Regulatory Review of Proposed Rule Related to Chlorophenols. Analyzed and evaluated the key toxicological and exposure assumptions that formed the basis for an EPA-proposed rule (58 FR 79:25706) whereby the use of certain chlorophenolic formulations in the wood surface protection industry would have been classified as hazardous waste under RCRA. As a result, EPA withdrew the proposed rule and decided not to list these chlorophenols as hazardous waste.

Development of Health-Based, Risk-Driven Remediation Assessments. Conducted and guided the development of health-based, risk-driven remediation assessments for RCRA facility investigations and as part of the RI/FS process at CERCLA sites. Obtained a no-action record-of-decision at the Packaging Corporation of America Superfund Site in Michigan.

Evaluation of Proposed Ecological Criteria/Water Quality/Soil Contaminants. Critically evaluated proposed ecological criteria for the Great Lakes, the State of New Jersey, for water quality

in nine states, and for soil contaminants nationwide. Presented critiques of ecological criteria before state and federal agencies and testified on the issues during federal TSCA rulemaking hearings.

Critique of Scientific Basis for Proposed Federal Standards. Critiqued and reviewed the scientific basis for proposed federal standards for dioxins and furans in wastewater treatment plant sludges. Provided expert opinion regarding the validity of ecotoxicological and human exposure parameters used by the EPA's contractor, negotiated more reasonable values with regulatory agencies, and testified in federal rulemaking proceedings. As a result, EPA withdrew the proposed national rule for landspread sludge.

Consumer Product Risk Assessment for a Paper Company Manufacturing Consumer Products from Excess Paper Fiber. Conducted a quantitative risk assessment to ensure that trace PCBs and dioxins/furans do not pose a health risk to consumers using Consumer Products Safety Commission (CPSC), Food and Drug Administration (FDA), and Occupational Safety and Health Administration (OSHA) exposure protocols.

Development of Sampling Programs to Support Risk Assessments. Guided the development of a statistically valid sampling program for sediment and biota to support a comprehensive risk assessment at a series of hazardous waste sites under state and federal jurisdiction. Directed the development of residential, recreational, occupational, and commercial exposure scenarios to characterize potential exposures in soil, air, water and biota. Developed health-based clean-up goals as part of the remediation strategy.

Design of a Statistically-Based Fish Sampling Plan. Designed a statistically based fish sampling plan through simulation modeling and predictive methods to ensure an optimal experimental design. Reduced sampling and analytical costs of the proposed plan while maximizing the power of the analysis. Completed this study by conducting the most comprehensive risk assessment to date of dioxin in fish, based on actual measurements of this contaminant in the fish that people are likely to consume.

Authored One of the First Risk Assessments for A Terrestrial Wildlife Species. Wrote and published one of the first risk assessments for a terrestrial wildlife species based on scientifically refined exposure parameters and toxicokinetic modeling.

***Dioxin* Bioaccumulation Factors.** Analyzed and evaluated reported bioaccumulation factors for dioxin and published a peer-reviewed paper that reinterpreted the wide variation in reported values on a common basis.

Advisor to Industry Association. Served as the toxicologist member of the Scientific Advisory Board to the Cement Kiln Recycling Coalition. The SAB to the CKRC is an independent blue ribbon panel chosen to evaluate the public health and environmental implications of using waste-derived fuels for producing Portland cement.

Numerous Multi-Pathway Exposure and Risk Assessments. Managed multiple-pathway exposure and risk assessments of emissions from resource recovery facilities, releases from leaking underground petroleum storage tanks, and environmental emissions, effluents, and soil contaminants from chemical manufacturing plants. Evaluated the risks to humans and wildlife from exposure to herbicides used for power line right-of-way maintenance.

Critique of Proposed Ambient Air Level Standards. Critiqued and reviewed the scientific basis of proposed state ambient air level standards for carcinogenic and noncarcinogenic air pollutants. Testified before the state air toxics board regarding this review and the development of ambient air guidelines.

Right-to-Know and Hazard Communication. Implemented right-to-know and hazard communication compliance programs for employers in four northeastern states, including twenty acute-care and rehabilitation hospitals. Conducted hazard communication training for over 3,000 employees. Dr. Keenan also has planned, coordinated, and managed regional and international symposia on environmental health related topics.

Comprehensive Literature Review and Report. Conducted a literature review and authored a comprehensive report on the protection of red spruce from spruce budworm defoliation via chemical and biological methods for Forest Service, Maine Department of Conservation, Augusta, Maine.

Relevant Expert Witness Experience

Deposition, Expert Report, Litigation Support, Trial Testimony; Sidley, Austin, Brown and Wood on behalf of Mallinckrodt, Inc.; ME. Provided expert testimony in U.S. District Court (*Maine People's Alliance & Natural Resources Defense Council, Inc. v. HoltraChem Manufacturing Company, LLC and Mallinckrodt, Inc.*) and in two oral depositions concerning the risks associated with consuming fish containing methyl mercury from the Penobscot River. Testified that potential exposure to methyl mercury from eating Penobscot River fish did not lead to human health risks and, in fact, was no greater than the exposure from eating fish found in other Maine rivers without point source discharges of mercury. In addition, quantified the upstream loading of mercury to the Penobscot River at 195 lbs. per year compared with discharge at the plant site of 12 lbs. per year. Authored an expert report that included an analysis of sources of mercury to Maine's environment as well as the development of a Microexposure Monte Carlo model for quantifying hypothetical exposures to anglers and their families. This case went to trial in U.S. District Court for the District of Maine, Docket No. 00-69-B, beginning in March 2002.

Expert Report, Depositions, Trial Testimony; Preti, Flaherty, Beliveau, Pachios & Haley on behalf of Kimberly-Clark Corporation; ME. Authored an expert report and is expected to testify at trial in this personal injury suit (*Anne Meader, et al. v. Kimberly-Clark, et al.*). Scope of testimony concerns the evolving state of knowledge in the scientific and regulatory communities regarding the association of dioxins and furans with the pulp and paper industry and the industry's and the governments' responses to this evolving awareness. In particular, he concluded that the levels of dioxins and furans in ash and sludge sent to a landfill from two mills are not a cause for regulatory or public health concern. This case is in Somerset County (Maine) Superior Court, Docket No. CV-00-0018.

Expert Report, Deposition, Trial Testimony; Frost, Brown, & Todd on behalf of A.K. Steel Corporation; OH. Authored an expert report and is expected to testify at trial in *United States of America, et al. v. AK Steel Corporation*. Scope of testimony is expected to focus on the evaluation of health risks posed by PCBs. This case is in the United States District Court for the Southern District of Ohio, Western Division, Case No. C-1-00530.

Deposition, Videotaped Trial Testimony; Greenebaum, Doll, & McDonald on behalf of Lafarge North America, Inc.; KY. Provided expert testimony in deposition and in videotaped testimony used at trial in *Lafarge North America Inc. v. Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky Natural Resources and Environmental Protection*, Cabinet File No.: DAQ-25389-037. Testified that exposure to trace levels of dioxin-like compounds from inhalation of ambient gypsum in the vicinity of the Lafarge plant did not lead to significant health risks.

Expert Report; Babst, Calland, Clements & Zomnir on behalf of Viacom, Inc.; IN. Authored an expert report which assessed the potential risks from PCBs at a former CBS-Westinghouse facility in

this personal injury case, *Craig Taylor et al. v. CBS Corporation* (now Viacom). This matter settled before trial.

Deposition, Expert Reports, Litigation Support; Kostow & Daar; PA. Provided expert testimony in three oral depositions concerning the establishment of risk-based re-entry criteria for PCBs, dioxins, and furans following the office building fire at One Meridian Plaza, Philadelphia, PA. Authored an expert report that ascertained safe exposure limits to these compounds and directed a risk assessment that evaluated the hypothetical exposures and associated potential risks under various use scenarios for the building. Prepared counsel for deposing litigant's experts based on sound toxicological principles. Testimony and analysis proved to be an important cornerstone of the defense for a reasonable restoration effort and facilitated the eventual settlement, which was achieved less than a month before trial.

Deposition, Expert Reports, Litigation Support; Hull, Webber, Reis, & Canney; VT. Provided expert testimony in oral deposition and provided litigation support to counsel concerning the toxicology of mercury and potential human exposures connected with a RCRA site in which mercury was released to the environment. The case was settled just prior to trial.

Expert Testimony before Peer Review Panel, Public Comments, Alternative Risk Assessments; General Electric Company; MA. In public testimony before the Housatonic River Risk Assessment Peer Review Panel, presented analysis demonstrating that the application of dioxin toxic equivalency factors to evaluate the potential health risks posed by PCBs is both inappropriate and unnecessary. Dr. Keenan's testimony and paper refuted the EPA analysis and demonstrated that the toxic equivalency (TEQ) method results in double counting the carcinogenic potential of the dioxin-like congeners in the PCB mixtures. A majority of the Peer Review panelists found this presentation to be "compelling" and recommended that TEQs should not be used for assessing risks to PCBs. Lenox, MA. November 18, 2003.

Public Hearing Testimony and Expert Reports; American Chemistry Council (Polychlorinated Biphenyls Panel), Utility Solid Waste Activities Group, and National Electrical Manufacturers Association; VA. Conducted analysis and wrote expert report demonstrating that U.S. EPA's proposed application of dioxin toxic equivalency factors to evaluate the risks posed by PCB mixtures over-predicts the cancer potency of PCBs by at least an order of magnitude. Presented these findings in public hearing to the U.S. EPA Science Advisory Board, Dioxin Reassessment Review, Arlington, VA.

Public Hearing Testimony and Expert Reports, General Electric Company, D.C. In public testimony before the Executive Committee of the U.S. EPA Science Advisory Board, presented analysis demonstrating that application of dioxin toxic equivalency factors to evaluate the risks posed by PCB Aroclor 1254 over-predicts its cancer potency by at least 30-fold. As a result, the issue as to whether it is appropriate to use the dioxin toxic equivalency method to evaluate the risks posed by PCB mixtures is one of the key questions to be addressed and evaluated by the National Academy of Sciences in their review of the EPA's Dioxin Reassessment. Washington, D.C. May 15, 2001.

Public Hearing Testimony and Expert Reports, General Electric Company, CT. Wrote expert report evaluating the procedures used to derive human health criteria for the Great Lakes Water Quality Initiative and presented findings to the U.S. EPA Science Advisory Board, Drinking Water Committee, Washington, D.C.

Blue Ribbon Panel Support and Expert Reports, General Electric Company, CT. Conducted the cancer dose-response assessment, wrote expert report, and provided expert opinion in the successful petition of the General Electric Company to revise the cancer slope factor for PCB mixtures.

Federal Rulemaking Testimony and Expert Reports, American Forest and Paper Association, D.C. Prepared expert testimony in U.S. EPA hearing on estimating exposures to dioxin-like compounds and on evaluating methods of environmental transport and resulting exposures. The EPA issued a consensus report of their evaluation in which they adopted many of our criticisms to the proposed rule. In addition, the EPA Panel appended the comprehensive expert report to the text of their findings.

Public Hearing Testimony and Expert Reports, National Council of the Paper Industry for Air and Stream Improvement, NY. Wrote expert report evaluating the procedures used to derive human health and wildlife criteria for the Great Lakes Water Quality Initiative and presented findings in public hearing to the U.S. EPA Science Advisory Board, Great Lakes Water Quality Subcommittee, Chicago, IL.

Public Hearing Testimony and Expert Reports, Pierce Atwood, ME. Directed study and provided regulatory testimony and comments concerning the consumption of freshwater fish by Maine anglers and on a pathway-specific description of bioaccumulation of dioxin-like compounds from multiple sources.

Adjudicatory Testimony, Expert Reports, Regulatory Support; Butler, Snow and O'Mara; MS. Expert testimony in adjudicatory hearing before the Mississippi Department of Environmental Quality, NPDES Permit Limits for Leaf River Forest Products, Jackson, MS. This pulp and paper mill obtained the permit limits requested in their petition.

Federal Rulemaking Testimony, Expert Reports, Regulatory Support; National Council of the Paper Industry for Air and Stream Improvement; NY. Testimony in public hearing before U.S. EPA TSCA Docket No. OPTS-62100: Proposed Rule for the Land Application of Sludge from Pulp and Paper Mills Using Chlorine and Chlorine Derivative Bleaching Processes (56 FR 21802), Washington, D.C.

Personal Injury Litigation Support, Confidential Forest Products Company. Directed the company's scientific defense of the personal injury claims related to alleged exposure of plaintiffs to dioxins and furans in wastewater effluent. Litigation support consisted of assisting counsel understand the scientific merits of the case, design of scientific and policy aspects of defense strategy, selection and preparation of testifying experts, and conduct of corroborative sampling, analysis, and investigation pertinent to the case.

Adjudicatory Testimony, Expert Reports, Regulatory Support; Eisenhower, Carlson. Rebuttal testimony in adjudicatory hearing before the Environmental Quality Commission of the State of Oregon regarding NPDES Waste Discharge Permits 100715 and 100716.

Public Hearing Testimony and Expert Reports, Pierce Atwood, ME. Testimony in public hearing before the Old Town Planning Board, Old Town, ME on a hazard evaluation of the metal and dioxin concentrations in the sludge/ash, lime mud and leachate at the James River Old Town Mill. This testimony and work was part of a successful effort to gain approval for an expansion of the landfill.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Confidential Client; WV. Expert testimony in public hearing before the West Virginia State Water Resources Board on Proposed Amendments and Revisions to 46 CSR 1 Title 46 Legislative Rule Series 1 Requirements Governing Water Quality Standards. Charleston, WV.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Spears and Lubersky. Expert testimony in public hearing concerning the petition for rule amendment to establish a health-based, water quality standard for 2,3,7,8,-TCDD. Environmental Quality Commission, Portland, OR.

State Rulemaking Testimony, Expert Reports, Regulatory Support; McGuire, Woods, Battle & Boothe. Expert testimony in public hearing before the Alabama Environmental Management Commission, Montgomery, AL concerning the establishment of a health-based water quality standard for dioxin in Alabama.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Butler, Snow and O'Mara; MS. Expert testimony in public hearing before the Mississippi Department of Environmental Quality, Starkville, MS on establishing a health-based water quality standard for dioxin in Mississippi.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Butler, Snow and O'Mara, MS. Expert testimony in public hearing before the Mississippi Department of Environmental Quality, Jackson, MS on establishing a health-based water quality standard for dioxin in Mississippi.

State Rulemaking Testimony, Expert Reports, Regulatory Support; International Paper Company and Georgia Pacific; AR. Expert testimony on the carcinogenic dose response of dioxin given in public hearing before the Arkansas Commission of Pollution Control and Ecology regarding NPDES No. AR0001970 Waste Discharge Requirements for International Paper Company and NPDES No. AR0001210 Waste Discharge Requirements for Georgia-Pacific Corporation, Little Rock, AR.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Florida Pulp and Paper Association; FL. Expert testimony in public hearing before the Hon. Carol M. Browner, State of Florida Environmental Regulation Commission, Orlando, FL on establishing a health-based water quality standard for dioxin in Florida.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Northwest Pulp and Paper Association; WA. Critical factors for establishing an ambient water quality standard for TCDD in the State of Washington. Presented in public hearing before the Department of Ecology for the State of Washington, Seattle, WA

State Rulemaking Testimony, Expert Reports, Regulatory Support; International Paper; AR. A reevaluation of the tumor histopathology of Kociba et al. (1978) using 1990 criteria: Implications for the risk assessment of 2,3,7,8-TCDD using the linearized multistage model. Expert testimony in public hearing before the Arkansas Commission of Pollution Control and Ecology, Little Rock, AR, August 27. As a result of this testimony, Arkansas reduced its cancer slope factor for dioxin sixteen-fold.

State Rulemaking Testimony, Expert Reports, Regulatory Support; South Carolina Pulp and Paper Association; SC. Establishing a health-based water quality standard for dioxin in South Carolina. Testimony in public hearing before the South Carolina Water Quality Commission, Georgetown, Greenville, and Columbia, SC.

Public Hearing Testimony and Expert Reports, Wassau Papers, WI. Evaluation of emissions from proposed sludge drying operation. Testimony in public hearing before the Wisconsin Department of Natural Resources, Texas, WI.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Florida Pulp and Paper Association; FL. Determination of acceptable levels of human exposure to dioxin. Testimony in

public hearing before the Hon. Carol M. Browner, Florida Department of Environmental Regulation, Tallahassee, FL.

State Rulemaking Testimony, Expert Reports, Regulatory Support; King & Spalding; GA. Amendments to Georgia water use classifications and water quality standards. Testimony in public hearing before the Georgia Board of Natural Resources, Atlanta, GA.

Public Hearing Testimony and Expert Reports, Pierce Atwood, ME, L.D. 2394. An Act to clarify the process by which the Board of Environmental Protection regulates the discharge of toxic substances to the state's surface waters. Testimony in public hearing before the Maine Legislative Committee on Energy and Natural Resources, Augusta, ME.

Public Relations Support, Northwest Pulp and Paper Association, WA. Dioxin: What are the risks? Town Hall TV Debate, Channel 2, Portland, OR.

State Rulemaking Testimony, Expert Reports, Regulatory Support; Boise Cascade; MN. Proposed revisions to Minnesota Water Quality Standards. Testimony in public hearing before the Minnesota Pollution Control Agency, St. Paul, MN.

State Rulemaking Testimony, Expert Reports, Regulatory Support; North Carolina Forest Products Association; NC. Establishing a health-based water quality standard for dioxin in North Carolina. Testimony in public hearing before the NC Environmental Management Commission - Water Quality Committee, Raleigh, NC.

Other Experience of Note

- Planned, coordinated, publicized and managed the North American Conference on Pesticide Spray Drift and Chemical Trespass, an international symposium on the legal, environmental, human health, and technological aspects of off-target pesticide drift for Board of Pesticides Control, Maine Department of Agriculture, Food and Rural Resources, Augusta, Maine. Edited and coordinated publication of the proceedings of the conference. Abstracted and authored a document which summarized the conference for legislative and regulatory use.
- Conducted research, personal interviews and authored a publication for laypersons about the ecological effects of biomass harvesting in the Maine forest for Maine Audubon Society, Falmouth, Maine. Maine Audubon Society, Falmouth, ME, 1981 – 1983.
- Developed and managed the environmental resource program at Maine Audubon including planning, grant procurement, budgeting, and implementation. Analyzed and researched environmental issues. Developed policy positions with trustees and staff; presented Maine Audubon's policies through appointments to statewide advisory boards, working groups, special committees, and through a program of public education utilizing television, radio, and the printed media.
- Wrote and produced "The Forest: Maine's Legacy and Future," a three-part documentary television series on Maine's forest resource.
- Planned, organized, and moderated the R.K. Mellon Conference on Chemical Control and Long Term Management of Gypsy Moth, under contract with Yale University.
- Wrote and edited wood energy publications under contract with the U.S. Department of Energy.

Publications

Price, P.S., J.C. Swartout, and R.E. Keenan. In submission. Characterizing inter-species uncertainty using data from studies of anti-neoplastic agents in animals and humans. In submission to *Fundamental and Applied Toxicology.*

Gray, M.N., L.L. Aylward, and R.E. Keenan. 2006. Relative cancer potencies of selected dioxin-like compounds on a body burden basis: Comparison to current Toxic Equivalency Factors (TEFs). *J. Toxicol. Environ. Health* 69: 907-917.

Keenan, R.E. and J.H. Samuelian. In press. An evaluation of the postulated TEQ enrichment of PCBs in fish tissue. *Human and Ecological Risk Assessment* (Ms. 05-66).

Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn, and S.B. Hamilton. In submission. An empirical evaluation of the dioxin Toxic Equivalency (TEQ) method for risk assessment of PCB mixtures. In submission to *Human and Ecological Risk Assessment.*

Keenan, R.E., E.S. Ebert, J.M. Hamblen, J.H. Samuelian and K.W. Holtzclaw. In submission. An evaluation of the TEQ approach for assessing risks associated with background exposures to dietary sources of PCBs in the U.S. food supply. In submission to *Human and Ecological Risk Assessment.*

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Selected Presentations and Testimony

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Keenan, R.E and J.H. Samuelian. 2005. Is TEQ enrichment of PCBs in fish tissue a common phenomenon? Platform Presentation at *Dioxin 2005 – the 25th International Symposium on Halogenated Environmental Organic Pollutants and Persistent Organic Pollutants*, Toronto, Ontario. August 25.

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Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn and S.B. Hamilton. 2004. An empirical evaluation of the cancer potency of dioxin toxic equivalents (TEQs) in four PCB mixtures. Platform presentation at *Society of Toxicology* (SOT). Baltimore, MD, USA. March 21-35.

Hamblen, J.M., R.E. Keenan, J.B. Silkworth, M.N. Gray, P.O. Gwinn, E.S. Ebert, and S.B. Hamilton. 2003. An empirical evaluation of the potency of dioxin toxic equivalents (TEQs) in PCB mixtures. Poster presentation at 13th Annual Conference of the *International Society of Exposure Analysis* (ISEA). Stresa, Italy. September 22-26.

Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn, and S.B. Hamilton. 2003. An empirical evaluation of the potency of dioxin toxic equivalents (TEQs) in several PCB mixtures. Poster presentation at *Dioxin 2003 – the 23rd International Symposium on Halogenated Environmental and Persistent Organic Pollutants,* Boston, Massachusetts, USA. August 24-29.

Keenan, R.E., P.O. Gwinn, and M.C. Maritato. 2003. The Potential Impact of Hormesis on Risk Assessment. Invited Platform Presentation at *Non-linear Dose-Response Relationships in Biology, Toxicology and Medicine – An International Conference.* University of Massachusetts, Amherst, MA. May 28.

Keenan, R.E. 2002. Mercury – An Overview About Its Effects On Us and the Environment. Dinner lecture to *Greater Portland Dental Society Meeting*, Portland, ME. September 19.

Keenan, R.E. 2001. Dioxin TEQs Overstate the Carcinogenic Potency of PCBs. Public hearing testimony to the *Executive Committee of the U.S. EPA Science Advisory Board,* Washington, D.C. May 15.

Keenan, R.E. 2000. Applying Dioxin TEQs for PCBs. Presentation of comments on behalf of the Polychlorinated Biphenyls Panel of the American Chemistry Council, the Utility Solid Waste Activities Group, and the National Electrical Manufacturers Association to the *U.S. EPA Science Advisory Board, Dioxin Reassessment Review*, Arlington, VA, November 1.

Keenan, R.E. and P.S. Price. 1999. Tricks of the Trade: Principles of Good Practice in Probabilistic Risk Assessment. Invited speaker at: *Second Annual Workshop on Practical Issues in the Use of Probabilistic Risk Assessment*, University of Florida, March 1. Sarasota.

Swartout, J.C., P.S. Price, S. Baird, H. Carlson-Lynch, M.L. Dourson, R.E. Keenan, C.A. Gillis, C.W. Schmidt, and K. Thompson. 1999. Probabilistic Uncertainty in Reference Doses. *Second Annual Workshop on Practical Issues in the Use of Probabilistic Risk Assessment*, University of Florida, March 2. Sarasota.

Anderson, P.D., A.L. Nightingale, R.E. Keenan, S. Craig, and J. Patarcity. 1998. Biota to Sediment Accumulation Factors for PAH, Metals, and Dioxin in Two East Coast Tidal Marshes. Presented at the *Thirteenth Annual Hydrocarbon Contaminated Soils Conference,* University of Massachusetts, Amherst, MA. October 21.

Price, P.S. and R.E. Keenan. 1998. Advances in non-carcinogenic risk assessment. Toxicology Round Table of the American Crop Protection Association. Seattle, WA. February 28.

Price, P.S. and R.E. Keenan. 1998. Characterizing the RfD/MRL/ADI in a Quantitative Framework of Uncertainty and Variability, *Annual Meeting of the Society for Risk Analysis*, December 7.

Price, P.S. and R.E. Keenan. 1998. Microexposure event modeling an approach to modeling time-varying exposures. New England Chapter – Society for Risk Analysis. Boston, MA. March 11.

Price, P.S., R.E. Keenan, and B.W. Schwab. 1998. Defining the Interindividual (Intraspecies) Uncertainty Factor. *Third Annual Workshop on Evaluation of Default Safety Factors in Health Risk Assessment*, November 11.

Price, P.S., R.E. Keenan, J.A. Rothrock, C.F. Chaisson, D.K. Waylett, M.E. Hawley, C.B. Sandusky, R. Sert, E. DeGraff, W.R. Muir, and J.S. Young. 1998. A case study and presentation of relevant issues on aggregate exposure. *ILSI Aggregate Exposure Workshop Program.* Washington, DC. February 9-10.

Price, P.S., R.E. Keenan, and S.J. Pauwels. 1998. Using an Integrated Microexposure Event and Toxicokinetic Model to Evaluate the Impact of Dioxin Intakes from the Consumption of Maine Freshwater Fish on Angler Bodyburdens. *25th Annual Aquatic Toxicity Workshop.* Quebec, Canada, October 21.

Rothrock, J.A., P.S. Price, R.E. Keenan, E.S. Ebert, C.F. Chaisson, W.R. Muir. 1998. The Application of Microexposure Event Modeling to the Evaluation of Water Related Exposures, *Annual Meeting of the Society for Risk Analysis*, December 7.

Iannuzzi, T.J. R.E. Keenan, and R.P. Cepko. 1997. Habitat stresssors and potential PCB risks to wildlife receptors in Clear Creek, Bloomington, Indiana. *SETAC.* San Francisco, CA. November 19.

Keenan, R.E., J.A. Rothrock, and P.S. Price. 1997. Should Maine's rivers have fish advisories for dioxin? *Society for Risk Analysis/International Society of Exposure Assessment Conference.* Washington, DC. December 10.

Keenan, R.E., J.A. Rothrock, and P.S. Price. 1997. Using an integrated microexposure event and toxicokinetic model to evaluate the need for dioxin fish advisories? *Society for Risk Analysis Annual Meeting and Exposition.* Washington, DC. December 7-10.

Keenan, R.E. and P.S. Price. 1997. FQPA aggregate exposure and common mode of action assessments: New approaches. *American Bar Association Section of Natural Resources, Energy, and Environmental Law. Environmental Quality Committee.* Washington, DC. September 9.

Keenan, R.E., J.H. Samuelian, T.J. Iannuzzi, S.P. Truchon, and R.P. Cepko. 1997. Calculation of hypothetical PCB risks to wildlife receptors in the Clear Creek Watershed, Bloomington, Indiana. *Dioxin 97*, Indianapolis, Indiana. August 24-29.

Keenan R.E., J.D. Avantaggio, and P.S. Price. 1997. Should Maine's rivers have fish advisories for dioxin? Using an integrated Microexposure Event and Toxicokinetic Model to evaluate this question. Invited keynote presentation at *SETAC North Atlantic Chapter Annual Conference.* Portland, Maine. June 13-14.

Keenan, R.E. 1997. Dioxins in the Environment: An Overview. *BFI Organics Dioxin Workshop*, Portland, Maine. June 6.

Keenan, R.E. and P.S. Price. 1997. Characterizing the uncertainty in the reference dose (RfD). *New England Chapter of The Society for Risk Analysis.* Cambridge, MA. February 26.

Keenan, R.E., J.A. Stickney, B. Mayes, C.A. Gillis, P.S. Price, and S.B. Hamilton. 1997. Implications of a recent feeding study on the cancer slope factor for PCB mixtures. Platform Presented at the *36th Annual Meeting of the Society of Toxicology (SOT).* Cincinnati, Ohio. March 9-13.

Price, P.S., R.E. Keenan, H. Carlson-Lynch, and C. Gillis. 1997. Defining the interindividual uncertainty factor (UHF): Implications for non-cancer dose response modeling. *Society for Risk Analysis/International Society of Exposure Assessment Conference.* Washington, DC. December 8.

Ebert, E.S., P.S. Price, and R.E. Keenan. 1996. Estimating exposures to dioxin-like compounds for subsistence anglers in North America. *Dioxin 96*, Amsterdam, The Netherlands. August 12-16.

Keenan, R.E., Ebert, E.S., and P.S. Price. 1996. Estimating exposures of subsistence anglers. *Society for Risk Analysis/International Society of Exposure Assessment Conference (SRA).* New Orleans. December 8-12.

Keenan, R.E., N.W. Harrington, P.S. Price, and R.O. Richter. 1996. A comparison of potential risks using default point estimates, Monte Carlo modeling, and Microexposure event analysis for evaluating impacted groundwater near the Stringfellow Superfund Site. *Superfund XVII Conference Proceedings.* Washington, DC. October 15-17.

Keenan, R.E., P.S. Price, J. McCrodden, and E.S. Ebert. 1996. Using a microexposure event analyses to model potential exposures to PCBs through ingestion of fish from the Upper Hudson River. *Platform Presentation at Dioxin 96 – the 16th International Symposium on Chlorinated Dioxins and Related Compounds,* Amsterdam, The Netherlands. August 12-16.

Keenan, R.E. and K.L. Rhyne. 1996. Risk assessment in environmental law. *King & Spalding Continuing Education Seminar, Georgia Bar Association*, Atlanta. February 23-24.

Maritato, M.C., D.W. Crawford, R.E. Keenan, and S.P. Truchon. 1996. Integrating advanced ecological risk assessment techniques with product life cycle impact assessments. Presented at *17th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Washington, DC.* November 17-21.

Price, P.S. and R.E. Keenan. 1996. Characterization of the interindividual (UF_H) factor: Alternative models and approaches. *National Health and Environmental Effects Research Laboratory.* September 24-27.

Price, P.S. and R.E. Keenan. 1996. An approach for Extrapolating Dose Rate Information From Animals to Humans. *Society for Risk Analysis/International Society of Exposure Assessment Conference (SRA).* December 8-12.

Keenan, R E. 1995. Cooperative Research and Development Agreement (CRADA) to Estimate Noncancer Risks from Exposure to Toxic Substances. *Presented at U.S. EPA Region I Seminar on Federal Technology Transfer and Assistance Opportunities*, Bath, ME. April 20.

Keenan, R.E. 1995. What is Risk? Presented at *What You Need To Know About Risk Assessment And Why*, Capitol Hill Club, Washington, D.C. March 1.

Keenan, R.E., M.H. Henning, J.A. Ducey, and E.S. Ebert. 1995. A field evaluation of the reproductive success of insectivorous passerines inhabiting a flood plain in the presence of PCBs. Presented at the *Hydrocarbon Contaminated Soils Conference*, New Orleans, LA. January 12.

Keenan, R.E., M.H. Henning, E.S. Ebert, and E.R. Algeo. 1995. Assessment of effects of PCB-contaminated sediments and floodplain soils on reproduction and community structure of insectivorous song birds. *Platform Presentation at Dioxin '95--15th International Symposium on Chlorinated Dioxins and Related Compounds*, Edmonton, Alberta. August 23.

Keenan, R.E., P.S. Price, E.S. Ebert, S.H. Su, and J.R. Harrington. 1995. Uncertainty and variation in indirect exposure assessments: An analysis of exposure to TCDD from a beef consumption pathway. *Platform Presentation at Dioxin 95--15th International Symposium on Chlorinated Dioxins and Related Compounds*, Edmonton, Alberta. August 21.

Keenan, R.E., P.S. Price, C.L. Curry, J.I. McCrodden, and J.G. Haggard. 1995. Using a microexposure monte carlo analysis to model potential exposures to PCBs through ingestion of fish

from the upper Hudson River. *Platform presentation at the Society for Risk Analysis Annual Meeting,* Honolulu, HI. December 5.

Keenan, R.E. 1994. Monte Carlo modeling of temporal and spatial variations in exposure. Presented during the Workshop on the Application of Monte Carlo Techniques to Exposure Assessment at the Annual Meeting of the Society For Risk Analysis, Baltimore, MD. December 4.

Keenan, R.E. and P.S. Price. 1994. Development of a Monte Carlo model of uncertainty and variability in reference doses. Poster presentation describing a Cooperative Research and Development Agreement (CRADA) project between McLaren/Hart and the U.S. Environmental Protection Agency. Presented at the *Annual Meeting of the Society of Toxicology*, Dallas, TX. March 14.

Keenan, R.E, M. Dourson, P.S. Price, J. Swartout, and S.H. Su. 1994. EPA and McLaren/Hart-ChemRisk joint project to develop a stochastic approach for assessing non-carcinogenic risk - A status report. Presented at the *Annual Meeting of the Society for Risk Analysis*, Baltimore, MD. December 7.

Keenan, R.E., P.S. Price, M.H. Henning, P.E. Goodrum, M.N. Gray, and R.A. Sherer. 1994. Using a MicroExposureJ Monte Carlo risk assessment for dioxin in Maine fish to evaluate the need for fish advisories. *International Society for Environmental Epidemiology/ International Society for Exposure Assessment Joint Conference*, Research Triangle Park, NC. September 18-21. (Accepted)

Keenan, R.E. 1993. Exposure assessment: Then and now and quantum leaps in the future. Invited presentation at *Conference on the Risk Assessment Paradigm after Ten Years: Policy and Practice Then, Now, and in the Future.* Sponsored by U.S. EPA, Naval Medical Research Institute, U.S. Army Biomedical Research, and Armstrong Laboratory, Dayton, OH. April 5.

Keenan, R.E., E.R. Algeo, E.S. Ebert, and D.J. Paustenbach. 1993. Taking a risk assessment approach to RCRA corrective action. Invited presentation at *The Development of Soil, Sediment, and Groundwater Cleanup Standards for Contaminated Sites -- How Clean is Clean?* Water Environment Federation, U.S. Environmental Protection Agency, and Agency for Toxic Substances and Disease Registry, Washington, D.C. January 12.

Keenan, R.E., M.H. Henning, P.E. Goodrum, M.S. Gray, R.A. Sherer, and P.S. Price. 1993. Using a MicroExposureJ Monte Carlo risk assessment for dioxin in Maine (USA) fish to evaluate the need for fish advisories. Platform presentation at *Dioxin '93 - the Thirteenth International Symposium on Chlorinated Dioxins and Related Compounds.* Vienna, Austria. September 21.

Keenan, R.E., P.S. Price, E.S. Ebert, P.E. Goodrum, M.N. Gray, and R.A. Sherer. 1993. A Monte Carlo risk assessment for dioxin in Maine fish: Using a MicroExposureJ approach to evaluate the need for fish advisories. *1993 TAPPI Environmental Conference*, Boston, MA. March 31.

Keenan, R.E. 1992. Ecological risk assessment in the 1990s. Presented at the *First National Conference on Risk Assessment and Community Relations.* General Electric Corporate Environmental Programs, Arlington, VA. September 15.

Keenan, R.E. 1992. Estimating exposures to dioxin-like compounds concerning methods of environmental transport and resulting exposures. Presentation at the *U.S. EPA Peer Review Workshop,* Vienna, VA. September 10.

Keenan, R.E. 1992. Concerning an evaluation of the procedures used to derive human health criteria for the Great Lakes Water Quality Initiative. Presentation to the *U.S. EPA Science Advisory Board, Drinking Water Committee*, Washington, D.C. April 14.

Keenan, R.E. 1992. Concerning a preliminary evaluation of the procedures used to derive human health and wildlife criteria for the Great Lake Water Quality Initiative. Presentation to the *U.S. EPA Science Advisory Board, Great Lakes Water Quality Subcommittee,* Chicago, IL. February 19.

Keenan, R.E., E.R. Algeo, and J.W. Knight. 1992. Applying ecological risk assessment strategies to address environmental problems. Presented at the *Seventh Annual Hydrocarbon Contaminated Soils Conference,* University of Massachusetts, Amherst, MA. September 22.

Keenan, R.E., E.R. Algeo, E.S. Ebert, and D.J. Paustenbach. 1992. Taking a risk assessment approach to RCRA corrective action. Presented at the *RCRA Corrective Action Workshop, Water Environment Federation,* New Orleans, LA. September 20.

Keenan, R.E., E.S. Ebert, J.W. Knight, and N.W. Harrington. 1992. Consumption of freshwater fish by Maine anglers. Contributed paper to *1992 TAPPI Environmental Conference*, Richmond, VA. April 15.

Keenan, R.E., E.S. Ebert, J.W. Knight, N.W. Harrington, and N.L. Bonnevie. 1992. Consumption of freshwater fish by Maine anglers. Presented at the Exposure Session during the *Thirteenth Annual Meeting, Society of Environmental Toxicology and Chemistry (SETAC)*, Cincinnati, OH. November 11.

Sherman, W. and R.E. Keenan. 1992. A pathway-specific description of bioaccumulation from multiple sources: A working hypothesis. Presented at *Bioavailability of Dioxin, PCBs, and Metals in Aquatic Ecosystems,* 1992 Rifkin Conference, Washington, D.C. May 14-15.

Keenan, R.E. 1991. Expert testimony in adjudicatory hearing before the Mississippi Department of Environmental Quality, NPDES Permit Limits for Leaf River Forest Products, Jackson, MS. December 17.

Keenan, R.E. 1991. Testimony in public hearing before U.S. EPA TSCA Docket No. OPTS-62100: Proposed Rule for the Land Application of Sludge from Pulp and Paper Mills Using Chlorine and Chlorine Derivative Bleaching Processes (56 FR 21802), Washington, D.C. October 29.

Keenan, R.E. 1991. Presentation to the U.S. EPA Peer Review Panel of Risk Assessments for Land Application of Pulp and Paper Mill Sludge, Greenbelt, MD. October 2.

Keenan, R.E. 1991. Rebuttal testimony in adjudicatory hearing before the Environmental Quality Commission of the State of Oregon regarding NPDES Waste Discharge Permits 100715 and 100716. September 4.

Keenan, R.E. 1991. A hazard evaluation of the metal and dioxin concentrations in the sludge/ash, lime mud and leachate at the James River Old Town Mill. Testimony in Public Hearing before the Old Town Planning Board, Old Town, ME. April 2.

Keenan, R.E. 1991. Establishing a health-based water quality standard for dioxin in West Virginia. Testimony in Public Hearing before the West Virginia State Water Resources Board on Proposed Amendments and Revisions to State Water Resources Board, 46 CSR 1 Title 46 Legislative Rule Series 1 Requirements Governing Water Quality Standards. Charleston, WV. June 20.

Keenan, R.E. 1991. Expert testimony in public hearing concerning the petition for rule amendment to establish a health-based, water quality standard for 2,3,7,8,-TCDD. Environmental Quality Commission, Portland, OR. June 13.

Keenan, R.E. 1991. Applying the strategy of risk assessment to address environmental problems. Keynote address to 1991 Annual Meeting of the First Tier Association of Railroad Environmental Attorneys, Jacksonville, FL. March 25.

Keenan, R.E. 1991. Applying the strategy of risk assessment to address environmental problems. Guest lecture to the Graduate Program in Toxicology and Public Health, University of Massachusetts. Amherst, MA. April 1.

Keenan, R.E. 1991. Establishing a health-based water quality standard for dioxin in Alabama. Testimony in Public Hearing before the Alabama Environmental Management Commission, Montgomery, AL. January 17.

Keenan, R.E. 1991. Ecological risk assessment in the 1990's. Contributed paper to *Environmental Remediation From Cradle to Grave: An Engineering Primer for Lawyers and Risk Managers.* Armstrong and Teasdale Attorneys at Law, St. Louis, MO. January 25.

Keenan, R.E. 1991. Establishing a health-based water quality standard for dioxin in Mississippi. Testimony in Public Hearing before the Mississippi Department of Environmental Quality, Starkville, MS. January 29.

Keenan, R.E. 1991. Establishing a health-based water quality standard for dioxin in Mississippi. Testimony in Public Hearing before the Mississippi Department of Environmental Quality, Jackson, MS. January 30.

Keenan, R.E. 1991. Issues in Dioxin Risk Assessment. Presentation given at Seminar on Nuisance and Toxic Tort Litigation in the Paper Industry, Simpson Thacher, & Bartlett, New York, NY. February 6.

Keenan, R.E. 1991. Reevaluating the cancer potency of dioxin for regulatory purposes. Presentation to the Minnesota Pollution Control Agency and The Minnesota Department of Health, St. Paul, MN. January 10.

Keenan, R.E. 1991. A toxicologic update concerning the carcinogenic dose response of dioxin. Testimony in Public Hearing before the Arkansas Commission of Pollution Control and Ecology regarding NPDES No. AR0001970 Waste Discharge Requirements for International Paper Company and NPDES No. AR0001210 Waste Discharge Requirements for Georgia-Pacific Corporation, Little Rock, AR. January 3.

Keenan, R.E. 1991. Establishing a health-based water quality standard for dioxin in Florida. Testimony in Public Hearing before the State of Florida Environmental Regulation Commission, Orlando, FL. June 5.

Keenan, R.E. and D.J. Paustenbach. 1991. The use and misuse of risk assessment to address environmental problems. Dinner lecture to *1991 Mobil Oil Corporation Environmental Awareness Conference*, Fairfax, VA. June 4.

Keenan, R.E. and D.J. Paustenbach. 1991. The application and use of health risk assessment to address environmental problems. Invited paper to the *Forum on Emerging Process Technologies*, Sandoz Corporation, Glasgow, Scotland. November 18.

Keenan, R.E., A.H. Parsons, E.S. Ebert, and J.W. Knight. 1991. Critical factors for establishing an ambient water quality standard for TCDD in the State of Washington. Presented before the *Department of Ecology for the State of Washington and the Environmental Managers and Legal Council for the Member Mills of the Northwest Pulp and Paper Association,* Seattle, WA. May 21.

Keenan, R.E., E.S. Ebert, D. Gunster, J.W. Knight, E.R. Algeo, M.N. Gray, and N.W. Harrington. 1991. Critical risk assessment factors for establishing a water quality standard for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. Platform presentation at *Dioxin '91 -- the Eleventh International Symposium on Chlorinated Dioxins and Related Compounds*, Research Triangle Park, NC. September 26.

Keenan, R.E., R.J. Wenning, E.S. Ebert, J.W. Knight, and C.A. Whitaker. 1991. Critical factors for establishing ambient water quality standards for TCDD. Contributed paper to *1991 TAPPI Environmental Conference*, San Antonio, TX. April 10.

Keenan, R.E., E.S. Ebert, E.R. Algeo, M.M. Sauer, J.W. Knight, and R.E. Kross. 1991. A critical evaluation of the EPA risk assessment for pulp and paper mill sludge. Contributed paper to *1991 TAPPI Environmental Conference*, San Antonio, TX. April 10.

Keenan, R.E. 1990. Critical factors for establishing ambient water quality standards for TCDD. Invited lecture to: *Dioxin in Maine's Rivers: A Symposium*. Bowdoin College, Brunswick, ME. December 1.

Keenan, R.E. 1990. A re-evaluation of the tumor histopathology of Kociba et al. (1978) using 1990 criteria: Implications for the risk assessment of 2,3,7,8-TCDD using the linearized multistage model. Keynote paper at *Dioxin '90 - the Tenth International Symposium on Chlorinated Dioxins and Related Compounds*, Bayreuth, West Germany. September 12.

Keenan, R.E. 1990. Dioxin risk assessment for the Columbia River. Contributed paper to *Dioxin '90 - Tenth International Symposium on Chlorinated Dioxins and Related Compounds*, Bayreuth, West Germany. September 13.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in Arkansas. Testimony in Public Hearing before the Arkansas Commission of Pollution Control and Ecology, Little Rock, AR. August 27.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in South Carolina. Testimony in Public Hearing before the South Carolina Water Quality Commission, Georgetown, SC. August 2.

Keenan, R.E. 1990. Evaluation of emissions from proposed sludge drying operation. Testimony in Public Hearing before the Wisconsin Department of Natural Resources, Texas, WI. May 23.

Keenan, R.E. 1990. Determination of acceptable levels of human exposure to dioxin. Testimony in Public Hearing before the Florida Department of Environmental Regulation, Tallahassee, FL. May 1.

Keenan, R.E. 1990. Risk Assessment for the Columbia River. Presentation to *Department of Ecology - State of Washington and Department of Environmental Protection. State of Oregon.* Prepared by Oregon EPA and the Northwest Pulp and Paper Association, April 16-20.

Keenan, R.E. 1990. Setting rational health-based water quality standards for dioxin. Risk assessment for the Columbia River. Contributed paper to *1990 TAPPI Environmental Conference*, Seattle WA. April 11.

Keenan, R.E. 1990. A reevaluation of dioxin cancer potency using the linearized multistage model. Contributed paper to *1990 TAPPI Environmental Conference*, Seattle, WA. April 11.

Keenan, R.E. 1990. Amendments to Georgia water use classifications and water quality standards. Testimony in Public Hearing before the Georgia Board of Natural Resources, Atlanta, GA. March 13.

Keenan, R.E. 1990. L.D. 2394. - An Act to clarify the process by which the Board of Environmental Protection regulates the discharge of toxic substances to the state's surface waters. Testimony in Public Hearing before the Maine Legislative Committee on Energy and Natural Resources, Augusta, ME. March 9.

Keenan, R.E. 1990. Dioxin -- What are the risks? Town Hall TV Debate, Channel 2, Portland, OR. March 4.

Keenan, R.E. 1990. Proposed revisions to Minnesota Water Quality Standards. Testimony in Public Hearing before the Minnesota Pollution Control Agency, St. Paul, MN. March 2.

Keenan, R.E. 1990. Examination of potential risks from exposure to dioxin in soils amended with sludge or ash. Presentation at a workshop sponsored by the *Maine Department of Environmental Protection and Maine Department of Human Services,* Augusta, ME. January 17.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in South Carolina. Testimony in Public Hearing before the South Carolina Water Quality Commission, Columbia, SC. August 1.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in South Carolina. Testimony in Public Hearing before the South Carolina Water Quality Commission, Greenville, SC. July 31.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in Texas. Presentation before the Texas Water Quality Commission, Austin, TX. July 12.

Keenan, R.E. 1990. Establishing a Health-based water quality standard for dioxin in North Carolina. Testimony in Public Hearing before the North Carolina Environmental Management Commission - Water Quality Committee, Raleigh, NC. July 11.

Keenan, R.E., W.R. Brown, and A.H. Parsons. 1990. An update of the scientific information critical to the establishment of state water quality standards. Presentation to U.S. Environmental Protection Agency Region VI, Dallas, TX. October 26.

Keenan, R.E., B.L. Finley, and A.H. Parsons. 1990. Criteria for achieving a no-action alternative: A case study. Contributed paper to *Haztech International '90*, Pittsburgh, PA. October 3.

Keenan, R.E., S.A. Martin, and W.J. Gillespie. 1990. A critical evaluation of the U.S. EPA human health and wildlife risk assessment for pulp and paper mill sludge. Presentation to U.S. EPA Office of Toxic Substances, Office of Solid Waste and Environmental Assessment, and Office of Water Programs, Washington, D.C. December 12.

Keenan, R.E., R.J. Wenning, and A.H. Parsons. 1990. A reevaluation of the cancer potency of 2,3,7,8-TCDD and determination of health-protective exposure levels. Invited lecture to: *Northeast Regional Meeting of the National Council of the Paper Industry for Air and Stream Improvement.* Boston, MA. October 25.

Keenan, R.E., N.D. Wilson, and J.W. Knight. 1990. Looking to the 1990's: Using risk assessment to design cost-effective solutions to environmental problems. Contributed paper to *Haztech International '90*, Pittsburgh, PA. October 3.

Keenan, R.E., N.D. Wilson, and J.W. Knight. 1990. Looking to the 1990's: Using risk assessment to design cost-effective solutions to environmental problems. Invited lecture to *1990 TAPPI New England Annual Meeting*, Harwichport, MA. June 15.

Keenan, R.E., E.S. Ebert, E.R. Algeo, and M.M. Sauer. 1990. A critical evaluation of the EPA risk assessment for pulp and paper mill sludge. Invited lecture to: *Northeast Regional Meeting of the National Council of the Paper Industry for Air and Stream Improvement*. Boston, MA. October 25.

Keenan, R.E., J. Graham, A. Finkel, A. Smith, and R. Frakes. 1990. Invited Panelist, *Workshop on Considerations in Risk Level Decision Making*. Maine Department of Environmental Protection, Augusta, ME. September 20.

Keenan, R.E., E.R. Rand, M.S. Sauer, J.W. Knight, and J.M. Michaud. 1990. Examination of potential risks from exposure to dioxin in soils amended with sludge or ash. Testimony in Public Hearing before the New Hampshire Department of Environmental Services and the Towns of Milan and Berlin, Milan, NH. June 19.

Keenan, R.E. 1989. Risk assessment for the Columbia River. Presentation to the Department of Ecology, State of Washington, Department of Environmental Quality - State of Oregon and Environmental Protection Agency Region 10, Portland, OR. December 18.

Keenan, R.E. 1989. Potential hazards posed by run-off containing TCDD-contaminated soil. Invited lecture to *Dioxin in Dirt--Does 1 ppb Make Sense?* Resources for the Future, Washington, D.C. November 20.

Keenan, R.E. 1989. Sensitivity analysis for dioxin risk assessment and implications for determining acceptable levels of daily exposure. Presented to the Maine Science Advisory Panel of the Maine Department of Human Services, Augusta, ME. November 17.

Keenan, R.E. 1989. Examination of potential risks from exposure to dioxin in sludge used to reclaim abandoned strip mines. Invited lecture to professional development course: *The Risk Assessment of Environmental and Human Health Hazards*, 28th Annual Meeting of the Society of Toxicology, Atlanta, GA. February 27.

Keenan, R.E. 1989. Examining environmental and human health impacts. Invited lecture to Cornell University seminar: *What Happens When the Landfill Fills Up?* Cornell University, Albany, NY. March 9.

Keenan, R.E. 1989. Uncertainties and conservatism in dioxin risk assessment. Contributed paper to *1989 TAPPI Environmental Conference*, Orlando, FL. April 19.

Keenan, R.E. 1989. Critical factors for consideration in setting rational health-based water quality criteria for dioxin. Oregon Department of Environmental Quality, Portland, OR. October 27.

Keenan, R.E. 1989. Sources of uncertainty in the carcinogenic dose-response assessment of dioxin. Bureau of Health, Maine Department of Human Services, Augusta, ME. October 12.

Keenan, R.E. 1989. Testimony presented at public hearing before the California Regional Water Quality Control Board regarding NPDES No. CA0004065 Waste Discharge Requirements for Simpson Paper Company, Shasta Mill, Redding, CA.

Keenan, R.E. 1989. Testimony presented at Public Hearing before the Maine Legislative Joint Committee on Energy and Natural Resources regarding LD1162 -- An Act Regarding Sludge Spreading, Augusta, ME. April 24.

Keenan, R.E. 1989. Health and environmental risks associated with recycling sludge and residuals. Testimony in Public Hearing before the Maine Land Use Regulation Commission regarding Proposed Changes to Chapter 10 Land Use Districts and Standards, Bangor, ME. April 20.

Keenan, R.E. 1989. Testimony before the North Carolina Air Toxics Committee regarding the development of ambient air level standards for carcinogenic pollutants, Winston-Salem, NC. January 12.

Keenan, R.E., J.W. Knight, E.R. Rand, and M.M. Sauer. 1989. Assessing potential risks to wildlife and sportsmen from exposure to dioxin in pulp and paper mill sludge spread on managed woodlands. Contributed paper to *Dioxin '89 - the Ninth International Symposium on Chlorinated Dioxins and Related Compounds*, Toronto, Ontario. September 21.

Cavaney, R., R. Estridge, and R.E. Keenan. 1988. Testimony on behalf of the American Paper Institute before the Subcommittee on Health and the Environment of the Committee on Energy and Commerce, U.S. House of Representatives, Washington D.C. December 8.

Keenan, R.E. 1988. The impacts upon human health of trace concentrations of dioxin in pulp and paper mill export vectors. Presentation to community leaders and the press, Escanaba, MI. June 30.

Keenan, R.E. 1988. How clean is clean? The use of risk-driven remediation as an approach to solving our hazardous waste problems. Invited paper to the seminar series: *On-site Corrective Action Solutions for RCRA/CERCLA Sites, Houston, St. Louis and San Diego.*

Keenan, R.E. 1988. Risk-driven remediation as an approach for determining cleanup of contaminated land. Presentation at 1988 Groundwater Technology Southcentral Regional Seminar, Baton Rouge, LA. January 20.

Keenan, R.E. 1988. Assessment of potential risks to consumers and to pulp and paper mill workers from dermal exposure to dioxin in bleached pulp, paper and pulp-based products. Testimony on behalf of the American Paper Institute before the U.S. Congress Office of Technology Assessment, Washington D.C. November 15.

Keenan, R.E. and B.W. Found. 1988. Assessment of potential risks to humans and to wildlife from herbicide applications on powerline rights-of-way. Testimony in Public Hearing before the Towns of Dixfield (November 7) and Pownal (February 24), ME.

Keenan, R.E., M.M. Sauer, and F.H. Lawrence. 1988. Assessment of potential health risks from dermal exposure to dioxin in paper products. Contributed paper to *Dioxin '88 - the Eighth International Symposium on Chlorinated Dioxins and Related Compounds*, Umea, Sweden. August 23.

Keenan, R.E. 1987. Assessment of potential health risks from dermal exposure to dioxin in paper products. Testimony presented on behalf of the American Paper Institute to the U.S. Environmental Protection Agency, the Food and Drug Administration, and the Consumer Products Safety Council, Washington D.C. October 15.

Keenan, R.E. 1987. Examination of potential risks from exposure to dioxin in paper mill sludge used to reclaim abandoned Appalachian coal mines. Contributed paper to *Dioxin '87 - the Seventh International Symposium on Chlorinated Dioxins and Related Compounds*, Las Vegas, NV. October 8.

Keenan, R.E. 1987. Potential impacts on human health and wildlife species from forestland application of paper mill sludge. Testimony in Public Hearing before the Town of Standish regarding S.D. Warren application to apply sludge and residuals under Chapter 567, Steep Falls, ME. September 12.

Keenan, R.E. 1987. Risk assessment methodology to place levels of dioxin in perspective. Presentation to the Pennsylvania Department of Environmental Resources, Harrisburg, PA. July 9.

Keenan, R.E. 1986. Relevant issues in setting sludge utilization regulations. Invited lecture to *1986 NCASI Northeast Regional Meeting*, Boston, MA. October 30.

Keenan, R.E. 1986. Potential impacts on wildlife from dioxin-containing sludges. Testimony in Public Hearing before Maine Board of Environmental Protection regarding Proposed Amendment to Chapter 567 Dioxin Standards, Rules for Land Application of Sludge and Residuals, Augusta, ME. April 16.

Lawrence, F.H. and R.E. Keenan. 1986. Assessment of human health risks and potential impacts on terrestrial wildlife from exposure to dioxin in BYPRO paper mill sludge used to reclaim abandoned strip mine sites. Testimony in Public Hearing before the Ohio Environmental Protection Agency, Logan, OH. September 25.

Keenan, R.E. 1985. Comparative hazard and benefits assessment via ranking scales and computer graphics. Invited lecture to *National Risk/Benefits Assessment Policy Work Symposium*, Ottawa, Ontario. March 7.

Keenan, R.E. 1984. Hazard Communication Training Programs. *Massachusetts Right-to-Know Law Seminar*, Boston, MA. December 17.

Television Productions

The Forest: Maine's Legacy and Future. 1983. Three one-hour public television documentaries. Written and co-produced with the Maine Public Broadcasting Network, Portland, ME.

Bugged by Gypsy Moths. 1982. Three public service announcements written for WCSH-TV, Portland, ME.

Professional Meetings Chaired

Thirty-Sixth Annual Meeting of the Society of Toxicology (SOT), Poster/Discussion Session on the Development and Applications of Probabilistic Reference Doses, Cincinnati, Ohio. 1997.

Fifteenth International Symposium on Chlorinated Dioxins and Related Compounds (Dioxin '95), Ecotoxicology Session. Edmonton, Alberta. 1995.

Society for Risk Analysis Annual Meeting, Workshop on Application of Monte Carlo Techniques to Exposure Assessment. Baltimore, MD. 1994.

Tenth International Symposium on Chlorinated Dioxins and Related Compounds (Dioxin '90), Risk Assessment Discussion Session. Bayreuth, West Germany. 1990.

Haztech International '90, Risk Assessment Sessions (2). Pittsburgh, PA. 1990.

Ninth International Symposium on Chlorinated Dioxins and Related Compounds (Dioxin '89), Pulp and Paper Symposium. Toronto, Ontario. 1989.

Fourth Annual Conference on Petroleum Contaminated Soils, Regulatory Session. Amherst, MA. 1989.

Understanding Toxicology and Chemical Risk Assessment -- A National Symposium for Risk Managers and Corporate Counsel, Conference Organizer and Chairman, University of Massachusetts Division of Public Health. Portland, ME. 1984.

North American Conference on Pesticide Spray Drift and Chemical Trespass, Conference Organizer and Chairman, Maine Board of Pesticides Control. Portland, ME. 1984.

R.K. Mellon/Yale University on Chemical Control and Long-Term Management of Gypsy Moth, Conference Organizer and Chairman. New Haven, CT. 1983.

Patrick Gwinn

Senior Environmental Scientist

Professional Summary
Mr. Gwinn has over 18 years of environmental consulting expertise, providing a broad base of experience in the areas of human health and ecological risk assessment, fate and transport dispersion modeling, air toxics sampling, and hazardous waste management. He has been instrumental in managing and conducting air quality modeling projects for a variety of purposes, human health and ecological risk assessments, site assessments, and remedial investigations for municipalities and the manufacturing and chemical industries. He has modeled the transport, exposure, and risks associated with chromium, PCBs, dioxins, chlorinated and aromatic hydrocarbons, lead, and other heavy metals.

Professional Qualifications
OSHA 8-Hour Hazardous Waste Safety Refresher Training, 2006

OSHA 40-Hour Health and Safety Training, Hazardous Material Handling, 1988

EPA/Air Waste Management Association Training, Course, Air Pathway Analysis at Superfund Sites, 1989

Education
M.S., Environmental Studies, University of Massachusetts, 1992

B.S., Industrial Chemistry, Keene State College, 1987

Memberships
American Chemical Society, Member (1984 – On-going)

Air Waste Management Association, Member (1990 – On-going)

Languages
English

Location
Portland, Maine

Summary of Core Skills
Human Health Risk Assessment
Over his career, Mr. Gwinn has completed human health risk assessments that have ranged from simple screening assessments to complex multi-pathway, multi-media, multi-chemical risk assessments. Mr. Gwinn has extensive experience evaluating the potential fate, transport, exposure and human health risks of chromium in the both aquatic and terrestrial environments. In addition, many of the risk assessments conducted by Mr. Gwinn focus the potential risks associated with bioaccumulative chemicals, such as dioxins and PCBs.

Ecological Risk Assessment

Mr. Gwinn has completed ecological risk assessments that evaluate the potential bioavailability and toxicity of chemical stressors in aquatic and terrestrial environments. In addition, Mr. Gwinn has evaluated the geochemistry of fresh and marine sediments as a means to ilucidate the bioavailability of metals in sediment. Chemicals evaluated include chromium, bioaccumulative PCBs and PAHs, and other heavy metals. These ecological risk assessments have been used in the assessment and remedy of hazardous waste sites, support of litigation, and for TMDL development. Sites have included freshwater and marine wetlands, streams, and their associated sediments.

Air Quality

Mr. Gwinn has conducted many dispersion modeling analyses and field sampling efforts in support of human health and ecological risk assessments and state/federal air quality permitting efforts. Air quality analyses have ranged from estimated emissions and downwind impacts from excavation/construction activities to analyzing air concentration, wet deposition, and dry deposition from complex industrial sources, such as industrial incinerators, automobile manufacturers, and sewage treatment plants. Mr. Gwinn has extensive experience with the following models: ISC3, ISC3-PRIME, AERMOD, SCREEN3, CTSCREEN, BLP, INPUFF2, BPIP, and PCRAMMET.

Employment History

Senior Environmental Scientist, AMEC Earth and Environmental (formerly Ogden Environmental and Energy Services), 2000 – Present

Senior Environmental Scientist, Ogden Environmental and Energy Services, 1998 – 2000

Senior Associate Environmental Scientist, McLaren/Hart, Inc., 1995 – 1998

Senior Project Chemist, Metcalf & Eddy, Inc., 1993 – 1995

Senior Associate Project Chemist, Metcalf & Eddy, Inc., 1990 – 1993

Project Chemist, Metcalf & Eddy, Inc., 1988 – 1990

Environmental Scientist, NUS Corporation, Inc., 1987 – 1988

Publications

Rifkin, E., P. Gwinn, and E. Bouwer. 2004. Total Chromium is not a good indicator of Toxicity. Env. Sci. Tox. Vol. 38, 14:257A–272A.

Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn, and S.B. Hamilton. 2004. An Empirical Evaluation of the Dioxin Toxicity Equivalence (TEQ) Method for Risk Assessment of PCB Mixtures. Environ. Sci. Technol. (submitted)

Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn, and S.B. Hamilton. 2003. An empirical evaluation of the potency of dioxin toxic equivalents (TEQs) in several PCB mixtures. *Organohalogen Compounds* 65: 312-315. Proceedings Dioxin 2003 – the 23rd International Symposium on Halogenated Environmental Organic Pollutants and Persistant Organic Pollutants, Boston, Massachusetts, USA. August 24-29.

Gwinn, P.O., N.M. Shear, J. Rothrock, M.H. Henning, S.A. Lewis, J.C. Banks, and J. Harrington. 1998. Title III delisting of ethylene glycol monobutyl ether – An assessment of emissions and health effects of a hazardous air pollutant. In: Air and Waste Management Association Annual Meeting Proceedings, San Diego, California June 14-19.

Shear, N.M., P.O. Gwinn, J. Rothrock, M.H. Henning, S.A. Lewis, and J.C. Banks. 1998. Title III Delisting of Ethylene Glycol Monobutyl Ether – A Weight-of-Evidence Approach for Evaluating an

Emissions Inventory. AWMA. Air and Waste Management Association, San Diego, California, June 14-18.

Maritato, M.C., P.O. Gwinn, C.S. Schmidt, and E.S. Ebert. 1997. Application of Exposure- and Risk-Based Principles in the Development of Industrial Remediation Goals for a Former Manufacturing Facility in Eastern Brazil. Water Environment Federation Industrial Wastes Technical Conference. March 3-5.

Presentations

Bouwer, E. Rifkin, E, and P. Gwinn. 2005. A Reassessment of Chromium Sediment Quality Values. The Eighth International In-Situ and On-Site Bioremediation Symposium. Baltimore, MD. June 6-9.

Keenan, R.E., J.M. Hamblen, J.B. Silkworth, M.N. Gray, P.O. Gwinn, and S.B. Hamilton. 2004. An empirical evaluation of the potency of dioxin toxic equivalents (TEQs) in four PCB mixtures. Toxicological Sciences (Supplement) 78: Abstract No. 1783.

Alsop, W.R., J.H. Samuelian, P.O. Gwinn. 2001. Evaluation of Alternate Approaches to Deriving Exposure Point Concentrations for Ecological Risk Assessments. Poster/platform presented at the SRA Conference, Seattle, Washington. December 2-5.

Alsop, W.R., P.O. Gwinn, J.H. Samuelian, and S. Clough. 2001. Development of a Realistic Screening Tool for Evaluating Potential Ecological Risks Associated with Land-Application of Pulp and Paper Mill Biosolids.

Gwinn, P.O., J. Rothrock, and R.E. Keenan. 1998. Application of USEPA's Part 503 Methodology to Pulp and Paper Industry Residuals. National Council of the Paper Industry for Air and Stream Improvement, Central-Lakes Regional Meeting. May 12-13.

Gwinn, P.O., N.M. Shear, J. Rothrock, M.H. Henning, S.A. Lewis, J.C. Banks and J. Harrington. 1998. Title III delisting of ethylene glycol monobutyl ether – An assessment of emissions and health effects of a hazardous air pollutant. In: Air and Waste Management Association Annual Meeting Proceedings, San Diego, California. June 14-19.

Detailed Skills by Representative Project

Human Health and Ecological Risk Assessment

Ecological Risk Assessment of Chromium in Baltimore Harbor Sediments, Honeywell International, MD. Conducted a critical review of the basis for the Maryland Department of the Environment's (MDE) proposed TMDL for chromium in Baltimore Harbor. Demonstrated to the state that the basis of the TMDL listing was not scientifically based, and suggested alternatives for evaluating the potential toxicity, if any, being contributed by chromium in sediments. Prepared white papers that discussed the role of geochemistry in determining the fate of chromium in water and sediment, and evaluated the toxicity of trivalent chromium on benthic dwelling organisms. Based on this work, the MDE agreed that there is not a current basis for developing TMDL allocations for chromium and, as such, will not pursue proposed allocations.

Development of a Strategic Plan for Chromium at the Dundalk Marine Terminal, Baltimore, MD. Honeywell International. Provided expert technical input on a multi-year strategic sampling and analysis plan to assess the potential ecological health risks from hexavalent chromium discharges from portions of the Dundalk Marine Terminal where chromite ore processing residual (COPR) had historically been used for fill material. Media evaluated for sampling included groundwater, storm water runoff, surface water, sediment and sediment pore water.

Human Health and Ecological Evaluations/Risk Assessments of Twenty Properties with Chromite Ore Processing Residual, Honeywell International, NJ. Conducted human health risk

assessments and baseline ecological evaluations for twenty properties in Hudson County, New Jersey where COPR fillI had been used for fill material. This was a multi-year effort to characterize potential human health and environmental risks associated with chromite ore processing residue (COPR), which was used extensively to fill wetland and low areas in eastern New Jersey. Exposure analyses included residential and recreational incidental ingestion of and dermal contact with soil, inhalation of wind- and vehicle-entrained dust, and contact with puddle water. Endpoints included cancer and non-cancer effects as well as the elicitation of allergic contact dermatitis (ACD). Risk assessments were submitted to NJDEP.

Human Health and Ecological Risk Assessment, Atlanta Gas Light, GA. Principal human health and ecological risk assessment scientist for a wetland containing PAHs, cyanide, and metals. Negotiated the technical approach of the risk assessments with the Georgia DNR under HSRA. Conducted a fast-tract baseline human health and ecological risk assessment and developed risk-based cleanup concentrations for surface water, soil, and sediment. Ecological risk assessment included a preliminary risk evaluation and supplementary sediment and surface water toxicity testing. Results of the risk assessment were used to develop time-critical cleanup goals and objectives for a site corrective action plan.

Human Health and Ecological Risk Assessment, General Electric Company, GA. Project manager for human health and terrestrial ecological risk assessment of 100 acres of undeveloped forest and wetland contaminated with PCBs. Provided technical consultation to the client regarding human health and ecological risk assessment and remediation alternatives. Negotiated technical approach for implementation of a post-corrective action risk assessment protocol with state regulatory agencies. Demonstrated that residual levels of PCBs remaining onsite after the corrective action were not significant to human health or ecological risk.

Probabilistic Microenvironment Air Exposure Model Development, Health Canada, Ontario. Manager in charge of critiquing a previously developed personal air exposure model and developing a technically and functionally improved model to Health Canada. The model, named the Canadian Air Personal Exposure Model (CAPEM) was developed on behalf of Santé Canada/Health Canada (SC/HC) as a tool for assessing potential exposures to chemicals in microenvironment ambient air. CAPEM is a probabilistic exposure model that uses age- and Canadian-specific time-activity distributions to estimate the amount of time individuals spend in specific micro environments at different levels of physical activity. CAPEM combines the time and inhalation rate distributions with distributions of microenvironment vapor concentrations to yield plausible distributions of personal exposures over time.

Human Health and Ecological Risk Assessment United Technologies Company, OH. Project manager for the preparation of a human health and ecological risk assessment for a former circuit manufacturing facility in Lexington, Ohio. The human health risk assessment evaluated potential worker, trespasser, and residential exposures to chlorinated solvents in soil, groundwater, and indoor air. Ecological risk to benthic and aquatic organisms was assessed for areas downstream of a groundwater plume discharge point.

Human Health and Ecological Risk Assessment, Centredale Manor Restoration Project Superfund Site, RI. On behalf of the Centredale Manor Superfund Site Participating Respondents' Group, provide human health and ecological risk assessment support, environmental fate and transport consultation, sampling design and data quality assurance. This Superfund site, based in North Providence, has multiple operating units and contemplated actions, including non-time critical removals and an RI/FS process. The Site is associated with human health issues and ecological

concerns from the presence of dioxins and furans in all environmental media, but particularly in riverine and aquatic environments and associated biota.

Monte Carlo Analysis of Exposures to PAHs in Soil, Honeywell International. Prepared a 1-dimensional Monte Carlo analysis of potential exposures to PAHs in soil using the @Risk application Excel. Data were used to assess the need for property cleanup given its intended use.

Human Health Risk Assessment, General Electric Company, Hoboken, NJ. Prepared technical comments on USEPA, Region II human health risk assessment related to incidental ingestion of soil containing mercury released during historical manufacturing processes in Hoboken, New Jersey. Prepared and presented a protocol to USEPA, Region II to assess site specific bioavailability of mercury in soil using *in vitro* and chemical speciation analyses.

Product Risk Assessments/California Proposition 65 Compliance Assessment (SAPPI Fine Paper). Project manager for the assessment of consumer paper product compliance with California's Proposition 65. For this risk-based assessed, AMEC demonstrated that paper used in high-end consumer magazines were in compliance with Prop 65 by estimating the product content and potential worker and consumer exposure to chemicals used in paper manufacturing. This compliance demonstration was conducted to ensure that the labeling requirements of Prop 65 were being adequately addressed. The study's conclusions mean that labeling or notification is not required for these products.

Product Risk Assessment, Mead Westvaco Corporation. Project manager for a project that assessed the potential human and ecological health risks to a new soil amendment product. Evaluated potential risks of the product if used as a flower garden soil amendment, as potting soil amendment of for agricultural use. Evaluated the potential for direct contact and indirect contact from potentially leached chemicals. Demonstrated that the new product was not likely to pose a substantial risk to human health or the environment at agronomic loading rates.

Pulp and Paper Sludge Application Study, Confidential Client. Project manager in charge of back-calculating Risk-Specific Concentrations for 11 chemicals in land-applied pulp and paper sludge. Modified EPA 503 rule methodology for application to pulp and paper residuals. Using fate, transport, and uptake models, evaluated 15 hypothetical human and ecological exposure pathways, and calculated risk-specific threshold concentrations. Results of the analysis were used to assess the potential impact of future state or federal regulatory efforts related to land applied residuals.

CERCLA Human Health Risk Assessment, CBS (Westinghouse), PA. Project scientist and task manager for the preparation of a human health risk assessment for a former transformer manufacturing facility in support of a CERCLA consent agreement. Evaluated residential and industrial exposures to organic and inorganic chemicals in soil, groundwater, surface water, sediment, surface water runoff, and light-nonaqueous phase liquids (LNAPL). Supported the estimation of indoor and outdoor air impacts from contaminated groundwater, LNAPL, and soil. Provided strategic regulatory consultation regarding human health risk assessment.

RCRA Risk Assessment, Merck Pharmaceuticals, NJ. Project scientist tasked with calculating potential construction worker health risks at a major pharmaceutical manufacturing facility in New Jersey. Estimated vapor-phase and particle-phase emission rates and impacts resulting from excavation of contaminated soil, contaminated groundwater dewatering, and soil storage and handing operations in support of a NJDEP RCRA facility risk assessment.

Human Health Risk Assessment, Hadco Manufacturing, Ft. Lauderdale, FL. Task manager responsible for modeling the exposure to volatile chemicals dissolved in household water sources for the FADEP on behalf of the Hadco Manufacturing facility in Ft. Lauderdale, Florida. Modeled

hypothetical concentrations of chlorinated solvents that could be pumped into a household water supply system and evaluated the risks to residents exposed to chemicals volatilized during shower or bath tub use. Also prepared an argument that groundwater in the vicinity of the facility was not likely to be a risk to nearby residences because of the saline nature of the aquifer.

Human Health Risk Assessment, General Electric Company, Recife, Brazil. Performed human health risk assessment to determine the hypothetical risks to industrial workers posed by existing conditions within a former lighting manufacturing facility in Brazil. Recommended remedial actions based on the results of the risk assessment such that risk to future workers would be significantly reduced. This risk assessment resulted in a focused remedial action aimed at reducing future worker health risks.

Human Health Risk Assessment, USEPA, Pembroke, IL. Performed baseline public health evaluation for the Cross Brothers hazardous waste site in Pembroke, Illinois. Focused on the identification of potential exposure pathways, evaluation of the pathways for potential public health risks, and determination of appropriate remedial action objectives.

Baseline Human Health Risk Assessment, USANG, IN. Performed baseline risk assessment for three hazardous waste sites for the U.S. Air Force. Evaluated all contaminants based on physical, chemical, toxicological, and biological characteristics; release mechanisms; and exposure pathways.

Air Quality

Fugitive Dust Assessment, Confidential Client, Maine. Conducted fingerprinting using principal components to assess whether quarry and tailings dust could be the origin of dust sampled at offsite locations. Additionally, conducted dispersion and deposition modeling of a variant of particle size to ensure that ambient air particle monitors adequately characterized potential releases from the facility and did not underestimate potential impacts to offsite areas.

Fugitive Dust Evaluation for the Hudson County Chromium Sites, Honeywell (AlliedSignal), Hudson County, NJ. As part of the NJDEP remedial investigation/human health risk assessment process, evaluated the potential for wind-blown and vehicle entrained emissions of dust from 20 sites containing hexavalent chromium in soil. Developed a methodology to assess the hypothetical generation of a wind- and traffic-entrained dust and, using ISC3ST, modeled the emissions to estimate an ambient air concentration to which a receptor (worker) may potentially be exposed. Using a risk-based approach, back-calculated Alternative Remediation Standards (ARS) for soil which, if achieved, would not result in adverse effects to human receptors. Using this method, we developed ARS values between that were more realistic and 10 to 100 times greater than the default cleanup standards proposed by the State of New Jersey.

Plant-Wide Air Toxics and PSD Increment Consumption/NAAQS Compliance Modeling, Bridgestone-Firestone, Aiken, SC. Modeled the emissions of 190 air toxics from a tire manufacturing facility to evaluate compliance with the state air toxics regulations. Evaluated the potential impact of doubling the facility on the local air quality by determining the PSD increment consumption of all criteria pollutants. In addition, conducted a NAAQS/SAAQS compliance modeling analysis.

Dispersion Modeling and Preparation of a PSD Permit for a Proposed Automotive Assembly Plant, Nissan North America, Canton, MI. Conducted time-critical PSD dispersion modeling for a proposed 500,000 vehicle per year automotive manufacturing facility in Mississippi. Developed the modeling protocol and collected emission and structure information to perform dispersion modeling to set the minor baseline levels of NO_2 and PM and to assess the potential for NAAQS violations for

NO_2, PM, and ozone. Conducted building downwash, cavity, and GEP analyses, evaluated potential emission impacts to soil and vegetation, and prepared modeling text for the PSD permit.

PSD Permitting, Covanta Energy, Oahu, HI. Managed and performed the air quality impact analysis in support of a PSD permit for a major modification of an existing RDF combustor. Prepared modeling protocol and PSD permit application for State of Hawaii. Created PSD increment consumption and NAAQS emissions databases. Conducted complex terrain modeling using CTSCREEN and AERMOD (ver 04300) to determine SIA's, PSD increment consumption, and NAAQS compliance.

Dispersion Modeling for Multipathway Risk Assessment, Covanta Energy, Oahu, HI. Modeled atmospheric transport and deposition of gaseous and particle-phase chemicals from a RDF combustor in support of a mulitpathway risk assessment. Evaluated both simple and complex terrain using AERMOD ver 04300.

PM-10 and NOx Emissions Modeling for PSD Permit Application, UCAR. Conducted multiple emission source dispersion modeling in support of a PSD permit application. Using EPA's Buoyant Line and Point Source model, simulated potential offsite air concentrations from 22 point and two line emission sources at 400 receptor locations. Modeling results indicated no significant deterioration to offsite receptor locations.

State Air Toxics Compliance Permitting, Stanley-Bostitch, North Kingston, RI. Conducted air dispersion modeling for a new manufacturing line to demonstrate compliance with the RIDEM Air Toxics regulations. Prepared permit for State Air Toxics Compliance.

Vehicular Traffic Emissions Impact Assessment, Oak Point Associates, Portland, ME. Assessed the potential for vehicular highway traffic emissions to result in elevated concentrations of criteria pollutants and air toxics at a proposed elementary school location. Conducted an emissions inventory for criteria pollutants and air toxics and modeled those emissions to estimate ambient air concentrations at the proposed school location. Compared the modeled results to health-based criteria to demonstrate that the potential for deleterious health impacts from vehicular emissions are not a concern.

Atmospheric Dispersion and Deposition Modeling of a Resource Recovery Facility and an Ash Landfill for use in a Multi-pathway Risk Assessment, Covanta Energy, Honolulu, HI. Evaluated the potential emission of vapor- and gaseous-phase chemicals from daily operations at a resource recovery facility and its associated ash landfill. Estimated long-term average air concentrations and atmospheric deposition rates for use in a multi-pathway risk assessment.

Accidental Ammonia Release Dispersion Modeling and Exposure Assessment, Cenex Harvest States, Pasco, WA. Conducted air dispersion modeling of an accidental short-term release of ammonia from a tank truck using INPUFF2 dispersion model and local meteorological data to assess the potential exposure to hypothetical receptors. Provided deposition testimony on the results of the modeling and the implications of the alleged exposures. Soon after the deposition, the case was settled.

Technical Review of Maine Department of Health Services Report on Chemical Assessment and Ranking Project, Phillips Elmet, Lewiston, ME. Provided a technical review and assessment of MDHS Draft Report on Chemical Assessment and Ranking Project. Conducted site specific dispersion modeling, hypothetical exposure assessment, and risk calculations to demonstrate that emissions from the Phillips Elmet facility do not pose a significant risk to the general public. Based on this finding, prepared comments to MDHS recommending that the facilities relative risk rank of 10 should, in fact, be zero.

Preparation of State Air Emissions License for a Turbine Manufacturing Facility, General Electric, Bangor, ME. Performed an emission inventory for the facility and prepared the license renewal application on behalf of The General Electric Company. Conducted onsite survey of fuel storage tank vents and delivery systems, boilers, generators, heating units, cutting, grinding, welding, and other metal fabricating processes and developed a plant-wide emissions inventory for criteria pollutants and hazardous air pollutants. The emissions inventory developed as part of this effort demonstrated that the source was a true minor source, and not a synthetic minor source as previously licensed. This modification in source status reduced the record keeping requirement of the plant personnel.

Vapor-phase PCB Air Dispersion Modeling, Confidential Client. Project manager responsible for the determination of hypothetical risks associated with volatilization of PCBs from the water column of a major river system in the Northeastern U.S. Modeled the dispersion of PCB vapor from the river water surface to hypothetical residences along and inland from the river's edge. Using the highest modeled ambient air PCB concentration, determined that risks associated with inhalation were insignificant.

Remedial Option Evaluation, Norwood PCB Site, USEPA. Task manager of a CERCLA remedial design for the Norwood PCB site. Estimated potential emissions of PCB laden dust and vapor-phase chlorinated solvents from the proposed remedial action of site soils. Using air dispersion modeling, evaluated potential air concentrations of site chemicals at neighboring residences, and evaluated the effect of three emission reduction techniques on the modeled air concentrations. Evaluated the effectiveness of dust and vapor suppression foam, windshields, and the use of a temporary enclosure. Information from this analysis was used to design the remediation of onsite soils and to establish the placement of offsite air monitoring stations.

Human Exposure to Airborne Particles Containing PCBs, General Electric, Anaheim, CA. Using local meteorological data and site-specific soils data, estimated the concentration of entrained particles in air. By applying site-specific information regarding soils and ground cover, we calculated airborne particle concentrations by particle size fraction. Applied physiologic parameters describing the fate of the particle size fractions in the respiratory tract as a function of activity patterns to determine the bioavailable portion of the airborne dust. Estimated particle exposure to the dust based on activities performed at the facility and its general surroundings.

Area Source Dispersion Modeling of a Former Landfill and Aeration Pond, Atofina Chemical (Elf Atochem), Carrolton, KY. In support of a RCRA RFI, modeling emissions of hazardous air pollutants from a former landfill and an aeration pond to assess the potential risks to hypothetical facility fenceline receptors. Previous air sampling measurements at the source areas indicated that air concentrations of several volatile organic chemicals were in excess of risk-based guidance values. However, dispersion modeling of the emissions to hypothetical fenceline receptors showed that the annual average air concentrations at the fenceline would be several orders of magnitude below the risk based guidelines. This assessment was used to eliminate the air pathway from further analysis for these sources in the RCRA RFI assessment.

Lead Emissions Evaluation, Charter Steel. Conducted dispersions modeling of lead emissions from a steel manufacturing facility to determine compliance with the National Ambient Air Quality Standard for lead. Modeled the emissions of lead assuming several configurations to identify the most cost-effective system.

HAP Delisting Petition, CMA. Air dispersion modeling scientist on a team working for the Chemical Manufacturers Association (CMA) responsible for removing ethylene glycol monobutyl ether (EGBE) from the glycol ethers definition as specified by Title III of the Clean Air Act Ammendment (CAAA) of

1990. Collected EGBE use and emission data from manufacturing facilities nationwide, electronic databases, and literature. Evaluated the potential impact of current and future emissions of EGBE on nearest offsite receptors, and researched past, current, and future production and use rates of EGBE. Evaluated the effect of delisting of EGBE on Title I of the CAAA as it pertains to volatile organic emissions from coatings and ink applications and groundlevel ozone concentrations.

Semiconductor Manufacture Emissions Dispersion Modeling, Confidential Client, CO. Conducted air dispersion modeling of chemicals being emitted as the result of semiconductor manufacturing. Emissions were released from point and area emission sources. Estimated highest potential offsite concentrations and highest potential concentrations are nearby sensitive receptors for a risk-based screening.

New Hampshire AirToxics Compliance Evaluation, Air National Guard, Concord, NH. Conducted tiered modeling of emissions solvents, metals, and particles to determine if the Air National Guard facility in Concord, NH is in compliance with the state's Air Toxics regulations.

Control Technology Assessment, L&RR Landfill Superfund Site, North Smithfield, RI. Performed ambient air and source monitoring and conducted dispersion modeling to determine destruction efficiencies and offsite impacts for three alternative treatment technologies for the L&RR Landfill Superfund Site in North Smithfield, Rhode Island. Technologies evaluated included incineration, internal combustion, and enclosed flaring. This project was a remedial construction oversight conducted on behalf of USEPA, Region I.

Catastrophic Atmospheric Release Analysis, Baird and McGuire Superfund Site, Holbrook, MA. On behalf of USEPA, Region I, conducted an analysis of a catastrophic release from a hazardous waste incinerator at the Baird and McGuire Superfund site, Holbrook, MA. The analysis showed that the instantaneous release would not result in significant chronic impacts, but that acute effects may be experienced in close proximity to the facility. Data from the analysis was used to modify emergency response planning for the facility.

Emissions Modeling and Air Toxics Permitting, Veteran's Administration, RI. Air dispersion modeler responsible for air toxics permitting of a biomedical incinerator in Rhode Island. Employed building downwash and cavity effect analyses, as well as screening-level and refined Gaussian dispersion modeling techniques to determine the potential short-term and chronic air concentrations at offsite receptor. Data from this analysis was used as input for a human health risk assessment and a state air toxics regulatory review.

Landfill Gas Migration Study, USEPA. Designed and performed study of landfill gas migration to determine the potential impact on neighboring residences at the Rose Hill Landfill Superfund site. Estimated landfill gas emissions to ambient air and the potential impacts to surrounding residences using measurements of chemical flux to air and computer modeling techniques.

Incinerator Performance Specification Preparation, Baird & McGuire Superfund Site, Holbrook, MA. Project scientist and air dispersion modeler for the Baird & McGuire Superfund site in Holbrook, Massachusetts. Prepared performance specifications for an air monitoring system and dispersion modeling protocols for the incineration of contaminated soils. Also provided consulting support to USEPA, Region I and USACE with matters related to the start up and operational testing of the onsite incinerator, air monitor stations, and meteorological stations. Conducted sampling of all waste streams from the incineration process to determine whether destruction and removal efficiencies and emissions were in compliance with the required design specifications.

Historical Tank Farm Emission Modeling, Bethlehem Steel. Conducted air dispersion modeling of volatile organic chemicals from a historical tank farm area in support of a RCRA facility investigation

risk assessment. Modeled emissions using ISC3ST to estimate short- and long-term air concentrations at hypothetical receptor locations both onsite and in neighboring areas.

Incinerator Emissions Modeling, PPG. Designed and conducted air dispersion and wet/dry depositional modeling of dioxins and furans from four industrial waste incinerators. Developed congener-specific annual average ambient air concentrations for dioxins and furans, as well as wet and dry deposition rates for particle-bound congeners. The generated information was used in a multi-pathway analysis to evaluate the hypothetical human and ecological health risks associated with the incinerator emissions.

Emissions Evaluation, Air Modeling Task, and Risk Assessment, Nassau County, NY. Project manager responsible for emissions estimates and air dispersion modeling of airborne chemicals released from a 54-mgd sewage treatment plant on Long Island, New York. This task was performed to support a human health risk evaluation and epidemiological study for the Nassau County Department of Health. Estimated and modeled emissions from the following waste water treatment plant processes: Primary infiltration, primary settling, waste scavenging, grit screening, dewatering, sludge thickening, aeration, final settling and power generation. Evaluated local building downwash and cavity effects. Data generated from the modeling was used to locate offsite air sampling stations, assess inhalation risks, determine the potential for malodorous impacts to the surrounding community, and to identify appropriate study areas for an on-going epidemiological study of the local population.

Particle and Vapor Emission Estimates and Transport Modeling, Confidential Client. Conducted detailed particle and vapor phase emission estimation resulting from construction operations and vehicular traffic at a manufacturing facility in eastern New Jersey. Emission estimates were coupled with local meteorological data in a short-term dispersion model to estimate local air concentrations. Air concentration data were used to demonstrate that nearby workers would not be subject to unacceptable heath risks from such emissions.

Particle and Vapor Emission Estimates and Transport Modeling, CBS (Westinghouse) Corporation. Using site-specific soil data, demonstrated that particle emissions resulting from vehicular traffic and construction machinery operation would not result in unacceptable health risks for workers. Performed particle emission calculations to estimate emission rates resulting from excavation, stockpiling, and truck transport of soil containing heavy metals and volatile and semivolatile organic metals.

John Samuelian, Ph.D.

Senior Environmental Scientist

Professional Summary

Dr. Samuelian brings 20 years of experience in environmental consulting, environmental and analytical chemistry, database development and management, human and ecological risk assessments, quality assurance, site investigation design, and remedial alternatives evaluation. He has served as environmental chemist, senior task leader, project manager, senior technical reviewer or QA/QC officer for a number of remedial investigation/feasibility studies; remedial designs; remedial action construction management; human and ecological risk assessments; commercial product risk assessments; aquatic ecology studies; manufactured gas plant sites; private well surveys; and USATHMA, USACE, RCRA and RBCA site investigations. Projects have included PCB and dioxin sites, building investigations, municipal and industrial landfills, arsenals, a lead shot site, pulp and paper mill sites, contaminated sediment sites, and solvent waste sites. These have ranged from several thousand to multi-million dollar projects. He has also served as QA/QC officer, auditor, and assessed overall data quality for similar projects. Dr. Samuelian has provided support for projects throughout the U.S. for clients from the public and private sectors.

Professional Qualifications

Training

Project Managers Training Course (January 1991 and June 1996)

First Aid/CPR (1992)

Expert Witness Training Course (July 1990)

Certified Organic Data Validator, USEPA Region II (January 1989)

40-Hour Hazardous Waste Operations Training (May 1987 and annual refreshers)

Technical Committees/Peer Panels

Maine Pulp and Paper Association, Solid and Hazardous Waste Committee. September 1999.

Peer Review Panel for Hexavalent Chromium Risk Reduction. USEPA National Center for Environmental Research and Quality Assurance, Washington D.C., 12-13 August 1998.

Ecological Soil Screening Levels (Eco-SSLs) Work Group. Member of Task Group 3 — Soil Chemistry. June and September 1998 (Work group convened by USEPA).

Education

Ph.D., Environmental Health Science, New York University, 1990

M. Ph., Environmental Health Science, New York University, 1985

M.S., Ecology/Environmental Toxicology, University of Tennessee, 1981

B.S., Biology, Union College, 1979

Memberships
Society of Environmental Toxicology and Chemistry (SETAC), Member (1982 – 2006)

Society of Risk Analysis (SRA), Member (1999 – On-going)

Languages
English

Location
Portland, Maine

Summary of Core Skills
Site Investigation, Remedial Investigation/Feasibility Studies, and Remedial Actions
Dr. Samuelian has significant experience in the design and implementation of projects ranging from Site Investigations, through Remedial Investigation/Feasibility Studies, and Remedial Actions. Projects have included terrestrial, aquatic, estuarine, and wetland sites impacted by heavy metals, PAHs, PCBs and dioxins; building investigations; municipal and industrial landfills; arsenals; a lead shot site; and solvent waste sites.

Risk Assessment
Dr. Samuelian has completed numerous human health risk assessments since the late-1980s. These have ranged from simple screening assessments to more complex multi-pathway, multi-media risk assessments. His interests the last few years have been in the development of probabilistic models to concurrently quantify uncertainty and variability in risk estimates.

He has served as project manager and other key roles in ecological risk assessments, predominantly of recalcitrant chemicals, such as PCBs and dioxins. These have also ranged from simple screening level assessments to more complex evaluations that ultimately could be used to support technical evaluations of National Resource Damage claims.

Expert Witness Litigation Support
Dr. Samuelian has provided support to expert witnesses as they prepare for testimony in civil proceedings and has been deposed on technical matters related to projects where he served a major role. He has also testified before administrative law judges and state environmental boards, as well as at public meetings.

Aquatic Ecotoxicology and Aquatic Toxicology
Dr. Samuelian has provided expert consultation for a number of aquatic ecology and aquatic toxicology studies. These have ranged from ecological effects assessment of different power plant intake designs and plant discharges, to field programs designed to assess potential effects of chemical releases on local biota.

Database Development, Management, and Programming
Dr. Samuelian has developed, or participated in the development of, a wide variety of databases that have been used to store and organize field and analytical data collected as part of RI/FS and other large-scale field programs. He has also developed a number of models and Excel Add-ins using a Visual Basic framework.

Homeland Security
Dr. Samuelian has experience in a number of projects that are relevant to homeland security. He has managed or performed a number of site investigations, monitoring programs, and human health and ecological risk assessments at military sites, and has focused the last few years on the integration of probabilistic models into these risk assessments. For example, he recently lead the development of a two-dimensional microexposure event model that estimates the risks over time to a receptor field

exposed to emissions from a combustion facility. He is also part of an AMEC project team that developed a model to estimate concentrations of pharmaceuticals in the environment from direct discharges. Both of these models can easily be integrated into vulnerability assessments and related planning assessments.

His direct experiences include oversight and participation in the scope development of unexploded ordnance surveys (UXO surveys) at military training areas and the ecological risk assessment of residues at a firing range. His expertise in analytical method QA/QC has been used to assess the suitability of analytical methods for explosives and complex chemicals, such as pharmaceuticals.

Quality Assurance
Dr. Samuelian has served as QA/QC officer, auditor, and assessed overall data quality for RI/FS projects, and is an expert in analytical data validation. He has served as instructor for EPA Region II's organic data validation training course.

Employment History
Senior Environmental Scientist, AMEC Earth and Environmental, 2000 – Present

Senior Environmental Scientist, Ogden Environmental and Energy Services, 1998 – 2000

Adjunct Professor, Westchester Community College, 1993 – 1996

Supervising Environmental Scientist, McLaren/Hart, Inc., 1996 – 1998

Senior Scientist, EA Engineering, Science and Technology, 1990 – 1996

Staff Scientist, Ebasco Services, 1987 – 1990

Intern, New York Power Authority, 1983 – 1984

Publications
Samuelian, J.H. and W.R. Alsop. 2005. Approaches to Calculating Media Concentrations for the Assessment of "Bright-Line" Compliance. In preparation for submission to *Soil & Sediment Contamination: An International Journal.*

Clough, S.R., R.E. Keenan, P.O. Gwinn, W.R. Alsop, J.H. Samuelian, K. Ramage, and W.J. Gillespie. 2004. A re-evaluation of the terrestrial wildlife risk of dioxins from pulp and paper residuals: Concentration and disposition of PCDD/PCDF in soil and small mammals at a former land application site in northwestern Maine. Submitted for review *to Environmental Toxicology and Chemistry.*

Anderson, P.D., V.J. D'Aco, P. Shanahan, S.C. Chapra, M.E. Buzby, V.L. Cunningham, B.M. DuPlessie, E. Hayes, F. Mastrocco, N.J. Parke, J.C. Rader, J.H. Samuelian, and B.W. Schwab. 2004. Screening Analysis of Human Pharmaceutical Compounds in U.S. Surface Waters. *Environmental Science and Technology.* 38(3): 838-849.

Samuelian, J.H., W.R. Alsop, J.C. Rader, and B.W. Schwab. 2003. Practitioner's Guide to Alternate Approaches to Deriving Exposure Point Concentrations for Human and Ecological Risk Assessments. Submitted to *Risk Analysis.*

Keenan, R.E., J.M. Hamblen, A.J. Heidorn, J.H. Samuelian, J.A. Stickney, and P.S. Price. Development of Chronic and Subchronic Reference Doses for Polychlorinated Biphenyls. (In review - submitted to Regulatory Toxicology and Pharmacology)

Keenan, R.E., P.D. Anderson, W.R. Alsop, J.H. Samuelian. 1999. Risk-based Management Principles for Evaluating Sediment Management Options.

[http://www.smwg.org/products/techpapers/paper3.pdf]

Samuelian, J.H. 1999. Ecological Guidance for Iron Toxicity in Soil. White Paper prepared for Task Group 3: Soil Chemistry. Ecological Soil Screening Level (EcoSSL) Work Group. USEPA. February.

Samuelian, J.H. and R.E. Keenan. Data Usability Assessment of Aroclor PCB and PCB Congener Analytical Results. (In preparation - to be submitted to Environmental Toxicology and Chemistry)

Samuelian, J.H. and R.E. Keenan. A Review of Polychlorinated Biphenyl Analytical Procedures and Evaluation. (In preparation - to be submitted to Environmental Toxicology and Chemistry)

Samuelian, J.H. 1990. The Analysis of Polychlorinated Biphenyl Congeners in the Estuarine Hudson River. Ph.D. Thesis, New York University.

O'Connor, J.M., J.H. Samuelian, K.J. Saloman, and J.C. Pizza. 1985. Measurement of the effect of Aroclor 1254 on the respiration of *Gammarus* using potentiometric respirometry. *Water Research.* 19:639-643.

Presentations

Characterization of Potential Risk for Several Active Pharmaceutical Ingredients: A Case Study of the Merrimack River. Platform presentation at the 2007 Northeast Science Forum – Pharmaceuticals and Personal Care Products: State of the Science, 8-9 August 2007, Portland, Maine. (Co-author with PhRMA Model Development Team)

The Avian Insectivore Exposure Pathway: Are We Evaluating it Correctly? Platform presentation at the 26th SRA Conference, 3-6 December 2006, Baltimore, Maryland. (Co-author with W. Alsop and T. Fischer)

GE Real Estate Vapor Intrusion Panel: Issues Related to Human Health Risk Assessments. Presented at the GE Global Real Estate Meeting, 8 November 2006, Stamford, Connecticut.

The Chebyshev UCL: Can You Get There from the Mean? Poster presentation at the 25th SRA Conference, 5-7 December 2005, Orlando, Florida. (Co-author with W. Alsop)

Revisiting Policies for Addressing Detection Limits for Risk Assessments and Regulatory Policy. Platform presentation at the 25th SRA Conference, 5-7 December 2005, Orlando, Florida. (Co-author with W. Alsop)

ERA Headaches: Resolving Some of the Questions that Keep Us All Up at Night. Platform presentation at the 25th SRA Conference, 5-7 December 2005, Orlando, Florida. (Co-author with W. Alsop)

Developing Spatial Averages for Discontinuous Chemical Contamination. Platform presentation at the SETAC Conference, 13-17 November 2005, Baltimore, Maryland. (Co-author with W. Alsop)

Is TEQ Enrichment of PCBs in Fish Tissue a Common Phenomenon? Platform presentation at the 25th International Symposium on Halogenated Environmental Organic Pollutants and Persistent Organic Pollutants (POPs) - DIOXIN 2005; 21-26 August 2005, Toronto, Canada. (Co-author with R. Keenan).

Are Sediment Toxicity Bioassays Always Relevant for Ecological Risk Assessments? Platform presentation at the North Atlantic Chapter Regional Meeting of SETAC, 8-10 June 2005, Burlington, Vermont. (Co-author with W. Alsop).

Spatially Identifying Data Gaps Using Geographical Information Systems. Platform presentation at the SRA Conference, 7-10 December 2004, Palm Springs, California. (Co-author with W. Alsop and K. Ausanka)

Does the Exposure Point Concentration Software ProUCL Provide a "Reasonable and Representative" Estimate for Human and Ecological Risk Assessments? Platform presentation at the SRA Conference, 7-10 December 2004, Palm Springs, California. (Co-author with W. Alsop)

Expediting the Ecological Risk Assessment Paradigm for Sediments. Platform presentation at the SETAC Conference, 14-18 November 2004, Portland, Oregon. (Co-author with S. Gormley, W. Alsop, and S. Clough)

Risk Management in a 2-D World. Platform presentation at the SETAC Conference, 14-18 November 2004, Portland, Oregon. (Co-author with W.R. Alsop)

Shortcomings of the TEQ Approach in Measuring Compliance with AWQC. Platform presentation at the SETAC Conference, 14-18 November 2004, Portland, Oregon. (Co-author with E.S. Ebert and R.E. Keenan)

Spatial Distribution of Polychlorinated Biphenyls in the Delaware River Basin. Poster to be presented at the SETAC Conference, 14-18 November 2004, Portland, Oregon. (Co-author with L.R. Gneiding and C.R. Harman)

Assessing Approaches to Estimating Uptake of Compounds by Plants and Animals for Ecological Risk Assessments. Paper presented at the SRA Conference, 7-10 December 2003, Baltimore, Maryland. (Co-author with W.R. Alsop and R. Davis)

Modeled versus Measured Uptake of Chemicals from Soil by Plants and Animals in Ecological Risk Assessment. Poster presented at the SETAC 24th Annual Meeting, 8-13 November 2003, Austin, Texas. (Co-author with J. Rothrock, W. Alsop, and R. Davis)

Assessing Alternate Approaches to Estimating Uptake of Compounds by Plants and Animals in Ecological Risk Assessments. Poster presented at the 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Amherst, Massachusetts. (Co-author with W. Alsop and R. Davis)

Approaches to Calculating Media Concentrations for the Assessment of 'Bright-Line' Compliance. Paper presented at the 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Amherst, Massachusetts. (Co-author with W. Alsop)

Innovative Approaches to Consider when Conducting Human Health and Ecological Site Risk Assessments. Presented at the ANG/CEV 2003 Environmental Workshop, 16-21 March 2003, Gulfport, Mississippi. (Co-author with M. Maritato and W. Alsop)

Assessing the Use and Misuse of Toxicity Equivalency Factors (TEFs) when Evaluating Dioxin Data for Ecological Risk Assessments. Paper presented at the SRA Conference, 8-11 December 2002, New Orleans, Louisiana. (Co-author with W.R. Alsop and J.C. Rader)

Assessing Alternate Approaches to Estimating Uptake of Metals by Plants and Animals in Ecological Risk Assessments. Paper presented at the SRA Conference, 8-11 December 2002, New Orleans, Louisiana. (Co-author with W.R. Alsop)

An Analysis of Integrating Conservatism Globally and Locally in the Environmental Evaluation Process. Poster/platform presented at the SRA Conference, 8-11 December 2002, New Orleans, Louisiana. (Co-author with M.N. Gray and W.R. Alsop)

The Hidden Role of Risk Management in the Development of Sediment Quality Guidelines. Poster/platform presented at the SETAC Conference, 16-20 November 2002, Salt Lake City, Utah.

(Presented paper and poster prepared by J. Rothrock, P. Anderson, B. Alsop, B. Schwab, and A. DiBenedetto)

New York City Department of Environmental Protection, Training Course for Organic Data Validation. EPA Methods 508, 524, and 525. Valhalla, New York, 16-20 September 2002.

Risk Management of Combustion Facilities Using a 2-D Microexposure Event Model. Poster presented at the SRA Conference, 2-5 December 2001, Seattle, Washington. (Co-author with M.N. Gray, W.R. Alsop, B.H. Magee, and P.S. Price)

Evaluation of Alternate Approaches to Deriving Exposure Point Concentrations for Ecological Risk Assessments. Poster/platform presented at the SRA Conference, 2-5 December 2001, Seattle, Washington. (Co-author with W.R. Alsop and P.O. Gwinn)

Development of a Realistic Screening Tool for Evaluating Potential Ecological Risks Associated with Land-Application of Pulp and Paper Mill Biosolids. Poster/platform presented at the SRA Conference, 2-5 December 2001, Seattle, Washington. (Co-author with W.R. Alsop, P.O. Gwinn, and S. Clough)

Application of a 2-D Linear Model to Assess Uncertainty and Variability in Potential Carcinogenic Risks from Combustion Facilities: Direct and Indirect Exposure Routes. Poster/platform presented at the ISEA Conference, 24-27 October 2000, Monterey, California. (Co-author with B.H. Magee, W.R. Alsop, A.L. Nightingale, and P.S. Price)

Modeling Uncertainty and Variability and the Noncarcinogenic Risks on the Consumption of Fish Containing PCBs. Presented at the SRA Annual Meeting, 5-8 December 1999. Atlanta, Georgia. (Co-author with R. Keenan, P. Price, and J. Hamblen)

Risk-Based Management Principles for Evaluating Sediment Management Options. Presented at the SETAC Annual Meeting. 15-18 November 1999, Philadelphia, Pennsylvania. (Co-author with R. Keenan, P. Anderson, and W. Alsop)

Background Risks to Children of Lead Exposures around the House. Poster presented at the Society of Risk Analysis Annual Meeting. 8-9 December 1998, Phoenix, Arizona. (Co-author with J. Beach, D. Dodge, S. Pauwels, T. Long, and P.J. Sheehan)

Lockheed Martin Idaho Technologies Company, Training Course for Organic Data Validation SW-846 Methods 8260, 8270, and 8082. Idaho National Environmental and Engineering Laboratory, Idaho Falls, Idaho, 20-24 July 1998.

Training Course for CLP Organic Data Validation. USEPA Region II and Westchester (NY) Community College. White Plains, New York, Seven Sessions over period 1991-1997.

Calculation of Hypothetical PCB Risks to Wildlife Receptors in Clear Creek Watershed, Bloomington, Indiana. Presented at Dioxin '97 C 17th International Symposium on Chlorinated Dioxins and Related Compounds, Indianapolis, Indiana, August 27, 1997 (Co-author with R. Keenan, T. Iannuzzi, S. Truchon, and R. Cepko).

Short Course: Ecological Risk Assessments: Study Design, Data Collection and QA/QC Protocols. SETAC, Northeastern Regional Chapter, April 24-25, 1997.

Short Course: Ecological Risk Assessments: Approaches and Applications. Eleventh Annual Contaminated Soils Conference, Amherst, Massachusetts, October 24, 1996.

Laboratory Quality Control Requirements of EPA CLP and Equivalent SW-846 Methods. Short Course for Quanterra, Inc. Garden Grove, California, December 1994.

Development of a Site Investigation Plan for a Lead Shot Site. Union College Seminar Series. Schenectady, New York, November 3, 1994.

How to Properly Use Validated Data. Presented at the USEPA RCRA Outreach Seminars: Quality Assurance in Environmental Decision-Making. Yorktown Heights, New York, November 2, 1994.

Detailed Skills by Representative Project

RCRA Site Investigation

RCRA Facility Investigation, NC. Provided technical support for an on-going RFI at an active facility in North Carolina. Evaluated the need to include arsenic as an analyte of concern for the facility's RCRA permit. Arsenic levels in soils from a remediated unit were statistically compared to soils collected from non-impacted areas onsite and in an adjoining cotton field. Using the non-parametric Wilcoxon Rank Sum Test, it was determined that the arsenic concentrations in the SWMU were comparable to that in the environs and that there was no need to include this analyte in the permit.

RCRA Facility Investigation, USMA-West Point, NY. Served as project manager for a RCRA facility investigation of four landfills at USMA-West Point in New York. Field program included the installation of monitoring wells, soil gas and soil vapor sampling, test pit excavations, and surface water and sediment collections. The results were used to show that no further investigation or corrective actions were required at the landfills.

Phase II Remedial Investigation and Interim Remedial Measures, U.S. Army. Project manager for a Phase II RI and IRM design of six landfills at a U.S. Army facility. Field program included confirmatory groundwater sampling, leachate sampling, soil gas and soil vapor sampling, unexploded ordnance (UXO) survey, test pit excavations, and surface water and sediment collections. Results of the investigation were used to develop a limited IRM at two of the landfills to intercept leachate and convey to treatment works.

RCRA Facility Assessment, Drum Storage Facility. Implemented a RCRA facility assessment of a drum storage facility. Facility manufactured flooring tiles that required staging and storage of drums containing VOCs. A focused soil, groundwater, and surface water program was implemented to determine the extent of contamination. Results of the investigation were used to develop an appropriate closure of the storage area.

Remedial Investigation/Feasibility Study

RI/FS, Remedial Design and Construction Management, Municipal Landfill, NY. Served as project manager for a RI/FS, remedial design, and construction management phases for a municipal landfill in New York State that received industrial waste. Chemicals of concern included VOCs, PAHs, PCBs, and metals. Field program included the installation of monitoring wells, soil vapor sampling, test pit excavations, leachate collections, ambient air sampling, surface water and sediment collections, and drum content waste characterization. Also performed the data evaluation and prepared human and environmental health risk assessments for this project. The results of the investigation and risk assessments showed that a 6 NYCRR Part 360 landfill closure would be appropriate for the site, even though drummed industrial waste was present in the landfill.

RI/FS, Chemical Industrial Landfill, NY. Served as project manager for a RI/FS of a chemical industrial landfill site in upstate New York. Field program included the installation of monitoring wells, soil vapor sampling, test pit excavations, leachate collections, ambient air sampling, and surface water and sediment collections. Chemicals of concern included VOCs, PAHs, PCBs, metals, and a site-specific chemical (toluic acid). Responsible for cost management and control and oversight of technical subcontractors. Principal author of the Project Plans, data quality assessment, data

evaluation, and human and environmental health risk assessments, and was the speaker at three public meetings.

Large-Scale RI/FS of Passaic River, NJ. Served as senior environmental chemist for a large scale RI/FS of the Passaic River, New Jersey. Sediments were collected using VibraCore and were analyzed for a variety of contaminants, included dioxins/furans, PCBs, VOCs, SVOCs, metals, and radionuclides. The latter were used to date the sediments and make a determination of sedimentation and erosion rates. Roles included field sample tracking and laboratory oversight, technical contact for data validation contractor, and database design and maintenance. Also assisted in the development of an Ecological Sampling Plan for the Passaic River, which targeted resident species for contaminant analysis, caged bivalve bioaccumulation study, and amphipod and polychaete sediment toxicity studies.

Fate and Transport Assessment, U.S. Navy, RI. Provided senior technical review and assisted in the fate and transport assessment of volatile compounds released from a landfill into a Rhode Island estuary at a U.S. Navy site. The landfill received municipal waste and some industrial waste from the naval facility. Toluene and several chlorinated hydrocarbon organics were the key chemicals of concern. Groundwater within the fill mass was partially tidally influenced, complicating the development and application of the site groundwater model. The model was ultimately used to determine whether capping and leachate interception would be a viable remedial alternative. This effort included participation in agency meetings and negotiation of work scopes.

RI/FS Workplan, Manufactured Gas Plant, MI. Prepared a Work Plan for an RI/FS at a manufactured gas plant site located in Michigan. The site was located in an industrial area adjacent to a river. The field program included soil vapor collection, ambient air sampling, soil sampling, and groundwater collection. Soil and groundwater samples were analyzed for the key MGP contaminants (e.g., PAHs, cyanides, phenolics).

RI/FS Workplan, Waste Solvent Site, NJ. Prepared and implemented a Work Plan for an RI/FS of a waste solvent site in New Jersey. The site was a former farm where drums containing chlorinated VOCs were recycled. The field program included soil vapor collection, ambient air sampling, soil sampling, and groundwater collection. Also performed the data evaluation and provided oversight of the preparation of the human health risk assessment.

RI/FS Workplan, Waste Solvent Site, NY. Prepared and implemented a Work Plan for an RI/FS of a waste solvent site in New York. The site was a former farm where drums containing waste toluene and adhesives were drained into trenches. The field program included soil vapor collection, ambient air sampling, soil sampling, and groundwater collection. Also performed the data evaluation and prepared the risk assessment for the site.

Field Program Sampling, Marathon Battery Site, NY. Provided field support for the collection of sediments and biota. Assisted in the collection of fish samples and sediment samples in the Hudson River as part of the Marathon Battery RI/FS. Fish were collected as part of the on-going monitoring and sediments were collected for use in bench-scale treatability testing.

Public Communications, Various Clients. As part of RI/FS projects have served as principal speaker at public information meetings and public hearings to discuss results of studies and proposed remedial actions. This effort included working with client and agency community relations staff, as well as preparation of Community Relations Work Plans.

Site Investigation

Confidential Client, Assessment of Public Domain PCB Data, Oregon. Performed an initial evaluation of the total PCBs, PCB homologs, and PCB congener data available in the public domain from investigations related to the Willamette River/Portland Harbor RI/FS. This work is being performed to gather information for strategic planning related to the potential addition of the client as a PRP for chemicals present within the Willamette River. Stormwater runoff from this facility, as well as other nearby industrial facilities is conveyed to the Willamette River via the City of Portland sewer system. This is a highly industrialized reach of the Willamette River with a large number of industrial facilities and sewer outfalls in close proximity. The primary objectives of this data evaluation include the following: (1) Review and summarize the total PCB, PCB homolog, and PCB congener data available in the public domain for biological and non-biological samples collected from the Willamette River; (2) Assess these results using statistical methods and chemical fingerprinting techniques to determine the potential contribution from client to nearfield sediments; and (3) Review the existing sedimentation potential and relevant maintenance dredging activities to determine whether or not the outfall area could be considered a net depositional (accretion) or erosional area. Data assessment and report preparation is currently on-going for this project.

Confidential Client, Potential Indoor Air Risks, California. Provided technical support for the review and assessment of indoor air concentrations in a potential lease property in California. Client was concerned with potential TCE concentrations measured in the indoor air. AMEC's assessment included review of sampling methods and analytical results, a summary of existing regulatory criteria for TCE in workspaces, and potential risks to workers based on California exposure assumptions. This assessment was used to negotiate lease agreements with the building owner.

Confidential Client, Vapor Intrusion Panel, Global. Invited to serve as a panellist at a Fortune 500 company's Global Real Estate meeting to discuss vapor intrusion issues and how they relate to property acquisition and portfolio risk management. Focus of effort was on risk assessment issues, particularly how EPA's Johnson & Ettinger model (J&E model) estimates indoor air concentrations, methods to adjust these concentrations to reflect commercial property conditions, risk assessment exposure assumptions, and toxicity benchmarks used to assess potential risks. Since staff from throughout the globe was present at this meeting, this provided an opportunity for non-US staff to become familiar with the J&E model and how vapor intrusion risk assessments may be used in support of the portfolio risk management.

Confidential Client, Vapor Intrusion Evaluation, California. Provided third party quality control support for the evaluation of vapor intrusion into an existing building as part of a due diligence evaluation. EPA's Johnson & Ettinger model were used to estimate potential building air concentrations and potential risks. Risk results were used to support the negotiation costs for the property acquisition.

Confidential Client, Vapor Intrusion Evaluation, Massachusetts. Provided third party quality control support for the evaluation of vapor intrusion into operating commercial building as part of a risk communication effort. Residual levels of TCE were detected in soil vapor due to residues present in groundwater underlying the building. Using the OSWER 2002 Vapor Intrusion Guidance, recommendations were made concerning potential the initial risk communications with building personal, and the follow-up investigations.

Environmental Chemistry and Field Investigation Support, Recycled Paper Mill, Baldwinsville, MA. Provided environmental chemistry and field investigation support for sediment and surface water investigation of residual PCBs on the Otter and Millers Rivers in Massachusetts. PCBs may have

been derived, in part, from the use of recycled paper at an operating paper mill. The focus of the field investigation is to better characterize the extent of PCB residues in support of human and ecological risk assessments. In addition, chemical fingerprinting methods were applied to the Aroclor PCB and PCB congener results collected from sediments to identify other potential source inputs to the rivers. The preliminary assessment confirmed unique Aroclor and congener profiles were present in sediments near suspected sources. Additional field testing is planned to assist source allocation. The project is being performed under the Massachusetts Contingency Plan.

Environmental Chemistry Support, Massachusetts Military Reservation, Cape Cod, MA. Provided environmental chemistry support for large-scale investigations of soil and groundwater contamination at the Massachusetts Military Reservation on Cape Cod. Efforts included identification of analytical methods for atypical chemical contaminants, review and interpretation of analytical data, evaluation of data validation results, and interpretation of analytical data usability.

Indoor Air Sampling Program, NJ. Provided technical support for the development of basement air sampling program at several residences. Groundwater containing elevated levels of chlorinated VOCs was migrating in bedrock towards residences near an active facility in New Jersey. This effort included an evaluation of the suitability of passive badge samplers as a screen for VOCs in basement air, which was determined to be too insensitive at the non-occupational air concentrations anticipated in the basements.

Interim Field Sampling Program, PCB Facility, MA. Co-developed an interim field sampling program at an active PCB facility in Massachusetts. Facility is currently classified as a Tier II waivered site under the Massachusetts Contingency Plan (MCP). The sampling program was designed to fill data gaps and expedite completion of the Phase III (Feasibility Study stage) under the MCP. Surface and subsurface soils, as well as filtered and unfiltered groundwater and stormwater will be collected.

Unexploded Ordnance Survey, Missile Range, CA. Provided technical support for the development of an UXO survey for a missile range in California. Initial results from an extensive UXO survey were used to fine tune the surveys to be performed at similar ranges.

Field Sampling Plan, IN. Prepared a Field Sampling Plan for two creeks near former PCB disposal sites in Indiana. This FSP included collection of surface water, sediments, and biota from a number of stations within streams located near former landfills that received PCB containing materials.

Emergency Spill Response Action, Casco Bay, Portland, ME. Provided technical support for an emergency spill response action. Provided technical oversight of a field collection team mobilized to collect surface water samples in Casco Bay (Portland, Maine) following an oil tanker spill of 750,000 gallons. Field program was designed to provide supporting documentation for potential NRDA claims.

Drinking Well Survey, NY. Performed private well drinking water survey to evaluate the potential impacts of a nearby municipal landfill in upstate New York. This project included development of resident interview questionnaire on their private groundwater usage, sample collection, chemical analysis for key contaminants (volatile organics, metals, indicator nutrients, and bacteria), and data interpretation.

Phase II Investigation Data Evaluation, Former Airplane Engine Construction Facility, NY. Performed the data evaluation as part of an expanded Phase II investigation of a former airplane engine construction site in upstate New York. The principal chemicals of concern were VOCs. The results of the investigation and subsequent human health risk assessment were used to delist the site from the New York State Hazardous Waste Site Registry.

Statistically-based Sampling Program, HI. Developed statistically-based sampling program for a soil vapor investigation of a pipeline in Hawaii. Results were used to develop a soil sampling program to quantify the extent of potential soil contamination in the pipeline right-of-way from historical spills and leaks.

Phase I Site Investigation, Letterkenny Army Depot, PA. Prepared the Phase I site investigation report for several operable units at the Letterkenney Army Depot in Pennsylvania. These sites included collection of soils, sediments, and surface water samples for SVOCs, explosives, and heavy metals. The results were used to develop a Phase II investigation Work Plan and risk assessment for the sites.

Ambient Air Sampling, Tank Removal Site, Plymouth, MA. Performed ambient air sampling at tank site undergoing remediation. Operated an onsite laboratory for the analysis of VOCs collected from multi-component sorbent traps at a tank removal site in Plymouth, Massachusetts. Onsite tanks were used to store a mixture of waste oil and solvent waste. Results were used to monitor for any potential releases of VOCs during the tank dismantling.

Landfill Gas Vent Sampling and Analysis, RI. Performed landfill gas vent sampling and analysis of a mixed industrial/municipal landfill in Rhode Island. Operated an onsite laboratory for the analysis of VOCs collected from the gas vents using bulb samplers. Results were used in conjunction with co-collected meteorological data to evaluate offsite transport of VOCs from the landfill vents.

Fate and Transport Summary, CO. Prepared a fate and transport summary in support of chemistry results from field investigations at Basin F in Colorado. This effort included an evaluation of existing physico-chemical parameters for standard and exotic chemicals present in the soil, surface water, and groundwater at the site. Also performed limited predictions of ultimate fate of some of the chemicals of interest.

Estuarine Field Program, NY. Designed and implemented an extensive field program in the estuarine reach of the Hudson River to characterize PCB congener concentrations in biota, sediments, surface water, and suspended sediments. Also was responsible for chemical analysis, and created computer programs to store, compile, and summarize the analytical results.

Risk Assessment

Environmental Chemistry, Field Investigation, and Risk Assessments, Centredale Manor Site, North Providence, RI. Provided environmental chemistry support for sediment and surface water investigation of residual dioxins/furans, PCBs, and other recalcitrant chemicals, in the Woonasquatucket River in Rhode Island. Chemical residues were derived from discharges of diverse former operations, which included herbicide formulations, drum recycling operations, and other chemical handling operations. Primary roles were to perform statistical analyses of the analytical results to identify spatial and temporal trends, and apply chemical fingerprinting methods (principal components and cluster analysis) to identify unique chemical signatures that may be attributable to different sources. The evaluation of potential methods to distinguish the sources is currently ongoing. This is an active project.

Chemical Forensics for Source Identification, Portland, Oregon. Applying forensic tools (principal components analysis and cluster analysis) to assess PCB congener results in the Willamette River to identify potential sources and relative contributions to sediment PCB concentrations. Results may be used to both limit liability and extent of remedial action(s).

Enhancements to Model to Predict Environmental Concentrations of Pharmaceuticals, Throughout U.S. Part of the technical team that developed a fate model that predicted environmental concentrations of pharmaceuticals. Model enhancements will include the addition of a biosolids module, which assesses the fate and disposition of pharmaceuticals that may accumulate in POTW sludge and then used as organic material for biosolids application. An additional model enhancement is the use of alternate xQy flows to be more representative of chronic exposures to aquatic organisms.

Streamlined Human and Ecological Risk Evaluations, Former Uranium Mine, Grand Canyon, Arizona. Developed human and ecological streamline risk evaluation work plans in support of the development of an EE/CA Work Plan for a former copper and uranium mine on the rim of the Grand Canyon. Both radionuclides and non-radionuclides (predominantly metal) were included in these assessments. Human health radionuclide risks will be evaluated using the RESRAD model, while non-radionuclide risks and all ecological risks will be evaluated using conventional EPA Superfund approaches.

Remediation Health and Safety Evaluation, Georgia. Prepared a health and safety evaluation for remediation workers, transportation, and receiving landfill workers for a proposed soil remediation project in Georgia. The active industrial site had inadvertent releases of phthalate compounds to subsurface soils and sediments due to an improper functioning containment system at their loading dock. The health and safety evaluation included a determination of potential risks associated with removal and handling of phthalate containing soils at the facility, potential transportation risks (which were *de minimus*) and special handling requirements for landfill staff that received the contaminated soils.

Derivation of Regional Background Phthalate Concentrations for Ditch Sediments, Georgia. An active industrial site had inadvertent releases of phthalate compounds to subsurface soils and sediments due to an improper functioning containment system at their loading dock. The resulting phthalate concentrations were evaluated in conjunction with sediment collected from nearby streams and ditches to derive an appropriate regional background concentrations for these compounds. This assessment was done in lieu of a formal risk assessment due to the comparatively small areal coverage of the phthalate impacted sediments. This value was then used to develop a remediation plan for these sediments.

Remedial Alternatives Human Health Risk Assessment, New Jersey. Developed a human health risk assessment to assess residual risks of different remedial alternatives for a brownfields site in NJ. The principal chemicals of concern were PAHs, metals, PCBs and dioxins. Based on the proposed remediation - based on a combination of excavation, consolidation and capping - we were able to show that potential human health risks were within EPA tolerance for likely end uses, and potential emergency breaches, of the cap.

Baseline Ecological Risk Assessment, Wilmington, North Carolina. Provided technical oversight for the preparation of a baseline ecological risk assessment of a creek and adjoining wetlands at a former wood treatment facility in North Carolina. Receptors of interest included benthic invertebrates, several fish species, Great Blue Heron, mink, and the red-tailed hawk. Chemicals of concern included several pesticides, metals, PAHs, and dioxins/furans. An HQ-based approach was used, and toxicity testing of sediments was also performed. The BERA was later supplemented with an evaluation of potential risks to insectivorous birds, whose exposure was estimated based on the collection of emergent insects in 2005 and 2006. The results of this evaluation showed no significant risks to this receptor. The emergent insect results were also used to derive biota transfer factors, which will be used to support the remedial alternatives assessment for this project.

Human and Ecological Risk Assessments, Gulf, North Carolina. Prepared Work Plans to perform the human and ecological risk assessments of a creek at a former wood treatment facility in Gulf, North Carolina. Receptors of interest included benthic invertebrates, Great Blue Heron, mink, deer, eastern kingbird, and the red-tailed hawk. Chemicals of concern included pentachlorophenol, metals, PAHs, and dioxins/furans. Following submissionof the Work Plan, a Screening Level ERA was prepared in accordance with NCDENR guidance which will be used to refine the exposure pathways and estimates.

Comments to the OMB Proposed Risk Assessment Bulletin. Provided technical support to the development of comments to the Office of Management and Budget's 9 January 2006 Proposed Risk Assessment Bulletin. The focus of the comments were to both commend the OMB for their recommendations where appropriate and also identify areas were further clarification would be useful to meet their primary objective to harmonize the risk assessment process across different regulatory disciplines.

Confidential Client, North Carolina. Provided third party quality control support for the assessment of vapor intrusion into an operating commercial laundry. Residual VOCs (perchloroethylene, trichloroethylene, and vinyl chloride) from historical operation spills were present in the soil vapour underlying a portion of the building. EPA's Johnson & Ettinger model were used to estimate potential building air concentrations. Default model assumptions were adjusted to reflect less than daily exposure in the rooms overlying the affected areas in order to achieve a more realistic exposure estimate.

Confidential Client, Vermont. Provided third party quality control support for the assessment of vapor intrusion into a school. The client's primary consultant estimated potential risks of a building expansion using the Johnson & Ettinger vapour intrusion. AMEC's review showed that some alternate assumptions could have been used, but this did not change the overall conclusion that there were not potential caner or non-cancer risks from the residual VOCs present in the soils.

Assess Inter- and Intra-Individual Variability for Mercury Exposure, Canada. As part of a project to re-examine the PEL for mercury in Canada, assessed multiple human health studies to develop an uncertainty factor that addresses inter- and intra-individual variability. This effort included review of relevant literature on industrial exposure to mercury (predominantly from former Chlor-Alkali workers). Statistical methods such as the jackknife will be used to quantify the variability.

Probabilistic Model to Assess MTBE Exposure in Canada. Updated an existing probabilistic exposure model that was used to estimate exposures to MTBE for different age groups of human receptors in Canada. Model refinement, including refining exposure assumptions, developing VBA code to provide a more usable interface, and update model to use @RISK 4.5.

Sediment PAH and Metals Bioavailability, OH. Developed a Focused Work Plan to assess the potential bioavailability of PAHs and metals from sediments near a former manufacturing facility discharge. Observed results exceeded screening "Consensus" sediment criteria for some parameters. Focus of this effort was to demonstrate that the bioavailability of the PAHs and metals was reduced in these sediments to the extent that the screening sediment criteria were not a relevant benchmark.

Reassessment of Sediment Remediation Goals for PCBs, PA. Provided risk assessment support to AMEC engineers for the re-assessment of acceptable soil and sediment remediation goals of PCBs at a site in Pennsylvania adjacent to the Delaware River. The original remediation goal was based on Aroclor PCB analysis and was established in the ROD for the project. Following subsequent collection and assessment of PCB congener and dioxin congener data, EPA attempted to reduce the

remediation goals while the remedial design was in progress. AMEC is currently supporting the client PRP group in negotiating a reconciliation of these differences (focusing on residual risk-basis and engineering design issues) in order to retain the historical remediation goal so that the remedial design and remediation program can resume.

Model to Predict Environmental Concentrations of Pharmaceuticals, Throughout U.S. Part of the technical team that developed a fate model that predicted environmental concentrations of pharmaceuticals. Information concerning the hydrology of multiple watersheds throughout the U.S. was obtained from the EPA database BASINS. Loadings to the watersheds from POTWs were calculated based on per capita usage of the different compounds, and the population served by the different watersheds. The model was designed to include degradation by various pathways, including human metabolism, treatment at the POTWs, loss during transport in the rivers and reservoirs, and loss from treatment by the drinking water purveyor. Predicted water concentrations were also compared to back-calculated acceptable drinking water concentrations to assess potential risks to individuals exposed to these chemicals via drinking water. This study was published in the journal *Environmental Science and Technology*.

Assessment of Suitability of TEQ Method for PCB Human Health Risk Assessments. Provided technical support for the evaluation of the suitability of the TEQ approach to assess potential human health risks associated with PCB exposure from fish ingestion. Methodology was based on the comparison of the TEQ derived from PCB congener analysis and comparison to TEQ content of Aroclor PCBs. Evaluation of different fish studies showed that the Aroclor PCB-based risk assessment was adequately protective.

Development of Site-Specific Uptake Factors for an Ecological Risk Assessment, Former Munitions Demolition Area, MA. Provided technical support for the development of site-specific soil-to-biota uptake factors in support of an ecological risk assessment of a former munitions demolition area at a military site in Massachusetts. Focus was on collection of empirical data of dyes, explosives and metals in plants, earthworms, and small mammal and comparison to co-located soil samples. Results of the evaluation showed that existing models conservatively overestimate the uptake that may occur.

Screening Ecological Risk Assessment, Massachusetts Military Reservation, Cape Cod, MA. Provided senior technical review of a screening ecological risk assessment, performed in accordance with EPA and MADEP guidance, for a former explosives demolition pit. The assessment included the development of appropriate assessment and measurement endpoints, screening of a large suite of chemicals identified during prior field investigations, and development of the work scope for a more detailed quantitative ecological risk assessment.

Human and Ecological Risk Assessments, Mill Operation, NC. Serving as Project Manager for Human and Ecological Risk Assessments to be performed at a former wastewater treatment plant associated with an operating mill in North Carolina. The facility is located adjacent to a river system. The key chemicals of concern are chlorinated solvents, particularly trichloroethane. This project site is being addressed as a Brownfields redevelopment, since the wastewater treatment plant will be transferred to the municipality following completion of the risk-based remedial action.

Peer Review Panel Recommendations, MA. Provided technical support for the development of recommendations for Peer Panel Review of a human health risk assessment of a river system in Massachusetts. Focus was on issues related to EPC development, exposure assumptions, and data quality assessment.

Development of Guidance for Risk-Based Corrective Actions for Petroleum Releases at U.S. Military Sites in Europe. Provided technical support and review for the development of supplemental guidance for the U.S. military to address petroleum spills in Europe. Methodology was based on ASTM RBCA guidance and included the development of an analytical method decision tree for use at these spill sites.

Statistically-based Sampling Program. Used power testing methods to develop the minimum number of samples required to verify exceedance of a screening criteria in support of an Ecological Risk Assessment.

Ecological Risks from Alternate Sludge Management Methods. Reevaluated the Meyn Model to assess potential ecological risks associated with exposure to pulp and paper mill sludges from different land-farming methods. This evaluation showed that the earlier work had overestimated the risks to shrews. An alternate model is under development that includes use of empirical data.

Microexposure Risk Model, WI. Assisted in the parameterization, code development, and QC for a microexposure event risk model that estimated human health risks from the ingestion of fish containing PCBs for a large river system in Wisconsin. This is a two-dimensional model that concurrently quantifies uncertainty and variability in estimated future risks, and also has the flexibility to assess the residual risks from different remedial alternatives.

Development of Spatial-Weighted Exposure Point Concentrations. Co-developed an approach to provide an upper 95 percent confidence limit estimate of the spatial-weighted average concentrations. This method has direct application to both human and ecological risk assessments where biased sampling indicates that spatial statistical approaches to deriving EPCs is required.

Evaluation of Alternative Approaches to Exposure Point Concentration Calculations. For projects in Massachusetts and California, evaluated the suitability and representativeness of alternative approaches to calculate EPCs, based on those published by Singh et al (1997). Alternative approaches were required since EPA's approach using the H-statistic yielded results that were not representative of the actual distribution of chemical concentrations at these two sites.

Geostatistical Evaluation in Support of Sediment Mass Estimate, WI. Evaluated the suitability of a PCB mass load estimate for sediments in a river system based on alternative geostatistical techniques. Krigiing and inverse distance squared averaging methods were used to estimate mass load. Result of the evaluation lead to identification of data gaps that were used to develop a future field sampling program.

Microexposure Risk Model, NY. Assisted in the parameterization, code development, and QC for a microexposure event risk model that estimated human health risks from the ingestion of fish containing PCBs. This model concurrently quantified uncertainty and variability in the risk estimates, and therefore serves as a useful tool for risk management decisions.

Human and Ecological Risk Assessments, Coastal Swamp, NJ. Prepared an HRA and ERA for an upland area and swamp impacted from a historical release from an adjoining waste oil lagoon. The ERA was prepared in accordance with EPA ERAGs guidance, under EPA Region II. Principal chemicals of potential ecological concern included PCBs, waste oil, and certain heavy metals. Portions of the swamp are tidally-influenced, while other areas are influenced by local hydrology. For the ERA, a wide variety of assessment and measurement endpoints were assessed, due to the large areal extent (400+ acres) of the swamp. Receptors included vegetation, small mammals, aquatic birds and raptors, and large mammals. The focus of the HRA was the upland area. Key receptor pathways included incidental dermal contact of soils and sediments, ingestion of groundwater, and vapor inhalation. The Johnson and Ettinger vapor intrusion model was used to assess potential vapor

exposures using different exposure scenarios. Results from both risk assessments will be used to support the RI/FS for the site.

Derivation of Ecological Risk-Based Clean-Up Levels, GA. Developed risk-based clean-up goals for ecological receptors at a property impacted by releases from an adjoining manufacturing facility in Georgia. Clean-up levels were derived for PCBs, phthalates, and select metals for the most sensitive avian receptor (American robin). In addition, a statistical analysis was performed to estimate the number of samples at concentrations above the clean-up level that could remain and still achieve the clean-up level, both property-wide and in the remediated area.

Review of Human Health Risk Assessment, NY. Assisted with the technical review of Agency human health risk assessment for a river system in New York. Efforts included (1) review of the suitability of the exposure point concentrations, (2) evaluation of the suitability of the angler survey(s) used in the risk assessment, and (3) evaluation of the risk modeling that was performed.

Review of Human Health Risk Assessment, NY. Assisted with the technical review of Agency human health risk assessment of chemical residues at residential properties located on an island downstream of a former manufacturing facility that used PCBs.

Derivation of Human Health-Based Clean-Up Levels, NJ. Assisted in the development of exposure assumptions to derive human health risk-based clean-up levels (HBCLs) for chemical residues at an active chemical manufacturing facility in New Jersey. Chief chemicals of concern included PCBs, and a variety of lower and higher molecular weight PAHs. Facility has been active for more than 50 years and had multiple areas of environmental concern (AECs). HBCLs were derived by developing realistic exposure assumptions based upon the use of the facility area and its physical features, as well as back-calculating from assumed potential carcinogenic risks of 1E-5 and potential non-carcinogenic hazard quotient of one. Limited air modeling using the ISCT3D model was used to estimate the amount of entrainment of exposed soils. HBCLs were also evaluated using the VLEACH model to determine whether the predicted concentrations would also be protective of groundwater quality. HBCLs were used as part of the feasibility study to identify appropriate corrective actions for each of the AECs.

Screening-Level Ecological Risk Assessment, GA. Prepared a screening-level ecological risk assessment for a property impacted by releases from an adjoining manufacturing facility in Georgia. The risk assessment was prepared in accordance with Georgia EPD guidance and USEPA Region IV guidance. Principal chemicals of potential concern included PAHs, PCBs, and certain heavy metals. Evaluated receptors included shrews, robins, raccoons, and deer. The evaluation showed that only PCBs were driving the risk, with hazard quotients greater than one calculated for food-chain transfer to the shrew and robin. Results were used to develop remediation levels and appropriate post-remediation confirmatory risk assessment work scope.

Derivation of Risk-Based Clean-Up Levels, NY. Served as task manager and assisted in the development of exposure assumptions to derive human health risk-based clean-up levels for chemical residues at residential properties located on an island downstream of a former manufacturing facility that used PCBs. Soils present on several of the properties were spoils from historical maintenance dredging operations of nearby channels. The risk-based clean-up levels were used in a feasibility study to identify appropriate corrective actions at these properties.

Risk Assessment Work Plan, MA. Provided technical support to prepare comments to an Agency prepared Work Plan for a river system impacted by PCBs in Massachusetts. Effort included evaluation of the suitability of the analytical program, sampling design, and exposure media for

appropriateness in developing a human health risk assessment and providing input to risk management decisions.

Screening-Level Ecological Risk Assessment, Various U.S. Locations. Prepared a screening-level ecological risk assessment for properties that may be used for landfarming of pulp and paper mill sludge and waste. Various landfarming methods were evaluated for six surrogate receptors (three avian, three mammalian) that may inhabit these areas. The principal chemical of concern was 2,3,7,8-TCDD. Risks were initially calculated based upon a 1 ng/Kg soil concentration, from which unit risks (i.e., the soil concentration which yields a hazard quotient of one) were derived. The unit risk values were then used to estimate the typical landfarming assumptions and techniques over a 20 year span that would not result in a risk in excess of one to the evaluated receptors.

Uncertainty Analysis for a Human Health Risk Assessment, OH. Assisted in the development of model and interpretation of the model results for a residential human health risk assessment. The residential properties had received soils contaminated with PAHs from an industrial facility. The model was developed to separate uncertainty from variability, was coded in Visual Basic, and included an innovative approach to determining exposure concentrations.

Ecological Risk Assessment Work Plan, GA. Co-authored an Ecological Risk Assessment Work Plan for a manufacturing facility in Georgia that included multiple operable units. Principal chemicals of potential concern included PAHs, PCBs, and certain heavy metals. The Work Plan was prepared in accordance with Georgia EPD guidance.

Ecological Risk Assessment Work Plan, NC. Provided technical support for an Ecological Risk Assessment Work Plan for an active pulp and paper mill in North Carolina. The site consisted of three operable units, including a creek, onsite landfill, and former chlor-alkali plant. Principal chemicals of potential concern included dioxins/furans, mercury, PAHs, PCBs, and chromium. The Work Plan was prepared in accordance with EPA ERT guidance.

Screening-level Ecological Risk Assessment of a Pulp and Paper Mill, NC. Provided technical support for the screening level ecological risk assessment of a creek which received discharges from treatment ponds at an active pulp and paper mill in North Carolina. The mink, wood duck, and belted kingfisher were evaluated as sensitive receptors for this screen. Based upon this evaluation, the principal chemicals of potential concern included dioxins/furans, mercury, PAHs, PCBs, and chromium. The results were used to develop the detailed Ecological Risk Assessment Work Plan for this site.

Supplemental Risk Assessment and Feasibility Study Support, Manufacturing Facility, ME. Prepared a supplemental risk assessment for an active plastic product manufacturing facility in Auburn, Maine. Historical operations from a prior site operator resulted in contamination of subsurface soils and shallow groundwater with VOCs and cresols. Exposure pathways evaluated include dermal contact, inhalation of vapors from soils and groundwater, non-potable incidental ingestion of groundwater, and ingestion of groundwater by residences. Planned approach is to also provide risk assessment support for a feasibility study of the facility, which may include the design of a focused, risk-based sampling program to support the FS, evaluation of supplemental field data against risk assessment performed as part of the RI, and determination of "residual risk" as part of the FS alternatives assessment.

Risk Assessment Support, Commercial Product Manufacturer. Commercial product was a new use for recycled paper. Pathways evaluated included worker exposure, and human and animal exposure to finished product. This effort included evaluation of Aroclor PCB, PCB congener, and

dioxin data collected on the raw recycled material, as well as determination of the appropriate use of the analytical data for the risk assessment.

Risk Assessment Support, CA. Provided risk assessment support for evaluation of chemical residues in food product. Assisted in the design, implementation, oversight, and interpretation of a project that quantified the phthalate content of commercial cheeses. This lawsuit was brought under California Proposition 65, which requires that manufacturers and vendors label their products if they contain chemicals listed within the proposition at concentrations in excess of a permitted exposure limit. This project included collection a wide variety of cheeses from supermarkets in California, processing under "phthalate-free" conditions, and analysis using the high-resolution EPA method 1625c.

Risk Assessment, CA. Provided risk assessment support for evaluation of chemical residues in commercial hair dye. Assisted in the design of an analytical program to speciate the organo-lead compounds in commercial hair dye. The program included chemical analysis for lead, anions, as well as visual analysis using scanning electron microscopy of crystals associated with treated hair. This lawsuit was brought under California Proposition 65, which requires that manufacturers and vendors label their products if they contain chemicals listed within the proposition at concentrations in excess of a permitted exposure limit.

Risk Assessment Support, Landfill Site, NY. The risk assessment evaluated off-landfill risks in streams, minor stream tributaries, and a recreational lake. This effort included integration of multiple investigation phases into a single database, exposure assessment for trespassers, residents, campers, and other potential receptors that may use the stream environs for recreational use.

Risk Assessment, Active Manufacturing Facility, Chicago, IL. The site is an active apparatus service center with historical PCB contamination in soils adjacent to the operations area. This effort included integration of multiple investigation phases into a single database; data evaluation; exposure assessment for onsite workers, construction workers, and trespassers; and calculation of potential risks to these receptors.

Risk Assessment in Support of a Tier I RBCA Site Assessment, Petroleum Facility, PA. This effort included assessing chemicals of concern, exposure pathway assessment, and related site assessment activities. The ASTM guideline for RBCA assessments was used to perform the Tier I assessment. Results of this evaluation identified data gaps for further evaluation as part of the Tier II assessment.

Human Health Risk Assessments, Petroleum Bulk Storage Facilities, NY. Prepared human health risk assessments for three petroleum bulk storage facilities located in New York City. Results were used to support the property transfer of two of these facilities, and the design of the remedial measures at the remaining facility.

Multi-Phase Site Investigation and Human and Environmental Risk Assessments, U.S. Army, NY. Served as project manager of a multi-phase site investigation and human and environmental risk assessments of a lead shot disposal site (skeet and trap range) located at an Army site in New York State. Field program included collection of shallow and subsurface soils, sediments, biota, plants, and exposure indicators (i.e., guano, egg shells). Lead shot was segregated from soil/sediment samples, enumerated, and weighed, to determine the extent of mass of shot present in the deposition area. An IEUBK model developed by the EPA was used to assess potential human health risks. Results of the investigation and risk assessment were used to develop a limited IRM at the site, which did not significantly disturb the wetland habitat.

Human Health Risk Assessment, NY. Prepared human health risk assessment for a site in upstate New York which lead to the site's removal (delisting) from the New York State Hazardous Waste Site Registry. Principal chemicals of concern were VOCs, including TCE and vinyl chloride. Exposure to site soils, surface water and sediments in a drainage swale, chemicals volatilizing from the subsurface, and site groundwater were used to assess site risks. The subsequent phase of the project included providing technical support for transfer of the site to new owners.

Human and Ecological Risk Assessments, NY. Prepared human health and ecological risk assessments for municipal and industrial landfill RI projects in upstate New York. Exposures to landfill soils, leachate, surface water and sediments, chemicals volatilizing from the subsurface, and site groundwater were used to assess site risks. Principal chemicals of concern included VOCs, metals, PAHs, and PCBs. This effort included derivation of a reference dose (RfD) for a site-specific chemical (toluic acid).

Screening-Level Risk Assessment and Data Evaluation, NJ. Performed the data evaluation and screening-level risk assessment for a road expansion in New Jersey. Under contract with NJDOT, evaluated the results from perimeter soil boring samples collected for the expansion of Routes 1&9. Also prepared a screening-level risk assessment of the chemical results.

Human Health Risk Assessment, Proposed Coal-Burning Power Station, NY. Provided technical support for the preparation of a human health risk assessment for a proposed coal-burning power station in New York. Effort included design of field sampling program, review of air modeling results, and exposure assessment/pathway development.

Human Health Risk Assessment Technical Quality Review. Prepared technical quality review of a human health risk assessment prepared for a waste-to-energy facility. Effort included review of analytical database for appropriateness and completeness, review of air modeling results, review of ecological modeling results, exposure assessment/pathway development, and risk calculations and conclusions.

Toxicological Data Analysis. Interpreted toxicology data for herbicides used for Right-of-Way Management for electrical transmission lines. Results were used to determine potential alternate herbicides and requirements for worker health and safety training.

Ecotoxicological Study. Performed an ecotoxicological study to determine the potential fitness effects of allelochemical exposure to insect larvae. Test organism was the southern armyworm larvae. Larvae were exposed to cyanide or pulegone (extracted from the pennyroyal mint, *Mentha pulegium*) and reproductive success, histopathology, and growth were evaluated. Cyanide was determined to potentiate growth and reproductive fitness, while pulegone (which is a natural insect repellant) significantly reduced growth and reproductive fitness.

Expert Testimony/Litigation Support

Quality Control of Lead Based Paint Residential Survey Database, Litigation Support Project in New England. Provided quality control review of an AMEC-developed database (using MS Excel) that compiled and summarized results from lead paint surveys of residences in a New England state. The focus of the effort was a review of the lookups, summary calculations (spot checks), some limited data validation, and following a result from the source datasheet to the summary calculations.

Expert Testimony and Technical Support, Former Gas Plant Site. Provided expert testimony and technical support to evaluate compliance with CERCLA RI/FS protocols and the National Contingency Plan for a former manufactured gas plant (MGP) site case. This involved a major mid-western utility and Fortune 500 pharmaceutical company. Remnants from the former MGP site were identified

during construction of an expansion for the pharmaceutical company. The results of the testimony were ultimately used as part of the settlement between the two parties.

Expert Testimony on Aquatic Ecological Impacts, Proposed Cogeneration Plant, NY. Provided expert testimony for the aquatic ecological impacts of a proposed 200 megawatt coal-powered cogeneration project in New York. Roles included oversight of the fisheries field collections, data fisheries data evaluation, and preparation of the 316(b) Demonstration.

Litigation Support, Pulp and Paper Client, NC. Provided litigation support for the evaluation of potential impacts of discharge from a pulp and paper mill located in North Carolina. Principal environmental concern was the impact of the colored discharge on the epibethic community. The results were used to determine the suitability of the discharge permit renewal.

Litigation Support, Cost Recovery Action, Municipal Landfill. Provided litigation support for cost recovery action at a municipal landfill containing hazardous industrial wastes. PRP waste allocation was performed as part of this cost recovery suit. This effort included providing consultation services to the prime contractor responsible for the expert testimony.

Aquatic Ecology/Aquatic Toxicology

Evaluated Suitability of Creek System to Support Subsistence Anglers, IN. Performed a semi-quantitative analysis of the ability of creek system downstream of a landfill to support subsistence anglers. This analysis was based on evaluation of fish sizes based on different sampling gear and catch-per-unit-effort. The analysis showed that it was unlikely that the creek system could support subsistence anglers in the area affected by the landfill and was used to reduce the consumption rate used by EPA in their risk assessment.

Technical Support for Development of NPDES Permit Levels, ID. Provided technical support for the evaluation of permit levels for an active pulp and paper mill in Idaho. Facility and discharge is located at the confluence of the Snake and Clear Rivers. Effort focused on the suitability of the pH, chloroform and dioxin permit levels for protection of salmonid species. Also provided support to preparing responses to NMFS comments to the proposed permit levels.

Biological Assessment for Listed Salmonids, ID. Provided technical support for the Biological Assessment of the NPDES permit renewal for Potlatch Corporation's bleach kraft mill in Lewiston, Idaho, at the confluence of the Snake and Clearwater Rivers. Role included preparation of life histories for several of the listed salmonids (e.g., spring/summer run chinook salmon, and fall run chinook salmon) and review of analytical data.

Ecotoxicology-Based Cleanup Goals, Former Wood Treatment Facility, NC. Co-developed a Work Plan to derive Ecotoxicologically Based Cleanup Goals (EBCGs) for a creek in North Carolina. The site was a former wood treatment facility. Site activities resulted in the contamination of creek sediments with PAHs. The EBCGs will be derived from amphipod toxicity tests, and will be used as targets for the planned bioremediation of the creek sediments.

Aquatic Sampling Program at Dioxin Site. Co-developed an aquatic sampling program for a large-scale RI/FS of a dioxin site. The field program included collections of game species, including striped bass, eel, blue crab, as well as indicator species (e.g., mummichogs). Bivalve bioaccumulation studies and amphipod and polychaete sediment toxicity studies will also be performed.

Intake Equipment Evaluation, Proposed Power Station, NY. Evaluated the suitability of alternate intake screen designs for a power station proposed on the Hudson River. This included evaluating engineering and environmental issues related to the use of different types of traveling screens, and

fixed wedged-wire screens. In addition, an assessment of the entrainment and impingement data from existing power generating facilities on the Hudson River was performed.

Sediment Toxicity Testing, Site-Specific Cleanup Goals, NJ. Designed sediment toxicity testing program for development of site-specific cleanup goals for sediments in a lake in New Jersey. Sediments had been historically contaminated with arsenic. Sediment toxicity tests included amphipod and polychaete bioassays.

316(b) Demonstration, Proposed Coal-powered Cogeneration Project, NY. Provided technical oversight for the preparation of a 316(b) Demonstration of potential entrainment and impingement impacts of a proposed 200 megawatt coal-powered cogeneration project in New York. Roles included oversight of the fisheries field collections, fisheries data evaluation, and review of other 316(b) Demonstration Reports of other power generating facilities in New York.

Estuarine Field Program, Hudson River, NY. Designed and implemented an extensive field program in the estuarine reach of the Hudson River for the collection of biota, as well as sediments, surface water, and suspended sediments. Biota collections were performed using trawls, seines, minnow traps, and plankton tows. Field program was designed to evaluate how exposure and life history of the white perch can be related to their PCB congener residues.

Striped Bass Tagging Program, Hudson River. Provided field support at a striped bass tagging facility. Assisted in the collection of brood stock and tagging of young-of-year striped bass raised in a hatchery on the Hudson River. Program was part of the settlement between the oversight agencies and the utilities for the construction and operation of power generating plants on the river.

Fisheries Sampling Program, NY. Implemented a fisheries sampling program for a suburban lake in Upstate New York. The field program included seasonal collections of yellow perch and other game species to characterize their life history. Also developed a method to quantify stressors by enumerating macrophage (ceroid) pigment centers in liver and spleens of the fish.

Toxicology

Statistical Evaluation of Resorcinol Toxicity. Performed a statistical analysis of resorcinol toxicity focusing on assessing whether there were any dose-related effects related to thyroid gland hyperplasia and locomotor effects. Standard statistical tools (Fisher's Exact Test, ANOVA, Dunnett's Test) were originally used by the laboratory to determine the potential presence of a dose-response relationship. Focus was assessing the results using non-conventional non-parametric tests including Mann-Whitney U Test and trend tests to verify the conclusion of no effects over the evaluated dose range.

Assessment of National Toxicology Program Bioassays for PCBs and Dioxins. Evaluated the National Toxicology Program Draft (2003) Bioassay Reports that evaluated the toxicity and carcinogenicity of 2378-TCDD, 23478-PeCDF, and 3,3',4,4',5-Pentachlorobiphenyl (PCB 126). The focus of this evaluation was the assessment of the completeness of the studies that assessed the chemicals individually and in combination to evaluate the suitability of the TEF approach for dioxin-like chemical risk assessments.

Alternate Avian Toxicity Reference Value for Dioxins. Assessed the basis for the historical avian Toxicity Reference Value (TRV) from EPA (1993) and evaluated alternate approaches for the application of uncertainty factors based on the same toxicity studies as used by EPA. Based on this assessment, the application of a 10X safety factor by EPA (1993) was not warranted.

PCB Blood Level Occupational Study. Provided technical support for the evaluation of PCB blood levels in former capacitor plant workers and rhesus monkeys. This was performed as part of a project to re-evaluate the reference does for PCBs used for risk assessments.

Oral Reference Dose Development in Support of a Human Health Risk Assessment, Industrial Landfill, NY. Derived an oral reference dose for a site-specific chemical (toluic acid) as part of a human health risk assessment performed for an industrial landfill RI project in upstate New York.

2-Aminoacetofluorene (2-AAF) Exposure Studies. Evaluated nuclear aberrations in mouse large intestines following exposure to 2-Aminoacetofuorene (2-AAF). Following exposure, the mouse intestines were prepared as "roll-ups" so that the entire tissue could be evaluated histopathologically for nuclear aberrations.

Database Development, Management, and Programming
Development of Database of the Fate and Transport Parameters for Pharmaceuticals. Assisted in the literature review, quality assurance, and development of a searchable database that compiles the fate and transport parameters relevant to the fate and transport of pharmaceuticals. Focus of this effort was in the compilation of data pertaining to (1) the bioconcentration potential, (2) physico-chemical properties, (3) environmental depletion mechanisms, and (4) removal processes in treatment facilities of pharmaceuticals found in the environment.

Modification of Johnson & Ettinger Vapor Intrusion Models. Developed modifications of the "advanced" soil vapor, groundwater, and soil Johnson & Ettinger vapor intrusion models to allow batch processing of multiple contaminants. These modifications expedite the evaluation of potential risks, and allow side-by-side comparison of the risks on a chemical-specific basis, as well as the calculation of cumulative risks, if required.

Development of Excel Add-ins. Updated and revised in-house developed MS-Excel Add-ins for the calculation of the H-statistic and normality testing. The H-statistic is used to derive exposure point concentrations per USEPA guidance. The normality test add-in, based on the Omnibus test from D'Agostino, is used to assess whether the analytical results are normally distributed with or without transformation. Both programs were developed using Visual Basic for Applications.

Spatial Bootstrap Model. Developed program (using Visual Basic for Applications as part of MS-Excel) to generate exposure point concentrations based on a spatially-weighted bootstrap approach. This methodology is a further refinement of the bootstrap approach, reflecting the spatial representation of the samples in the EPCs.

Database Refinements, Various Locations. Refined MS-Access databases originally developed and designed by other parties (typically lead RI/FS contractors), for use in human and ecological risk assessments. This is often required since the data assessment approach for risk assessments can differ from those of site assessment.

Pulp and Paper Mill Survey Database. Developed a database system in MS-Access97 that stored results of a survey of a wide variety of pulp and paper mills. The objective of the survey was to identify possible sources of mercury contamination in the mills. Database was also designed to interface with other software for data presentation and evaluation.

Database Design. Developed database system in MS-Access97 that integrates storage of field and analytical results with a module to summarize statistical results. Visual Basic code was used to calculate summary statistics and exposure point concentrations, used for both data evaluation and risk assessment. Database was also designed to interface with kriging software for data presentation and evaluation.

Visual Basic Programming in Support of Large-Scale Human Health Risk Assessment, CA. Developed Visual Basic code for manipulation of data and statistical analyses in support of a large scale human health risk assessment in California. This involved interfacing with the Microexposure model that evaluates human health risks associated with the ingestion of contaminated fish. Coding in Visual Basic within MS Access framework permitted the storage of interim summary calculations that can then be accessed by queries for subsequent data evaluations.

Multiple Function Database in Support of Field Investigation, IN. Developed a sample tracking system, field collection data, and chemical analytical databases in Paradox in support of the field investigation for an ecological and human health risk assessment performed in Indiana.

Database Development, Various Clients. Developed standard field forms for database entry to facilitate entering, compiling, and evaluating field data for projects ranging from site investigations through complex RI/FS. Familiar with Paradox and MS Access database programs.

PCB Database, NY. Assisted in the review and downloading of pertinent information from a database prepared for the Hudson River (New York) PCB contamination. Results were used to calculate summary statistics and exposure point concentrations.

Bibliography of Human and Ecological Effects, NY. Developed keyword index for a bibliography of potential human and ecological effects of non-ionizing radiation associated with high voltage transmission lines. Bibliography was used by technical staff from the New York Power Authority during public hearings associated with the permitting of the Marcy South Transmission Line in New York State.

Quality Assurance

Data Validation Training and Manual Development, NY. Developed the manual and provided instruction for a data validation course for water quality staff from NYCDEP. Focus was on revising EPA Region II data validation guidance for use with data generated from EPA Methods 508, 524, and 525.

Data Validation Review, Former Wood Treatment Site, GA. Prepared data validation reviews of analytical results from confirmatory collections of sediments, soils, and waters from a former wood treatment site in Georgia. Prior analytical results had shown elevated concentrations of arsenic, which, during initial data review, were found to be possibly erroneous. Results from the data review of the confirmatory sample collections may be used to assist in cost recovery from the prior laboratory.

Preliminary Data Validation Review, NH. Prepared initial data validation reviews of analytical results from sediments, soils, and waters collected from a PAH site in New Hampshire. The initial reviews included a determination of PARCC compliance, as well as the identification of any results that may be qualified based upon EPA Region I data validation requirements.

QA Review, MA. Provided QA review of data validation reports prepared by an outside contractor for a site in Massachusetts. Data validation reports were reviewed on behalf of outside counsel for compliance with EPA Region I requirements and completeness.

Data Validation Training and Manual Development, ID. Developed the manual and provided instruction for a data validation course for environmental chemists and remediation staff at the Idaho National Environmental and Engineering Laboratory environmental restoration project in Idaho Falls. Focus was on revising EPA Superfund data validation guidance for use with data generated from EPA SW-846 Methods 8260, 8270, and 8082.

Technical Support and QA/QC for Ecological and Human Health Risk Assessment, IN. Technical Support QA/QC officer for an ecological and human health risk assessment investigation being performed in Indiana. This investigation required evaluation and modification of existing EPA analytical protocols and included the collection of fish, crayfish, and rodents.

QA/QC Aquatic Ecological Risk Assessment, Passaic River, NJ. QA/QC officer for an aquatic ecological risk assessment on the Passaic River. This program included oversight of the sample collections, sample tracking, laboratory analyses, and data validation. Also provided technical support to the data validator for resolving issues related to data quality evaluation and developed data validation protocols for non-CLP analytical methods (e.g., herbicides, TPH, organotins).

EPA Data Validation Workgroup. Managed data validation services for 2 years as part of the REM III and ARCS II Superfund projects with EPA Region II. Participated in a work group to develop EPA Region II data validation protocols to comply with National Functional Guidelines. Assisted EPA Region II personnel in the development of Special Analytical Services (SAS) Contract Laboratory Program (CLP) requests. Served as an unbiased QA auditor for mobile analytical laboratory at a remediation project in New Jersey.

QA Audit of Laboratory, NJ. Performed a QA audit of a mobile analytical laboratory at a remediation project in New Jersey. The onsite laboratory was used for the analysis of PCBs and lead to determine appropriate disposal of the excavated soils.

Data Quality Management Programs, Various Clients. Developed program that integrated sample management activities, field and laboratory sample coordination, data validation, evaluation of project and laboratory quality control, electronic database development, and data evaluation. Program has been successfully implemented for USACE, Navy, and private client projects.

Data Validation Activities, Various Clients. Versed in CLP and non-CLP organic, inorganic, and radionuclide data validation. Data validation activities have included in-house projects, contracting with other consulting firms, and supporting a mixed waste site RI/FS in Idaho and South Dakota. Developed data validation protocols for non-CLP procedures (e.g., SW-846 methods). Prepared Data Validation Standard Operating Procedures for DOE contractor for their mixed-waste site RI/FS in Idaho, and private client investigations. Have performed validation of organic and inorganic chemical data for EPA (Regions I through IV and X), NYSDEC, MADEP, and NJDEP.

Data Validation Activities, Various USACE Projects. Have performed validation of data under contract at a prior position with Baltimore COE and Omaha COE. Samples consisted of soils, sediments, surface water, and groundwater for a wide variety of target analytes. Developed data validation protocols for non-CLP procedures (e.g., SW-846 methods). Also developed recommendations for extrapolating results from the data quality assessment of a subset of data to the remaining unvalidated samples in the dataset.

Laboratory Audits, NJ. Performed laboratory audits in support of a multimillion dollar RI/FS in New Jersey. Audits included administrative and technical review of laboratory's capabilities to perform non-standard analytical procedures, including radiochemistry. Have also performed QA audits of fisheries sampling procedures, soil vapor surveys, and field gas chromatography operations.

Senior Technical Review, Various Projects. Senior technical reviewer for federal DOD contracts (USACE and Navy) and private client projects. These projects have ranged in size from Phase I site assessments and UST projects, up to large-scale RI/FS projects. Also provided senior technical support for client and agency meetings for these projects.

Regulatory Review

Sludge Land-Treatment Regulations. Compiled and reviewed the land treatment regulations of 19 states to identify issues relevant to the land spreading of industrial sludge.

Risk Assessment Algorithm Review. Provided technical support to review risk assessment algorithms for Part 503 indirect risk assessment. This project included a detailed assessment of the risk assessment algorithms used to predict risk from land disposal of pulp and paper mill sludge and evaluation of the fate and transport assumptions used to build the model.

EPA Model Review, American Petroleum Institute. Provided technical support to review EPA model for transport of refinery residuals. This project included a detailed assessment of the suitability of the soil transport model used for an indirect risk assessment of refinery residuals. Providing comments to EPA in support of the American Petroleum Institute.

Remedial Action

Interim Remedial Action at PCB Site, MA. Provided oversight for maintenance for this Interim Remedial Action at a PCB site in Massachusetts. The macadam cap, which served as an IRM at this active facility, was inspected and maintenance activities performed to ensure that the cap integrity would be maintained. This project included coordination of subcontractors for asphalt removal and replacement.

Construction Management, NY. Provided construction management for a landfill closure in New York. The site, which received industrial waste in drums, was remediated following 6 NYCRR Part 360 landfill closure requirements. This phase of the project included coordination and oversight of contractors, project cost and schedule tracking, and assistance to the municipality for cost recovery submissions to the State.

Phil Perhamus, PWS

Senior Biologist

Professional summary

Mr. Perhamus is a biologist with seventeen years of experience in natural resources and the environmental sciences. He specializes in wetland studies, natural resources, impact assessments, and ecological risk assessment. His specific capabilities include wetlands delineation, wetlands permitting, habitat restoration, environmental impacts assessment, aquatic and terrestrial wildlife surveys, threatened and endangered (T&E) species surveys, environmental investigations, and stream assessments.

Mr. Perhamus has experience with various State and Federal agencies such as the New Jersey Department of Environmental Protection (NJDEP), the Pennsylvania Department of Environmental Protection (PADEP), the Pennsylvania Fish and Boat Commission (PAFBC), the Pennsylvania Department of Conservation and Natural Resources (PADCNR); the New York State Department of Environmental Conservation (NYSDEC), the Connecticut Department of Environmental Protection (CTDEP), the Maine Department of Inland Fisheries and Wildlife, the United States Army Corps of Engineers (USACOE), the United States Coast Guard (USCG), the United States Fish and Wildlife Service (USFWS); the United States Environmental Protection Agency (USEPA), and the United States Department of Agriculture (USDA). He also has extensive experience working with various local municipalities and county agencies. His clients have included private industry, federal and state agencies, engineering and geotechnical firms, land developers, municipalities, conservation and preservation groups, and individual landowners.

Professional Qualifications

Professional Wetland Scientist (PWS), 2006, Society of Wetland Scientists (SWS), Certification No. 1640.

Commonwealth of Virginia, Licensed Professional Wetland Delineator, Department of Professional and Occupational Regulation, License No. 3402 000063.

Certificate of Training. U.S. Army Corps of Engineers Wetland Delineator Training. 1998.

Education

Graduate Studies, Environmental Science. Rutgers University, New Brunswick, NJ. 1990-1994.

B.S., Ecology. Unity College, Unity, ME. 1990.

Continuing Education and Professional Training

Wetlands Monitoring. Rutgers University, Cook College of Continuing Professional Education. New Brunswick, NJ. 2005

Ecological Risk Assessment. Rutgers University, Cook College Office of Continuing Professional Education. New Brunswick, NJ. 2005.

Stream Restoration. Rutgers University, Cook College Office of Continuing Professional Education. New Brunswick, NJ. 2004.

NJDEP Landscape Project Training. New Jersey Department of Environmental Protection, Endangered and Nongame Species Program, Trenton, NJ. 2004 and 2005.

Freshwater Wetlands Construction Techniques. Rutgers University, Cook College Office of Continuing Professional Education. New Brunswick, NJ. 2004

Hydrology of Wetlands. Rutgers University, Cook College Office of Continuing Professional Education. New Brunswick, NJ. 2004.

Stream Encroachment Permit Program. Rutgers University, Cook College Office of Continuing Professional Education. New Brunswick, NJ. 2003.

New Jersey Coastal Program Review. Rutgers University, Cook College Office of Continuing Education. Toms River, NJ. 2002.

Comprehensive Restoration of Aquatic Environments. National SETAC Workshop; Newark, NJ. 2001.

Limnology: Lake Evaluation and Management. HDC-SETAC Short Course; West Chester, PA. 2001.

Threatened and Endangered Species of Northern New Jersey. Rutgers University, Cook College Office of Continuing Professional Education. North Brunswick, NJ. 2001.

Threatened and Endangered Species of Southern New Jersey. Rutgers University, Cook College Office of Continuing Professional Education. North Brunswick, NJ. 2000.

Wetland Plants of New Jersey. HDC-SETAC Short Course; Stockton, NJ. 2000.

GPS Mapping of Watersheds. HDC-SETAC Short Course; Stockton, NJ. 2000.

NJ Freshwater Wetlands; Permits and Regulations. Rutgers University, Cook College Office of Continuing Professional Education. North Brunswick, NJ. 1999 and 2005.

Integrated Design of Constructed Wetlands. National SETAC Short Course; Charlotte, NC. 1998.

ASTM Phase I Environmental Site Assessment. McLaren/Hart, Inc.; Warren, NJ. 1998.

Basic Wetland Delineator Training. Institute for Wetland and Environmental Education and Research (IWEER). Mt. Laurel, NJ. 1998.

Bioassessment. SETAC Short Course; Avondale. PA. 1998.

Ecological Risk Assessment. U.S. EPA Environmental Response Team (ERT); Edison, NJ. 1997.

Ecological Impact, Risk Assessment, and Cleanup Decisions at Superfund Sites. National SETAC Short Course; Houston, TX. 1993.

Ecological Risk Assessment. National SETAC Short Course; Cincinnati, OH. 1992.

Dangerous Goods Shipping Seminar in Compliance with DOT and ICAO Regulations. Roy F. Weston, Inc.1996.

OSHA 10-Hour Construction Safety Training.

OSHA Site Health and Safety Coordinator Training. 29 CFR 1910.120(e)(4).

OSHA 40-Hour Health and Safety Training. 29 CFR 1910.120(e)(3).

Memberships
Society of Wetlands Scientists (SWS)
New York State Wetlands Forum (NYSWF)
Delaware River Invasive Plants Partnership (DRIPP)
Society of Environmental Toxicology and Chemistry, Hudson-Delaware Chapter (HDC-SETAC)
Pennsylvania Biodiversity Partnership (PABIODIV)

Summary of core skills

Natural Resources
Mr. Perhamus has conducted numerous and varied natural resource studies including surveys for periphyton, phytoplankton and zooplankton, aquatic and terrestrial vegetation, benthic macroinvertebrates, fish, herptiles, small and large mammals, and birds. He has also conducted numerous field surveys for federally-listed and state-listed plant and animal species, and their respective habitats. These species have included swamp pink (*Helonias bullata*), Knieskern's beaked rush (*Rhynchospora knieskernii*), sickle-leaved golden aster (*Chrysopsis falcata*), tall pawpaw (*Asimina triloba*), bog turtle (*Clemmys muhlenbergii*), wood turtle (*Clemmys insculpta*), Pine Barrens tree frog (*Hyla andersonii*), and northern pine snake (*Pituophis melanoleucus melanoleucus*).

Ecological Risk Assessment
Mr. Perhamus has conducted small and large scale empirical-based ecological risk assessments at CERCLA, RCRA, and State-lead sites nationwide. He worked closely with the U.S. Environmental Protection Agency/Environmental Response Team (U.S. EPA/ERT) for 8 years (1990 to 1998) under the Response Engineering and Analytical Contract (REAC) during the formulation of the 1997 Ecological Risk Assessment Guidance for Superfund (ERAGS) document. He was a contributing author to the U.S. EPA Representative Biological Sampling Document (Appendix B in ERAGS). He has conducted ecological risk assessments that have incorporated a multitude of techniques including extent and magnitude of contamination studies, biological assessments and surveys, wildlife community and population analyses, biological tissue collection, toxicity identification and evaluation (toxicity testing), laboratory phytotoxicity evaluation, X-ray fluorescence (XRF) screening of site matrices, and radiological surveys.

Environmental Impacts Assessment
Mr. Perhamus has conducted and prepared numerous Environmental Assessments (EA) and Environmental Impact Statements (EIS) for the Federal Communications Commission (FCC), PA

Department of Environmental Protection, the U.S. Army Corps, various municipalities, and private landowners in New Jersey and Pennsylvania. He has also provided expert testimony in defence of these assessments to municipal boards. These boards have included the South Brunswick, NJ Planning Board, the Bordentown Township Planning Board, and the Upper Mount Bethel Township, PA Zoning Board.

Wetlands Delineation, Permitting, Restoration and Monitoring

Mr. Perhamus has conducted numerous wetland delineations and assessments in a multitude of habitat types nationwide. He has developed regulatory permits under the programs of the NJDEP, PADEP, NYSDEC, CTDEP, the U.S. Army Corps, and the U.S. Coast Guard. He has developed both conceptual and construction-ready wetland restoration plans and has been intimately involved in the field implementation of these restorations and subsequent monitoring. He has experience presenting restoration projects to Federal and State level funding sources such as the U.S. Fish and Wildlife Service Partners in Wildlife Program, the NJ Wetlands Mitigation Council, the PA Growing Greener Grant program, and the PA Department of Conservation and Natural Resources.

Employment history

Senior Biologist, AMEC Earth & Environmental, Inc., Somerset, NJ, 2003-present
Senior Biologist, Princeton Hydro, LLC, Ringoes, NJ, 2000-2003
Senior Associate Environmental Scientist, McLaren/Hart, Inc., 1998-2000
Project Scientist, Roy F. Weston, Inc./REAC, Edison, NJ, 1990-1998
Wildlife Intern, The Nature Conservancy, Long Island Chapter, Shelter Island, NY, 1990
Vegetation Intern, The Massachusetts Audubon Society, Lincoln, MA, 1989
Research Intern, The Institute of Ecosystem Studies, Millbrook, NY, 1988.
Wildlife Intern, Maine Department of Inland Fisheries and Wildlife, Augusta, ME. 1987.

Presentations / publications

Contributing Author, Appendix D *in* ITRC. 2005. Characterization, Design, Construction, and Monitoring of Mitigation Wetlands. The Interstate Technology & Regulatory Council, Mitigation Wetlands Team.

Perhamus, P.K., M. Watson, and W. Simmons. 2003. Landscape-scale Examination of an Eroding River in a Developed Watershed. SETAC 24th Annual Meeting; Austin, TX.

Gneiding, L.R., C.R. Calhoun, **P.K. Perhamus**, and C.R. Harman. 2003. Low Benthic Macroinvertebrate Numbers: Contaminant or Habitat? SETAC 24th Annual Meeting; Austin, TX.

Gneiding, L.R., C.R. Calhoun, **P.K. Perhamus**, and C.R. Harman. 2003. An Instream Aquatic Study of a Stream Receiving Treated Groundwater from a Landfill. SETAC 24th Annual Meeting; Austin, TX.

Perhamus, P. 2002. Assessment of the Manasquan River. Final Report for the Monmouth County Health Department, on behalf of the New Jersey Watershed Management Area 12 TMDL Committee.

Harman, C.R. and **P. Perhamus**. 1999. Evaluation of Potential Impacts to Wetland Systems from Groundwater Extraction Systems. SETAC 20th Annual Meeting; Philadelphia, PA.

Baron, L., **P. Perhamus-Kim**, C. Harman, N. Bonnevie. 1998. Applications for Approaches for Evaluating the Bioavailability of Metals in Terrestrial and Aquatic Environments. SETAC 19th Annual Meeting; Charlotte, NC.

Kim, P.Y., P. Bovitz, B. VanDerveer, M. Donohue, K. Munney, and M. Sprenger. 1994. The Use of Chemical, Histopathological, and Toxicity Evaluations to Investigate a Wildlife Kill. SETAC 15th Annual Meeting; Denver, CO.

Henry, R.G., **P. Kim**, B. VanDerveer, and M. Sprenger. 1993. The Use of Water and Sediment Toxicity Evaluations and Biological Surveys to Establish Ecological Risk and Justify Remedial Activities at a Superfund Site. SETAC 14th Annual Meeting; Houston, TX.

Kracko, K., **P. Kim**, and M. Sprenger. 1992. An Ecological Assessment of Aquatic and Terrestrial Habitat Impacted by a Tannery. SETAC 13th Annual Meeting; Cincinnati, OH.

VanDerveer, W.D., M.D. Sprenger, D.A. Adams, and **P. Kim**. 1991. Evaluation of Field and Laboratory Methodologies for Use in Coastal Plain Riverine Site Monitoring Plans. SETAC 12th Annual Meeting; Seattle, WA.

Details by project :

NATURAL RESOURCES / T&E SPECIES

Tinicum Township and The Tinicum Conservancy – The Giving Pond Phase 1 Baseline Natural Resource Inventory (NRI), Tinicum Twp., Bucks Co., PA: Project Manager for a baseline Natural Resource Inventory (NRI) of a former sand and gravel quarry acquired by the PA Department of Conservation and Natural Resources (DCNR) Delaware Canal Park System for transformation into a State Park and Environmental Education Center. This project was co-managed with Forbes Environmental and Land Use Planning, and pulled together a large multi-disciplinary project team including various private and public sector volunteers at the local, state, and federal level. The study examined the physical and biological resources existing at the site, assessed the potential impacts for the proposed site transformation, and developed a conceptual habitat management plan.

Monmouth County Board of Health – Manasquan River Assessment Project, Freehold and Howell Twps., Monmouth Co., NJ: Project Manager for a Rosgen-based assessment of the upper Manasquan River and its associated watershed. Using the Rosgen stream classification methodology, the upper Manasquan River was examined for its severe erosion problems and subsequent elevated nutrient and fecal coliform levels and associated biological impairment. Problems stream segments were identified along the reach of the upper Manasquan, evaluated for their departure from stable conditions, and assessed for their stabilization and restoration potential. Current NJ Best Management Practices (BMPs) were evaluated for incorporation into concepts of Low-Impact Design (LID) and Sustainable Drainage Systems on local and regional scales in the watershed. The results of this study were presented in a public forum at a New Jersey Department of Environmental Protection (NJDEP) Stormwater Conference and posted on the Internet.

Chesterfield Township – Crosswicks Creek NRI, Chesterfield Twp., Burlington Co., NJ: Project Manager. Conducted a Natural Resource Inventory (NRI) for the Crosswicks Creek watershed within the boundaries of Chesterfield Township, NJ. This project involved the inventory of the physical and natural resources existing within the study area, and also the evaluation and feasibility for public access to the Crosswicks Creek. 2006.

Tinicum Conservancy – Roaring Rocks/Swamp Creek Biodiversity Study, Tinicum Twp., Bucks Co., NJ: Project Manager. Conducted a biological inventory of the aquatic components of the Roaring Rocks and Swamp Creek subwatersheds as part of a larger biodiversity study funded by the Commonwealth of Pennsylvania. This project involved fishery and benthic macroinvertebrate surveys.

CSX Transportation – Shorter Alabama Derailment Site, Shorter, Macon Co., AL: Conducted a benthic macroinvertebrate and herptile survey at a train derailment site involving an acetone and methylene chloride spill and subsequent fire, for the purposes of assessing the impacts of the derailment upon the local aquatic system.

CSX Transportation – Former Crosstie Chipping Facility Site, Brewton, Escambia Co., AL: Conducted a benthic macroinvertebrate and herptile survey at a crosstie chipping facility formerly contaminated with PAHs and other organics for the purposes of assessing the impacts of the site operations upon the local aquatic system. 2006.

Civalier Engineering & Surveying, Inc. – Gaughan Swamp Pink Project Site, Sewell Twp., Gloucester Co., NJ: Conducted a field survey of an 8-acre property for the federally-listed plant species swamp pink (*Helonias bullata*). 2006.

HMG Engineering, Ltd – Deleyer Property Site, Lower Mt. Bethel Twp., Northampton Co., PA: Project Manager; conducted a Phase 1 bog turtle survey for a proposed agricultural development site.

Tinicum Township – Tinicum Creek Sheephole Road Restoration, Tinicum Twp., Bucks Co., PA: Under a PA Growing Greener Grant, conducted a Rosgen-based stream assessment for a degraded section of the Tinicum Creek.

Howmet Industries Site, Rockaway Twp., Morris Co., NJ: Conducted a fishery and benthic macroinvertebrate survey of a trout-production stream located adjacent to a metallurgical facility.

Kin-Buc Landfill, Edison Twp., Middlesex Co., NJ: Project Team Member for a small mammal survey (muskrat) investigation of the tidal estuarine marshes throughout the Kin-Buc Landfill area. Collected specimens were used to characterize the population and for tissue residue analysis of PCBs.

Heleva Landfill Superfund Site, Lehigh Co., PA: Conducted stream electroshocking and a benthic macroinvertebrate survey of Coplay Creek as part of a long-term monitoring program of the stream's aquatic resources.

Sadat Associates – Chambers Bridge Road Site, Brick Twp., Ocean Co., NJ: Conducted a wetlands delineation for the development of a proposed athletic facility. This project involved a habitat evaluation for the protected Pine Barren treefrog, (*Hyla andersonii*).

GeoTrans, Inc. – Sparta Telecom Tower Site, Sparta, Sussex Co., NJ: Performed a Phase 1 survey for bog turtle (*Clemmys muhlenbergii*) habitat within and around the proposed development footprint of a telecommunications tower.

Gael Telecommunications – Woodmansie Site, Barnegat Twp., Ocean Co., NJ: Conducted a field survey for the protected plant species, Knieskern's beaked-rush (*Rhynchospora knieskernii*) at a proposed telecommunications tower site.

Sprint Telecommunications – Germania Site, Galloway Twp., Atlantic Co., NJ: Conducted a field survey for the protected plant species, Knieskern's beaked-rush (*Rhynchospora knieskernii*) at a proposed telecommunications tower site.

Fort Dix – LFSH, AAR, and LFBF Complex Site, Fort Dix, Plumsted Twp., Ocean Co., NJ: Conducted a field survey for the State-threatened sickle-leaved golden aster (*Chrysopsis falcata*) at a proposed construction site within a military installation located within the NJ Pinelands Protection Area.

Fort Dix – MOUT Complex Site, Fort Dix, Plumsted Twp., Ocean Co., NJ: Conducted a field survey for the NJ State-threatened northern pine snake (*Pituophis melanoleucus melanoleucus*) and the sickle-leaved golden aster (*Chrysopsis falcata*) at a proposed construction site within a military installation located within the NJ Pinelands Protection Area.

Cornell-Dubilier Site, Bound Brook, NJ: Project Team Member for a large-scale fishery survey of the Bound Brook to determine human health and ecological risk potential from PCB-contaminated sediments. The results of this study, in conjunction with other ongoing studies, resulted in a temporary moratorium for fish consumption in the Bound Brook.

National Lead Industries Superfund Site, Pedricktown, Salem Co., NJ: Project Team Member for a small mammal community survey, gross necropsy, and tissue residue analysis for metals accumulation. Implemented an *in situ* earthworm bioaccumulation test using submerged growth chambers.

Small Mammal Method Development Project, Franklin Twp., Somerset Co., NJ: Implemented various small mammal collection techniques to augment a population and community database for the U.S. EPA Environmental Response Team (ERT). These techniques included the use of snap traps, Havahart traps, Sherman traps, Longworth traps, Victor mole traps, and pitfall traps.

Tex Tin Superfund Site, Texas City, Galveston Co., TX: Conducted a benthic macroinvertebrate survey of the estuarine habitats surrounding the facility.

Marzone Pesticides Site, Tifton, Tift Co., GA: Conducted a comprehensive wildlife survey of the aquatic and terrestrial habitats surrounding the site, including benthic macroinvertebrate, fish, amphibian, vegetation, terrestrial insect, and small mammal.

Lemon Lane Landfill Site, Bloomington, Monroe Co., IN: Conducted stream electroshocking in the waterways surrounding the site for a fishery survey and tissue residue analysis.

Fox River Group – Lower Fox River Risk Assessment, WI: Conducted a boat-mounted electroshocking survey for the collection of fish tissue samples for use in both ecological and human health risk assessments.

ECOLOGICAL RISK ASSESSMENT / BIOLOGICAL ASSESSMENT

Golder Associates, Inc. – PJP Landfill Superfund Site, Jersey City, Hudson Co., NJ: Field Team Leader for a multi-phased project addressing the outstanding wetland and ecological issues following adoption of the Record of Decision (ROD). The first phase involved the development of a NJ Department of Environmental Protection (NJDEP) Waterfront Development Permit to address encroachments into regulated areas associated with a drum removal. The second phase involved a wetlands delineation and application to the NJDEP for a Line-Verification Letter of Interpretation (LOI) to quantify on-site wetland resources. The third phase involved an assessment to determine the potential for impacts to the existing wetland resources from the site.

Cannelton Industries Site, Sault Ste. Marie, Upper Peninsula, MI: Project Manager and Field Team Leader for a large-scale phased ecological risk assessment of a mercury- and chromium-contaminated river system and its surrounding terrestrial environment. This risk assessment examined multiple exposure aquatic and terrestrial pathways using empirical data derived from extensive wildlife surveys, X-ray fluorescence screening of sediment, an extent and magnitude of contamination investigation, benthic macroinvertebrate surveys, and vegetation community analysis. The results of this study were presented at the 1992 13th Annual SETAC Meeting in Cincinnati, OH.

Leeds Silver Site, Leeds, UT: Project Manager and Field Team Leader for a biological assessment of a metal-contaminated forested wetland surrounded by a desert environment. This assessment examined various aspects of the wetland system, including the vegetation, small mammal, and zooplankton communities. Highly acidic surface water (pH<2) and sediment were collected for toxicity identification and evaluation. Tree core analyses were conducted to evaluate the historical insults to the wetland system. A field radiological survey of the surface water was also conducted. The results of this project were presented in the 1993 14th Annual SETAC Meeting in Houston, TX.

Richardson Hill Wildlife Kill, Sidney, NY: Project Manager and Field Team Leader for an emergency response investigation of a wildlife kill associated with open water bodies located downgradient of municipal landfills. The wildlife kill comprised large numbers of fish, amphibians, and several terrestrial mammals. Using chemical, toxicity, and histopathological analyses, the cause of the wildlife kill was determined to be unrelated to the upgradient landfill, but was linked to cyclical fluctuations in environmental conditions. The results of this project were presented at the 1994 15th Annual SETAC Meeting in Denver, CO.

Triassic Technology – Mustang Gas & Oil Site, Millstone Twp., Monmouth Co., NJ: Project Manger and Field Team Leader for a Baseline Ecological Evaluation (BEE) of a large wetland complex (forested deciduous, scrub/shrub, emergent, and open water) providing habitat for a protected bird species, the barred owl (*Strix varia*). The results of this assessment indicated that the suspect facility was not a source of contamination for this wetland complex.

TriState Environmental Management Services – Clayton Farm Property Site, Freehold and Manalapan Twps., Monmouth Co., NJ: Project Manager and Field Team Leader for a Baseline Ecological Evaluation (BEE) of a DDT-contaminated farm property, proposed for residential development. This assessment included a benthic macroinvertebrate survey, a fishery survey, and fish tissue residue analyses for site-specific body burden levels to be used in a food chain model.

TriState Environmental Management Services – Jersey Avenue Redevelopment Site, City of New Brunswick, Middlesex Co., NJ: Project Manager and Field Team Leader for a Baseline Ecological Evaluation (BEE) of an urban stream associated with a redevelopment site.

EMS, Inc. – Allen's Propane Site, Hammonton Twp., Atlantic Co., NJ: Project Manager; supervised a NJDEP Baseline Ecological Evaluation (BEE) project that examined the potential for impacts from a propane storage facility.

ExxonMobil Corporation – Distribution Terminal #3018, Flemington, Hunterdon Co., NJ: Conducted a Baseline Ecological Evaluation (BEE) of a former petroleum distribution facility exhibiting organic contamination in ground water.

ExxonMobil Corporation – Bayway Refinery, City of Linden, Union Co., NJ: Conducted a Supplemental Baseline Ecological Evaluation (BEE) of a petroleum refinery with large-scale historical contamination of soil, sediment, and water. This evaluation involved AVS/SEM sampling and a benthic macroinvertebrate survey.

Vertex Engineering – Aberdeen Twp. Site, Aberdeen Twp., Monmouth Co., NJ: Project Manager and Field Team Leader for a Baseline Ecological Evaluation (BEE) for a proposed residential development.

Former Arsynco Facility Site, Carlstadt Borough, Bergen Co., NJ: Conducted a NJ Baseline Ecological Evaluation (BEE) for a State-lead Superfund site situated upgradient of an extant contaminated tidal marsh system.

Madisonville Creosote Site, Madisonville, St. Tammany Parish, LA: Project Manager and Field Team Leader for a biological assessment of a creosote-contaminated forested riverine wetland system associated with the Black River. This assessment involved an extent and magnitude of contamination investigation for sediment and surface water, a benthic macroinvertebrate survey, and a wildlife habitat survey in support of an ecological risk assessment.

Crab Orchard National Wildlife Refuge Site, Marion, IL: Project Manager for a desk-top ecological risk assessment of a PCB-contaminated terrestrial system. This particular risk assessment utilized dietary assimilation rates and dermal absorption rates to arrive at a variety of exposure scenarios for mammalian receptors.

Circle Smelter Site, IL: Project Manager for a biological assessment of an expansive metal-contaminated forested wetland and floodplain following a 100-year flood. This project involved extensive sediment and surface water sampling, small mammal surveys, vegetation community characterization, and crayfish collection and analyses for use in food chain modelling.

Malvern TCE Site, Malvern, Chester Co., PA: Project Manager and Field Team Leader for a biological assessment of a TCE-contaminated stream system. Surface water and sediment samples were collected throughout the watershed to determine the extent and magnitude of contamination, and the expansive forested wetland areas within the watershed were mapped.

Valero Refinery, Greenwich Twp., Gloucester Co., NJ: Project Team Member for a Baseline Ecological Evaluation (BEE) of an oil refinery. A potential natural resource damage assessment claim was dismissed as a result of on-site meetings with the NJ Department of Environmental Protection.

Confidential Client – Whippany Facility, Hanover Twp., Morris Co., NJ: Conducted a Baseline Ecological Evaluation (BEE) of a PCB-contaminated wetland complex associated with a telecommunications research and development facility.

Coastal Oil Eagle Point Refinery, Westville Borough, Gloucester Co., NJ: Project Team Member for a Baseline Ecological Evaluation (BEE) of coastal riverine resources adjacent to an oil refinery.

Palmerton Zinc Site, Palmerton, Carbon Co., PA: Project Team Member for a large-scale ecological risk assessment of a metal-contaminated terrestrial and aquatic complex involving a comprehensive assessment of the Aquashicola Creek, its tributaries, and associated riparian corridors. This assessment included surveys for fishery resources, periphyton, small mammals, stream hydraulics, and vegetation communities.

Gulton Industries – Mark IV Site, Metuchen Borough, Middlesex Co., NJ: Project Team Member for a Baseline Ecological Evaluation (BEE) of a metals-contaminated forested wetland system. This project involved the collection of soil invertebrates for site-specific body burden levels to be used in food-chain modelling.

LCP Chemicals Site, Brunswick, GA: Project Team Member for a large-scale, multi-phased ecological risk assessment of an expansive PCB- and mercury-contaminated tidal salt marsh. This investigation involved the collection and analysis of various organisms including snails, fiddler crabs, killifish, predatory fish (spot), terrapins, and clapper rails for modelling contaminant uptake.

ChemGraphics, City of Secaucus, Hudson Co., NJ: Project Team Member for a Baseline Ecological Evaluation (BEE) of an open space forested wetland system located within a commercial park.

Fullco Lumber Site, Hayleysville, AL: Project Manager and Field Team Leader for a biological assessment of a creosote-contaminated forest community. This project included a small mammal survey for wildlife community characterization and mammal tissue residue analysis.

Marty Indian School, Marty, SD: Project Manager and Field Team Leader for a benthic macroinvertebrate study of a stream system located downgradient of a No. 2 fuel oil spill.

OECI Site, Asshipun, WI: Project Team Member for a multi-phased biological assessment of a hydrogen-cyanide contaminated emergent marsh system.

UGI Tract, City of Allentown, Lehigh Co., PA: Conducted a preliminary ecological risk assessment of a trout-production stream and riparian wetland complex, located downgradient of historical metal-contaminated industrial facilities, performed under the PA Act II, Land Recycling Act Program.

GES-Mobil, Medford Lakes, Burlington Co., NJ: Project Team Member for an ecological risk assessment of a coastal plain wetland complex located downgradient of a service station. This assessment emphasized the results of a benthic macroinvertebrate survey to indicate the absence of potential impacts to aquatic biota.

GPU Energy, Cape May, Cape May Co., NJ: Project Team Member for a Baseline Ecological Evaluation (BEE) of a PCB- and PAH-contaminated tidal salt marsh.

ENVIRONMENTAL ASSESSMENT (EA) / ENVIRONMENTAL IMPACT STATEMENTS (EIS)

Geo Trans, Inc. – Orient Point Telecom Tower Site, Orient Point, Suffolk Co., NY: Project Manager. Conducted an FCC-based Environmental Assessment (EA) for a proposed telecommunications facility situated on a coastal waterfront site within a 100-year floodplain. 2006.

GeoTrans, Inc. – Mamaroneck Telecom Tower Site, Village of Mamaroneck, Westchester Co., NY: Project Manager. Conducted an FCC-based Environmental Assessment (EA) for a proposed telecommunications facility situated within the 100-year floodplain of the Sheldrake River. 2006.

GeoTrans, Inc. – Long Beach Telecom Tower Site, City of Long Beach, Nassau Co., NY: Project Manager. Conducted an FCC-based Environmental Assessment (EA) for a proposed telecommunications facility situated on a coastal waterfront site within a 100-year floodplain.

GeoTrans, Inc. – Pequannock Telecom Tower Site, Pequannock Twp., Morris Co., NJ: Project Manager; conducted an FCC-based Environmental Assessment (EA) for a proposed telecommunications tower situated within a 100-year floodplain.

GeoTrans, Inc. – Union Beach Telecom Tower Site, Union Beach, Monmouth Co., NJ: Project Manager; conducted an FCC-based Environmental Assessment (EA) for a proposed telecommunications tower situated within a 100-year floodplain.

Amtrak – Connecticut River Moveable Bridge Project, Old Lyme & Old Saybrook, CT: Prepared a compliance statement for potential ecological impacts from the replacement of submarine communication and signal cables.

Amtrak - Thames River Moveable Bridge Project, Groton & New London, CT: Prepared a compliance statement for potential ecological impacts from the replacement of submarine communication and signal cables.

Alliance Homes - Skyview Development Site, Hopewell Twp., Mercer Co., NJ: Conducted an Environmental Impacts Assessment for the development of a major residential subdivision.

All-Pro Landscaping - Hainesport Site, Hainesport Twp., Burlington Co., NJ: Conducted an Environmental Impacts Assessment for the development of a commercial landscaping facility.

Beazer Homes - Milestone at Lawrenceville Site, Lawrence Twp., Mercer Co., NJ: Conducted an Environmental Impacts Assessment for the development of an age-restricted residential subdivision. A significant portion of this property was relinquished to the Township to be designated as open space.

DeLuca Homes – Metz Tract, Lower Makefield Twp., Bucks Co., PA: Conducted an Environmental Impacts Assessment for the development of a residential subdivision on a property containing historical resources.

The Quaker Group – Clifton Mill Project Site, City of Bordentown, Burlington Co., NJ: Conducted an Environmental Impacts Assessment for the final-phase development of a residential

subdivision. Expert testimony was provided at the City of Bordentown Planning Board Meeting in defence of the assessment findings.

The Quaker Group – Valley Day School Site, Lower Makefield Twp., Bucks Co., PA: Conducted an Environmental Impacts Assessment for the proposed development of a day school.

McMahon Associates – Route 100 By-Pass, Upper Uwchlan Twp., Chester Co., PA: Conducted a Pennsylvania Department of Environmental Protection (PADEP) Environmental Assessment (EA) as part of a Joint Permit Application with the U.S. Army Corps Harrisburg District.

Princeton Junction Engineering – Palomar Associates Development Site, Clinton Twp., Hunterdon Co., NJ: Conducted an Environmental Impacts Assessment (EIA) for the development of a residential subdivision.

Princeton Junction Engineering – Tamasi Property Site, South Brunswick Twp., Middlesex Co., NJ: Conducted an Environmental Impacts Assessment and soil sampling investigation of a former tree farm property proposed for a minor subdivision. Expert testimony was also provided at the South Brunswick Township Planning Board Meeting in defence of the findings.

WETLANDS RESTORATION AND MONITORING

Middletown Township Environmental Commission – McClees Creek Baseline Assessment Project, Middletown Twp., Monmouth Co., NJ: Project Manager for a baseline assessment of a tidal salt marsh experiencing rapid encroachment by the invasive species, common reed (*Phragmites australis*). The assessment involved an evaluation of the existing and historical environmental conditions and hydraulic modelling to determine the cause of the wetland's disturbed condition, and to arrive at a sustainable remedy. The results of this assessment were used to develop a construction-ready restoration plan that was presented to the NJ Wetlands Mitigation Council, in cooperation with the U.S. Fish and Wildlife Service.

CP Railway – Afton NY Stream Restoration, Village of Afton, Chenango Co., NY: Prepared a streambank stabilization plan for rip-rap areas and moderately-steep riparian slopes of a rail construction and rehabilitation project.

Chemical Leaman Tank Lines (CLTL) Superfund Site, City of Bridgeport, Gloucester Co., NJ: Conducted long-term monitoring of an expansive red maple swamp to measure the effects of a large-scale pump-and-treat groundwater remediation system. The methodology and interim results of this project were presented in a platform session at the 1999 20th Annual SETAC Meeting in Philadelphia, PA.

Ewan Property Superfund Site, Shamong Twp., Burlington Co., NJ: Conducted long-term monitoring of a red maple - Atlantic white cedar swamp to measure the effects of a nearby pump-and-treat groundwater remediation system.

Confidential Client – Vernal Habitat Enhancement Site, Tinicum Twp., Bucks Co., PA: Constructed stone weirs within a seasonal stream to enhance amphibian breeding habitat by extending the water-holding period of existing vernal pools.

Peruzzi Pontiac/GMC Truck – Peruzzi Property Site, Preston Twp., Wayne Co., NJ: Conducted long-term restoration monitoring of three emergent wetlands constructed under a U.S. Army Corps permit.

OENJ – Woodbridge Restoration Project, Woodbridge Twp., Middlesex Co., NJ: Provided oversight and conducted planting activities at a tidal emergent marsh restoration site.

Hopkins Farm, Upper Freehold Twp., Monmouth Co., NJ: Project Team Member for a Swamp Pink survey and wetlands restoration monitoring.

Sayreville Landfill III, Sayreville Borough, Middlesex Co., NJ: Project Team Member for the development of a wetlands restoration plan of a tidal emergent marsh.

Orleans Homebuilders – Buckingham Restoration, Buckingham Twp., Bucks Co., PA: Project Team Member for the field implementation of a wetlands restoration effort.

WRS – Pascale Property/Cooper Chemical Site, Warren Co., NJ: Performed a landscaping inventory on a private estate containing buried unexploded ordnance (UXOs), and mapped the locations of key horticultural specimens using GPS.

U.S. EPA – Zschiegner Property, Howell Twp., Monmouth Co., NJ: Developed a conceptual wetlands restoration plan for a forested deciduous wetland system slated for remediation of chromium waste.

WETLANDS DELINEATION AND PERMITTING (1989 MANUAL)

ExxonMobil Corporation – Former Lail Property Site, East Greenwich Twp. & Paulsboro Borough, Gloucester Co., NJ: Prepared a Multiple Permit Application for the environmental remediation of a freshwater tidal marsh and embayment. These permits included a NJDEP Statewide General Permit No. 4; a NJDEP Waterfront Development Permit; a NJDEP Upland Waterfront Development Permit; a NJDEP 1970 Coastal Wetlands Act Permit, a NJDEP Coastal Area Facilities Review Act (CAFRA) Permit, a NJDEP Tidelands License; and a U.S. Army Corps of Engineers Nationwide Permit No. 38.

Civalier Engineering & Surveying, Inc. – Goodwin Property Site, Franklin Twp., Gloucester Co., NJ: Project Manager. Conducted a wetlands delineation and prepared an application for the NJDEP for approval of the proposed wetland boundaries. 2006.

Civalier Engineering & Surveying, Inc. – Wilkins Property Site, Harrison Twp., Gloucester Co., NJ: Project Manager. Conducted a wetlands delineation and prepared an application for the NJDEP for approval of the proposed wetland boundaries. 2006.

Civalier Engineering & Surveying, Inc. – Mt. Calvary Apostolic Church Site, Winslow Twp., Camden Co., NJ: Project Manager. Conducted a wetlands delineation and prepared a NJDEP Special Activity Waiver application for the redevelopment of a church property. 2006.

Civalier Engineering & Surveying, Inc. – Congregation B'nai Tikvah Association Site, Washington Twp., Gloucester Co., NJ. Project Manager. Conducted a wetlands delineation of a

forested riparian corridor and prepared a NJDEP General Permit No. 11 (GP11) application for a stormwater outfall.

Civalier Engineering & Surveying, Inc. – Marten Avenue Site, Mt. Laurel Twp., Burlington Co., NJ. Conducted a wetlands delineation of a forested system and prepared an application to the NJDEP for approval of the proposed wetland boundaries. 2006.

Civalier Engineering & Surveying, Inc. – Davidson Road Site, Woolwich Twp., Gloucester Co., NJ. Conducted a wetlands delineation of a former agricultural property and prepared an application to the NJDEP for approval of the proposed wetland boundaries. 2006.

Civalier Engineering & Surveying, Inc. – JM Land Site, Gloucester Twp., Camden Co., NJ: Project Manager; conducted a wetlands delineation and permitting project (NJDEP Statewide General Permit No. 6) for a proposed residential development.

Civalier Engineering & Surveying, Inc. – Signature Homes Site, South Harrison Twp., Gloucester Co., NJ: Project Manager; conducted a wetlands presence/absence assessment for a proposed residential subdivision.

Civalier Engineering & Surveying, Inc. – Mitchell Property Site, Voorhees Twp., Camden Co., NJ: Project Manager; conducted a wetlands delineation for a freshwater wetlands transition area (i.e., wetland buffer) that encroached the site boundary.

Civalier Engineering & Surveying, Inc. – Gaughan Property Site, Mantua Twp., Gloucester Co., NJ: Project Manager; conducted a wetlands delineation and permitting project involving the application to the NJDEP for a Line-Verification LOI and a Transition Area Waiver (Averaging Plan) of a forested property proposed for commercial development into an automobile service garage.

Civalier Engineering & Surveying, Inc. – Orchard Estates Site, Monroe Twp., Gloucester Co., NJ: Project Manager for a wetlands delineation and application to the NJDEP for a Line-Verification LOI, a Freshwater Wetlands General Permit No. 6, a Freshwater Wetlands General Permit No. 11, and a Transition Area Waiver (Averaging Plan Option). This project site was located adjacent to a large swamp pink (*Helonias bullata*) population. Numerous meetings and discussions with regulatory bodies (NJDEP, U.S. Fish and Wildlife Service, Green Acres) were conducted to arrive at a development scenario acceptable to all parties.

Civalier Engineering & Surveying, Inc. – Windsor Estates Site, South Harrison Twp., Gloucester Co., NJ: Project Manager; conducted a wetlands delineation and permitting project for a proposed residential subdivision. This project involved the application to the NJDEP LURP for a Line-Verification LOI, Transition Area Waiver (Averaging Plan), General Permit No. 2 (GP2), General Permit No. 6 (GP6), and a General Permit No. 7 (GP7).

Civalier Engineering & Surveying, Inc. – Saddlebrook Estates Site, Monroe Twp., Gloucester Co., NJ: Conducted a wetlands delineation and developed applications to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI), a Freshwater Wetlands General Permit No. 6, and a Freshwater Wetlands Transition Area Waiver (Averaging Plan Option).

Civalier Engineering & Surveying, Inc. – Warren Park Estates Site, Pennsville Twp., Salem Co., NJ: Project Manager for an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI), a Freshwater Wetlands General Permit No. 6, and a Transition Area Waiver (Averaging Plan Option).

Civalier Engineering & Surveying, Inc. – Harrison Twp. Site, Harrison Twp., Gloucester Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Civalier Engineering & Surveying, Inc. – Mt. Calvary Apostolic Church Site, Winslow Twp., Camden Co., NJ: Project Manager for a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) and a Transition Area Waiver (Special Activity Option). This project required on-site meetings with the NJDEP to resolve vernal habitat issues on the adjacent property.

Civalier Engineering & Surveying, Inc. – Spino Property Site, Voorhees Twp., Camden Co., NJ: Project Manager for a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Civalier Engineering & Surveying, Inc. – Winslow Twp. Site, Winslow Twp., Camden Co., NJ: Project Manager for a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Presence/Absence Letter of Interpretation (P/A LOI).

Civalier Engineering & Surveying, Inc. – Herskowitz Property Site, Woodbury Heights Borough, Gloucester Co., NJ: Project Manager for a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) for the expansion of an existing commercial retail facility.

Civalier Engineering & Surveying, Inc. – Sewell Auto Garage Site, Mantua Twp., Gloucester Co., NJ: Project Manager for a wetlands delineation of a forested wetland complex proposed for commercial development.

Civalier Engineering & Surveying, Inc. – Aboud Property Site, Deptford Twp., Gloucester Co., NJ: Project Manager for a wetlands delineation of a forested deciduous wetland system proposed for a single-family residential dwelling.

Civalier Engineering & Surveying, Inc. – Tarpy Drive Site, Deptford Twp., Gloucester Co., NJ: Project Manager for a wetlands delineation of a forested tract proposed for residential development.

Civalier Engineering & Surveying, Inc. – Ellsworth Property Site, Monroe Twp., Gloucester Co., NJ: Project Manager for a wetlands delineation of a large agricultural and forested property situated in the NJ Pinelands Protection Area.

NJ Army National Guard – Various Sites, State-wide: Conducted wetlands delineations for the Bordentown Armory OMS (Burlington Co.), Bordentown CSMS (Burlington Co.), Bridgeton Armory (Salem Co.), Cape May Armory (Cape May Co.), Cherry Hill Armory (Camden Co.), Dover Armory (Morris Co.), Flemington Armory (Hunterdon Co.), Fort Dix UTES (Ocean Co.), Franklin Armory (Sussex Co.), Hackettstown Armory (Warren Co.), Hammonton Armory (Atlantic Co.), Lawrenceville

Complex (Mercer Co.), Morristown Armory (Morris Co.), Newton Armory (Sussex Co.), Picatinny FMS/AASF (Morris Co.), Pitman Armory (Gloucester Co.), Princeton Armory (Mercer Co.), Sea Girt NGTC (Monmouth Co.), Somerset Armory (Somerset Co.), Toms River Armory (Ocean Co.), Tuckerton Armory (Ocean Co.), Vineland Armory (Cumberland Co.), West Orange Armory (Essex Co.), and West Trenton (Mercer Co.).

ACT Engineers, Inc. – Princeton Theological Seminary Site, West Windsor Twp., Mercer Co., NJ. Conducted a wetlands delineation and submitted an application to the NJDEP for approval of the proposed wetlands boundaries.

GeoTrans, Inc. – Confidential Site, Hanover Twp., Morris Co., NJ: Project Manager for a wetlands permitting project involving the application to the NJDEP for a General Permit No. 4 (GP4) for the remediation of contaminated wetland soils.

AMEC Civil, LLC – Shark River Route 35 Bridge Site, Belmar Borough, Ocean Co., NJ: Prepared a Multiple Permit Application (Waterfront Development, CAFRA, and Water Quality Certificate) for a proposed stone jetty in a previously sub-tidal area.

Ogle Property Site, N. Brunswick Twp., Middlesex Co., NJ: Project Manager for a wetlands delineation of a residential property for proposed home expansion.

Princeton Junction Engineering – Marlton Woods Site, Evesham Twp., Burlington Co., NJ: Conducted a wetlands delineation of a formerly drained agricultural parcel, developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI), and prepared an Environmental Impacts Assessment (EIA) for a proposed residential development.

Princeton Junction Engineering – Gillespie Site, Hopewell Twp., Mercer Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Notice of Violation (NOV) site. This wetland system was severely disturbed with unauthorized excavation and fill, and required the use of heavy machinery to determine the extent of hydric soils. The delineation was conducted in the presence of a NJDEP Enforcement Officer.

Princeton Junction Engineering – Gunther Property Site, Upper Freehold Twp., Monmouth Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) for a minor residential subdivision.

Princeton Junction Engineering – Lauricella Property Site, Hopewell Twp., Mercer Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) for a minor subdivision.

Princeton Junction Engineering – Perrine Property Site, Cranbury Twp., Middlesex Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) for the expansion of an existing commercial facility.

Devine – Devine Property Site, Vernon Twp., Sussex Co., NJ: Conducted a wetlands delineation in response to a Notice of Violation (NOV) issued by the NJ Department of Environmental Protection to a private landowner. On-site meetings with the landowner and the NJDEP Enforcement Officer resulted in a plan of action to resolve the NOV.

Civil Dynamics, Inc. – Voorhees Sewer Project, Voorhees Twp., Warren Co., NJ: Project Manager; conducted a wetlands delineation for a proposed sewer improvement project.

Civil Dynamics, Inc. – Maskells Mills Dam, Lower Alloways Creek Twp., Atlantic Co., NJ: Project Manager; conducted a wetlands delineation within a 300-foot envelope around a proposed dam rehabilitation site.

Civil Dynamics, Inc. – Highland Lakes Beach Redevelopment Project Site, Vernon Twp., Sussex Co., NJ: Project Manager; conducted a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Civil Dynamics, Inc. – Harrisonville Dam, Harrison Twp., Gloucester Co., NJ: Project Manager; conducted a wetlands delineation within a 300-foot envelope around a proposed dam rehabilitation site.

Hughes Environmental, Inc. – Linwood/MacDonald YMCA, Sandyston Twp., Sussex Co., NJ. Conducted a wetlands delineation for a YMCA summer camp facility encompassing forested, scrub-shrub, emergent, and lacustrine wetland systems.

CAP Inc., Montgomery Twp., Somerset Co., NJ: Project Manager for a wetlands delineation and wildlife habitat survey of an expansive farm property/forested wetland system.

Mountain Creek – Vernon Township Site, Vernon Twp., Sussex Co., NJ: Project Team Member for the delineation of wetlands on the Vernon Valley – Great Gorge ski area property and the former Action Park amusement park. Developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) and Freshwater Wetlands General Permit No. 6.

Bohler Engineering - Campus Drive Site, Parsippany – Troy Hills Twp., Morris Co., NJ. Conducted a wetlands delineation and developed a Letter of Interpretation (LOI) application to the NJ Department of Environmental Protection (NJDEP).

Metrologic Instruments – Gloucester Township Site, Gloucester Twp., Camden Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Elizabethtown Water Company – Raritan Township Site, Raritan Twp., Hunterdon Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI) for a proposed minor subdivision.

Candullo Property, Millstone Twp., Monmouth Co., NJ: Conducted a wetlands delineation of a forested wetland/upland complex identified as providing habitat for a protected species, the barred owl (*Strix varia*).

Windsor Management – Hogback Road Site, Bordentown Twp., Burlington Co., NJ: Developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI). This project included a field survey for two protected plant species, pale Indian plantain (*Cacalia atriplicifolia*) and tall pawpaw (*Asiminia triloba*), documented by the NJDEP to have the potential to occur on the site. No individuals of either species were found.

Windsor Management – County Home Road Site, Pilesgrove Twp., Salem Co., NJ: Conducted a wetlands delineation of an expansive forested wetland adjacent to a proposed residential subdivision. This project included a habitat survey for the protected bog turtle, *Clemmys muhlenbergii*).

Windsor Management – Woolwich Township Site, Woolwich Twp., Gloucester Co., NJ: Conducted a wetlands delineation of numerous agricultural properties proposed for a residential subdivision.

Windsor Management – Mensch Property Site, Upper Deerfield Twp., Salem Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Zigga Homes – Brookhill Estates Site, Edison Twp., Middlesex Co., NJ: Project Manager for a wetlands delineation and development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation (LOI).

Zigga Homes – Amboy Avenue Site, Edison Twp., Middlesex Co., NJ: Project Manager for a wetlands delineation and development of an application to the NJ Department of Environmental Protection (NJDEP) for a Presence/Absence Letter of Interpretation (PA LOI).

Zaidi Homes – Old Bridge Township Site, Old Bridge Twp., Middlesex Co., NJ: Conducted wetlands delineations of several private properties proposed for minor subdivision.

Jomo – Jomo Property, Old Bridge Twp., Monmouth Co., NJ: Conducted a cursory wetlands delineation to resolve outstanding land use and permitting issues for a private landowner.

Cranbury Township Pump Station Project, Cranbury and South Brunswick Twps., Middlesex Co., NJ: Developed a Freshwater Wetlands General Permit No. 2 from the NJ Department of Environmental Protection (NJDEP) for a linear utility development project.

Pond & Spitz Homes – Cropwell Road Site, Cherry Hill Twp., Camden Co., NJ: Conducted a wetlands delineation and developed an application to the NJ Department of Environmental Protection for a Freshwater Wetlands Statewide General Permit No. 6.

Brennan Transportation – Rancocas Road Site, Burlington Twp., Burlington Co., NJ: Conducted a wetlands delineation of a farm property proposed for a minor subdivision.

Harowitz Property Site, Lawrence Twp., Mercer Co., NJ: Project Manager for a wetlands delineation and the development of an application to the NJ Department of Environmental Protection (NJDEP) for a Line-Verification Letter of Interpretation.

Versar Inc. – Ft. Monmouth Telecommunications Improvement Project, Boroughs of Eatontown, Oceanport, Shrewsbury, and Tinton Falls, Monmouth Co., NJ: Project Manager and Field Team Leader for the development of a Multiple Permit and Federal Consistency Determination application to the NJ Department of Environmental Protection (NJDEP) for an Upland Waterfront Development Permit, Coastal Area Facilities Review Act (CAFRA) Permit, Coastal Wetlands Permit, Section 401 Water Quality Certificate, and a Freshwater Wetlands General Permit No. 2.

Versar Inc. – Ft. Monmouth Nature Trails Project, Boroughs of Eatontown, Oceanport, Shrewsbury, and Tinton Falls, Monmouth Co., NJ: Project Manager and Field Team Leader for the development of a Multiple Permit and Federal Consistency Determination application to the NJ Department of Environmental Protection (NJDEP) for a Waterfront Development Permit, Coastal Area Facilities Review Act (CAFRA) Permit, Coastal Wetlands Permit, Section 401 Water Quality Certificate, and a Freshwater Wetlands General Permit No. 17.

East Freehold Sanitary Sewer System Project, Freehold Twp., Monmouth Co., NJ: Conducted a wetlands delineation for a proposed water supply development project.

Zion, Breen & Richardson Associates – Stabilization of Lock 1 / Path Development Project, (Delaware and Raritan Canal), Hamilton Twp., Mercer Co., NJ: Developed a Multiple Permit Application to the NJ Department of Environmental Protection for a Waterfront Development Permit and Freshwater Wetlands Transition Area Waiver (Averaging Plan Option) for the restoration of Lock 1 of the Delaware and Raritan Canal. Also developed an application to the U.S. Coast Guard, and to the U.S. Army Corps Philadelphia District for all applicable Nationwide Permits (NWPs).

WETLANDS DELINEATION AND PERMITTING (1987 MANUAL)

PA Army National Guard – Various Sites, State-wide: Conducted wetlands delineations for the Cambridge Springs Site, McKean Co., South Mountain Site, Franklin, PA, the Graterford State Correctional Institution Site, Graterford, PA, and the Northeast Philadelphia Airport, Philadelphia Co. as part of the transformation of the 56th Brigade to a Stryker Brigade Combat Team (SBCT).

NC Army National Guard – Camp Butner, Granville and Durham Cos., NC: Provided technical support to a wetlands delineation and permitting project for the proposed development of a military range.

Fort Pickett - Brunswick, Dinwiddie, and Nottoway Cos.; Blackstone, VA: Conducted wetland delineations at various proposed construction locations throughout the installation as part of the transformation of the 56th Brigade to a Stryker Brigade Combat Team (SBCT).

Shell Energy – NedPower Mt. Storm Project Site, West Virginia. Conducted a wetlands delineation of a mountain ridge system for the proposed location of wind turbine facilities. A Jurisdictional Determination (JD) was received for this delineation from the USACOE, Pittsburgh District.

Policelli Engineering, Inc. – Landis Property Site, Hamilton Twp., Monroe Co., PA: Project Manager. Conducted a wetlands delineation of a forested system for the proposed development of a residential dwelling. 2006.

Policelli Engineering, Inc. – Shoemaker Property Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager; conducted a wetlands delineation for a proposed residential development.

Policelli Engineering, Inc. – Martin Property Site, Hamilton Twp., Monroe Co., PA: Project Manager; conducted a wetlands delineation for a proposed residential development.

Policelli Engineering, Inc. – Woolverton Property Site, Washington Twp., Northampton Co., PA: Project Manager; conducted a wetlands delineation for a proposed residential development.

Policelli Engineering, Inc. – Creek Road Site, Upper Mt. Bethel, Northampton Co., PA: Project Manager for a wetlands delineation of an agricultural property for proposed residential development.

Policelli Engineering, Inc. – Delabole Estates Site, Pen Argyl Borough, Northampton Co., PA: Project Manager for a wetlands delineation of a forested property for a proposed residential subdivision.

Policelli Engineering, Inc. – Bickford Property Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager for a wetlands delineation of a forested property for proposed residential development.

Policelli Engineering, Inc. - Laurel Hill Subdivision Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager for a presence/absence delineation for wetlands at a proposed residential subdivision site.

Policelli Engineering, Inc. - Miller Property Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager for a wetlands delineation on a residential lot for the siting of an on-site wastewater disposal system.

HMG Engineering, Ltd. – Deleyer Property Site, Lower Mt. Bethel Twp., Northampton Co., PA: Project Manger; conducted a wetlands delineation for a proposed agricultural development site.

HMG Engineering, Ltd. – Confidential Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager; conducted a wetlands delineation of a residential property in violation of the Clean Water Act.

Currie Property Site, Stroud Twp., Monroe Co., PA: Project Manager for a wetlands delineation of a forested property for a residential development.

Robinson Property Site, Upper Mt. Bethel Twp., Northampton Co., PA: Project Manager for a wetlands delineation of an agricultural property for a residential subdivision.

CSX Transportation, Inc., Genesee River Dredging Project, City of Rochester, Monroe Co., NY: Developed a Joint Permit between the Corps – Buffalo District and the NYSDEC Region 8 for the remediation (by dredging) of contaminated sediments from the Genesee River.

Commonwealth Construction & Development, Inc. – Kimberton Ridge Site, East Vincent Twp., Chester Co., PA: Conducted a wetlands delineation and developed an application to the U.S. Army Corps Philadelphia District for a Jurisdictional Determination (JD) of the proposed wetland boundaries.

Brandywine Realty Trust – Newtown Office Commons Site, Newtown Twp., Bucks Co., PA: Conducted a wetlands delineation and application for a Jurisdictional Determination (JD) from the U.S. Army Corps, Philadelphia District.

Boucher & James – Datesman Property Site, Wrightstown Twp., Bucks Co., PA: Conducted a wetlands delineation of a large farm property, a significant portion of which was to be designated as Township open space.

Windsor Management – Failor Farm Site, Lower and Upper Allen Twps., Cumberland Co., PA: Conducted a wetlands delineation of a farm property proposed for a residential subdivision.

Windsor Management – Stark Farm Site, Southampton Twp., Cumberland Co., PA: Conducted a wetlands delineation of a farm property proposed for a residential subdivision.

Orleans Homebuilders – Byers Station Site, Upper Uwchlan Twp., Chester Co., PA: Conducted a wetlands delineation of specific problem areas associated with road crossings for a proposed residential subdivision.

Cornell Radiation Disposal Site (RDS)/Chemical Disposal Site (CDS), Lansing Twp., Tompkins Co., NY. Project Team Member for the development of a U.S. Army Corps (Buffalo District) Pre-Discharge Notification (PDN) for proposed remedial activities.

Richard Welch – Spring Oak Farm Site, Solebury Twp., Bucks Co., PA: Developed a PA Department of Environmental Protection / U.S. Army Corps Joint Permit application for a channel crossing associated with a proposed minor subdivision.

Orleans Homebuilders – Wiltshire Walk Project, Newtown Twp., Bucks Co., PA: Developed a PA Department of Environmental Protection / U.S. Army Corps Joint Permit application for a stream enclosure and relocation of an existing road crossing.

Richard Brown Associates – H&K Tool and Machine Company Site, Lower Southampton Twp., Bucks Co., PA: Developed an application to the U.S. Army Corps Philadelphia District for a Jurisdictional Determination (JD) of a Notice of Violations (NOV) site. A cease-and-desist order was implemented, and the violations were resolved through the use of sediment and erosion controls.

Mathurin Property Site, Penn Forest Twp., Carbon Co., PA: Conducted a wetlands delineation of a residential lot previously designated as wetland. The results of the delineation indicated that the majority of the lot area was non-wetland and developable.

WETLANDS DELINEATION AND PERMITTING (NJ PINELANDS COMMISSION)

Fort Dix – Tiger Base Well Site, Fort Dix Military Reservation, Ocean and Burlington Cos., NJ. Conducted a wetlands delineation of a forested system for the proposed development of a potable well.

Fort Dix – IR Settlement Well Site, Fort Dix Military Reservation, Ocean and Burlington Cos., NJ. Conducted a wetlands presence/absence determination of a military training facility for the proposed development of a potable well.

Fort Dix – ASP Potable Well Site, Fort Dix, Plumstead Twp., Ocean Co., NJ: Conducted a wetlands delineation within a 300-foot envelope around a proposed potable well development footprint within the NJ Pinelands Protection Area.

Fort Dix – Rock Crusher Potable Well Site, Fort Dix, Plumstead Twp., Ocean Co., NJ: Conducted a wetlands presence/absence assessment within a 300-foot envelope around a proposed potable well development footprint within the NJ Pinelands Protection Area.

Fort Dix – ARDC Potable Well Site, Fort Dix, Plumstead Twp., Ocean Co., NJ: Conducted a wetlands delineation within a 300-foot envelope around a proposed potable well development footprint within the NJ Pinelands Protection Area.

Fort Dix - MOUT Complex Site, Fort Dix, Plumsted Twp., Ocean Co., NJ: Conducted a wetlands delineation in various NJ Pine Barrens habitats for a proposed military training facility.

Civalier Engineering & Surveying, Inc. – Howard Brown Site, Monroe Twp., Gloucester Co., NJ: Project Manager. Conducted a wetlands delineation and prepared an application to the NJ Pineland Commission for approval of the proposed wetland boundaries.

Civil Dynamics Inc. – Lake Fred Dam Project Site., Galloway Twp., Atlantic Co., NJ: Project Manager; conducted a wetlands delineation and provided on-call wetlands consulting support for a dam replacement project on the campus of the Richard Stockton College of New Jersey. This project was situated upgradient of known breeding habitat for the state-endangered Pine Barrens treefrog (*Hyla andersonii*). Civil Dynamics and AMEC demonstrated that the proposed dam replacement would not adversely impact this species.

ENVIRONMENTAL INVESTIGATION

Fort Dix – Mirror Lake Site; Burlington Co., NJ: Conducted monthly surface water monitoring for total and dissolved metals in a public lake located downgradient of an environmental remediation project.

ExxonMobil Corporation – Vacuum Oil Site, City of Rochester, Monroe Co., NY: Project Team Member for the environmental investigation of a former petroleum distillery and research facility. This project involved the re-creation of a historical site features map using a combination of ground-truthing, historical records review, and public and private entity interviews.

GCL Tie and Treating Site, Sidney, NY: Project Manager for a phyto-toxicity evaluation of creosote-contaminated soils in support of a Remedial Investigation/Feasibility Study (RI/FS). This evaluation involved conducting a laboratory toxicity test using the plant species, rape (*Brassica major*), to test

various bio-remediation measures. The results of the evaluation indicated clear differences in phyto-toxicity, correlating with the degree and duration of bio-remediation.

Overpeck Creek, Bergen Co., NJ: Project Team Member for a sediment sampling event and benthic macroinvertebrate survey of the Overpeck Creek.

American Cyanamid NPDES Outfall Project, Princeton, Mercer Co., NJ: Project Team Member for an environmental investigation examining the likely source for reduced pH conditions from a NPDES outfall. This study revealed that stormwater and surface water flow through a low pH forested wetland system resulted in the acidic measurements.

Ashley Valley Site, UT: Collected groundwater from mountainside seeps to determine the extent of heavy metals release from upgradient municipal wastewater treatment lagoons.

Former Lail Property Site, East Greenwich Twp & Paulsboro Borough, Gloucester Co., NJ: Collected vibracore samples to 10-foot depths in a PCB-contaminated tidal embayment.

Halby Chemical Site, Wilmington, DE: Conducted surface sediment sampling in Level C for full TCL scan within an industrial complex.

Hyman-Viener Site, MD: Conducted grid soil sampling to determine the extent and magnitude of heavy metals at a rough-graded construction site.

Summitville Mine Superfund Site, Rio Grande Co., CO: Project Team Member for a subsurface sediment evaluation of the Alamosa River for AVS/SEM analysis.

AT&T Antenna Fields, Various U.S. Locations: Conducted Phase I Environmental Site Assessments of telecommunication facilities located in Ft. Lauderdale, FL; Andytown, FL; Hialeah Gardens, FL; Manahawkin, NJ; and Ocean Gate, NJ.

Lucent Technologies – Morristown Facility, Morristown, Morris Co., NJ: Project Team Member for the development of all applicable air permits from the NJ Department of Environmental Protection (NJDEP).

Southern Shipbuilding Superfund Site, Slidell, St. Tammany Parish, LA: Conducted an extent and magnitude of contamination investigation for surface sediment within Bayou Bonfouca.

White Phosphorous Dump Zone ROD Updates, Aberdeen Proving Grounds (APG), MD: Project Manager for the annual technical and administrative updates to the Record of Decision (ROD) for the WPDZ site.

Empire Knight Literature Review, U.S. EPA Environmental Response Team (ERT): Project Manager for a comprehensive written literature review of the environmental chemistry and toxicology of inorganic and organic mercury in marine environments.

Vegetation Assessment Project, Edison Twp., Middlesex Co., NJ: Project Manager for re-designing an existing phyto-toxicity laboratory for the U.S. EPA Emergency Response Team (ERT).

Representative Sampling Document, U.S. EPA Environmental Response Team (ERT): Project Manager for revisions to the draft versions of the U.S. EPA's Representative Sampling Document (Biota), currently appendicized in the U.S. EPA's 1997 Ecological Risk Assessment Guidance for Superfund (ERAGS) document.

ENVIRONMENTAL EDUCATION

12th Annual Delaware River Watershed Youth Leadership Eco Summit – Monroe Co., PA: Was an invited instructor to provide hands-on wetlands delineation activities to middle-school and high-school groups.

Girl Scouts Great Valley Council, Troop #870 - Camp Helena, Lehigh Co., PA: Led a hands-on demonstration of the aquatic biological communities present within a pond system located at a Girl Scout campground.

Cub Scouts Minsi Trails Conference, Pack 11 – Merrill Creek Reservoir, Warren Co., NJ: Led the outdoor activity components for the Webelos' Forestry achievement requirement.

High Bridge Environmental Steering Committee – High Bridge Open Space Day Project, Borough of High Bridge, Hunterdon Co., NJ: Conducted nature walks for the general public participating in a Borough-sponsored outdoor event.

Envirothon, Swartswood State Park, Sussex Co., NJ: Provided an on-site lecture and field practical for introducing the concepts of wetlands delineation to high school students competing in the 2000 Envirothon.

SETAC/Hudson Delaware Chapter - Amphibian Walk, Stockton, Hunterdon Co., NJ: Led a hands-on nature tour about amphibians at a Hudson-Delaware Chapter of the Society of Environmental Toxicology and Chemistry meeting.

Interpretive Vegetation Tour, Massachusetts Audubon Society, Lincoln, MA. Led an interpretive nature tour for local journalists and the general public regarding the evolutionary adaptations of plants dealing with nutrient availability.

Charles R. Harman, P.W.S.

Senior Associate Ecologist

Professional summary

A terrestrial ecologist, Mr. Harman has 20 years of experience in the environmental consulting field. Mr. Harman specializes in natural resource related assessment and management activities, including ecological risk assessments, biological assessments, natural resource damage assessments, wetlands management and ecological restorations. He is responsible for the completion of ecological risk assessment projects and wetlands evaluations at hazardous waste sites and industrial facilities around the country. His duties include client and project management, supervision of junior staff, and technical completion of work assignments.

Professional qualifications

Qualified by NJDEP under N.J.A.C. 7:1E to certify Environmentally Sensitive Areas Protection Plans as an Ornithologist/Ecologist; 1998

Professional Wetland Scientist, Registration Number 249, Issued by Society of Wetland Scientists; 1995

Certificate of Completion; U.S. Army Corps of Engineers Wetlands Delineator Certification Training Program

Education

Southwest Texas State University, San Marcos, TX, M.A., Biology (GPA: 4.0 on a scale of 4.0), 1986

Texas A&M University, College Station, TX, B.S., Wildlife Ecology, 1977

Continuing Education

Law Seminars International, *Natural Resource Damages Litigation Workshop*, 2005

Hudson-Delaware Chapter SETAC Fall Workshop, *Tools for Improved Natural Resource Damage Assessment, Habitat Enhancement and Environmental Restoration*, 2005

Nicholas School of the Environment and Earth Sciences, Duke University, *Preparing and Documenting Environmental Impact Analyses*, 2005

Nicholas School of the Environment and Earth Sciences, Duke University, *New Advances in Ecological Risk Assessment*, 2004

Cook College Continuing Education, Rutgers Univ., *Natural Resource Damage Claims*, 2004

SETAC Short Course, *Natural Resource Damage Assessment Cooperative Efforts*, 2001

Cook College Continuing Education, Rutgers Univ., *Environmental and Ecological Risk Assessment*, 2001

Cook College Continuing Education, Rutgers Univ., *Threatened and Endangered Species of Northern New Jersey*, 2001

Cook College Continuing Education, Rutgers Univ., *Restoration of Native Woodlands*, 1999

American Society of Civil Engineers, *Design & Operation of Constructed Wetlands for Wastewater Treatment*, 1998

Cook College Continuing Education, Rutgers Univ., *Planning Hydrology for Wetlands Construction*, 1997

Cook College Continuing Education, Rutgers Univ., *Identification of Grasses, Sedges, and Rushes*, 1996

Cook College Continuing Education, Rutgers Univ., *Evaluation of Wetlands*; 1996

Cook College Continuing Education, Rutgers Univ., *Wetland Vegetation Identification*, 1995

Cook College Continuing Education, Rutgers Univ., *1987 ACOE Delineation Refresher Course*, 1995

Cook College Continuing Education, Rutgers Univ., *Hydric Soils*, 1994

Cook College Continuing Education, Rutgers Univ., *Hydrology of Wetlands*, 1994

Cook College Continuing Education, Rutgers Univ., *Wetland Construction Techniques*, 1994

Cook College Continuing Education, Rutgers Univ., *NJ Freshwater Wetlands Permits*, 1994

Cook College Continuing Education, Rutgers Univ., *Lake Management*, 1993

SETAC Short Course, Ecological Impact, Risk Assessments, & Cleanup Decisions at Hazardous Waste Sites, 1993

Wetlands Mitigation and Restoration - Design, Installation and Evaluation Workshop; 1993

Water Environment Federation/ATSDR, *Ecological Risk Assessment Seminar*, 1993

SETAC Short Course, *Ecological Risk Assessment*, 1992

Executive Enterprises, *Minimizing and Resolving Natural Resource Damage Claims*, 1992

OSHA 8-hour Hazardous Waste Operations Supervisors Training; 1992

REWAI Learning Center, *Wetlands Delineation/Assessment Course*, 1990

OSHA 40-hour Health and Safety Training; 1987

Memberships

Society of Environmental Toxicologists and Chemists

Hudson/Delaware Chapter of the Society of Environmental Toxicologists and Chemists

- Chapter Vice-President - 1994
- Chapter President – 1995

Interstate Technology Regulatory Council

- Ecological Enhancements Team
- Mitigation Wetlands Team
- Constructed Wetlands Team
- Small Arms Firing Range Team

Society for Ecological Restoration

Society of Wetlands Scientists

The Association of State Wetland Managers

Special Activities

2006: Lead Instructor. Ecologically Focused Remediation Strategies Short Course, 27th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, Quebec, Canada.

2006: Instructor. Constructed Wetlands in New Jersey, Lorman Education Services, Cherry Hill, NJ.

2004 – Present: Member Journal Editorial Board, Integrated Environmental Assessment and Management

2004/2005: Instructor. Administration and Enforcement of Wetlands in New York Seminar, Lorman Education Services, Buffalo, NY

2003 – Present: Course Instructor. Ecological Risk Assessments at Hazardous Waste Sites, Cook College Continuing Education Course, Rutgers University.

Location

Somerset, New Jersey

Summary of core skills

Ecological Risk Assessment

Mr. Harman utilizes his expertise in vertebrate zoology and physiology, botany, and applied and systems ecology in the development of ecological risk assessments at CERCLA, RCRA, and other hazardous waste sites. He has been involved with ecological risk assessments at over 25 CERCLA sites and 3 RCRA corrective action sites. He has conducted biotic characterizations for hazardous waste sites located in freshwater wetlands and estuaries. He performed a detail vegetative analysis of a 1,300-acre RCRA Corrective Action site in support of an ecological risk assessment. Mr. Harman has conducted ecological risk assessments using a variety of USEPA headquarters, regional, program, and State methodologies. Mr. Harman has been involved at sites ranging in physical location from New England to the tropics and has focused on terrestrial, aquatic, and wetland systems.

Environmental Impact Assessment and Environmental Permitting

Mr. Harman has managed the assessment of potential impacts to natural resources as part of complex Environmental Assessment (EA) projects under NEPA or Department of Defense related regulations. Projects have included energy related activities such as wind farm development and LNG terminal siting, as well as large scale construction and development. Mr. Harman managed a project to assess the potential for impacts to wetlands and other sensitive receptors from construction related activities associated with the development of an energy wind farm located in West Virginia. Mr. Harman also the assessment of potential impacts to wetlands and threatened and endangered species such as blunt mannagrass, the timber rattlesnake, the Indiana bat, and the eastern woodrat at another wind farm site in Pennsylvania. Mr. Harman was responsible for the preparation of comments on a Resource Report for a fling under FERC for the siting of a proposed LNG terminal and pipeline in Maryland, as well as the subsequent preparation of sections of the DEIS and FEIS. Mr. Harman was responsible for the assessment of potential impacts to biological resources, including wetlands and threatened and endangered species such as the Pine Barren Pine Snake as part of the preparation of several EAs for Fort Dix in southern New Jersey. Mr. Harman has conducted threatened and endangered species surveys as part of biological characterizations, including surveys for swamp pink in New Jersey wetlands.

Mr. Harman has developed wetland and other natural resource permits through both Federal and State agencies. Mr. Harman has obtained General Wetland Permits under the New Jersey Freshwater Wetlands Protection Act and has obtained Nationwide Wetland permits under the Clean Water Section 404 Program in New Jersey, New York, Pennsylvania, and Puerto Rico in advance of landfill construction activities and new building activities. Mr. Harman has obtained new stormwater permits under NJPDES programs for the construction of aircraft hangers and addressed state concerns at chemical plants for NPDES permit renewals. He has obtained stream encroachment permits, and permits under Coastal Zone Management Regulations for remedial construction activities. He oversaw the preparation of air permits for discharges from new building construction and has assisted in the preparation of RCRA Part B permit applications.

Wetlands Delineation and Mitigation

Mr. Harman has been actively involved in the design and construction of both mitigation wetlands and constructed wetlands for treatment purposes. He has designed and managed wetland restoration projects as part of remediation activities including red maple swamps, freshwater marshes and coastal emergent marshes. Mr. Harman has delineated wetlands using both the 1987 and 1989 manuals. He has designed and conducted detailed evaluations of the potential for ecological impacts to wetlands from the implementation of remedial actions, including pump and treat systems. He has evaluated wetlands and other ecological receptors at sites located in sensitive habitats, including the New Jersey Pinelands, the New Jersey Hackensack Meadowlands, coastal estuaries, and freshwater swamps and marshes. Mr. Harman has conducted wetland delineation projects in Connecticut, Delaware, Maine, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, Puerto Rico, and Virginia.

Employment history

Ecologist, AMEC Earth & Environmental (formerly Ogden Environmental & Energy Services), 2000 - Present

Ecologist, Ogden Environmental and Energy Services Co., Inc., 2000

Environmental Scientist, McLaren/Hart, Inc. (formerly Fred C. Hart Associates), 1990 – 2000

Environmental Scientist, Fred C. Hart Associates, Inc., 1987 – 1990

Instructor, Southwest Texas State University, 1986 – 1987

Officer, United States Navy, 1977 - 1981

Detailed core skills or details by project

Mr. Harman has been involved in a number of projects, including:

Ecological Risk Assessment

Ecological Risk Assessment, ExxonMobil, Former Lail Property, Paulsboro, NJ (Ongoing): Project Director for remedial investigation/ecological risk assessment for PCB-contaminated freshwater tidal sediments located in Paulsboro, New Jersey. Responsible for overall technical approach to the project, quality oversight and client management. Project activities thus far have included: delineation of PCB-contaminated sediments material in tidal wetlands and mudflats through the collection of over 1000 surface water, sediment, groundwater, vegetation, and biota samples. Oversaw the completion of a detailed fauna/flora survey and habitat characterization that will be used to support ecological restoration and mitigation activities. Preparing Remedial Investigation Report and Ecological Risk Assessment for aquatic and terrestrial ecological receptors for submission to regulatory team consisting of NJDEP (lead agency), USFWS, Delaware River Basin Commission (DRBC), NOAA, and USACOE.

Ecological Risk Assessment, Orphan Mine Site, Grand Canyon, AZ (Ongoing) Task manager for the preparation and implementation of an ecological risk assessment being planned for an former mine site located adjacent to the Grand Canyon. Constituents of concern include a number of metals and various radionuclides. Assisted with negotiations with the U.S. National Park Service regarding Conceptual Site Models and lists of preliminary Constituents of Concern. Present activities include preparation of an Ecological Risk Assessment Work Plan.

Ecological Risk Assessment, ExxonMobil, Bayway Ecological Evaluation Support, Linden, NJ (Ongoing): Managing the completion of the multi-tiered ecological assessment of a 900-acre refinery located in Linden, New Jersey under New Jersey Department of Environmental Protection (NJDEP) protocols. Directing field and office efforts to evaluate potential impacts to natural resources on the site. Activities have included the preparation and execution of sampling work plans for sediment/surface water sampling and biological characterization, completion of ecological evaluations, and the review of remedial action selection reports to ensure the resolution of ecological concerns. Supporting the client at project meetings with the NJDEP and providing strategic guidance on resolving technical issues with the State.

Ecological Risk Assessment, ExxonMobil, KRGP Sediment Evaluation, Kingsville, TX (Ongoing): Project manager for the completion of an ecological risk assessment for an ephemeral stream located in South Texas. Project has included the collection of surface water, sediment and surface soil samples that were analyzed for chromium and the completion of a Screening Level Ecological Risk Assessment under Texas ecological risk guidelines. Activities also included the characterization of plant communities along the length of the stream and benthic invertebrate communities within the aquatic system. Providing strategic and technical guidance to the client on the ecological ramifications of the chromium results in negotiations with the landowner.

Ecological Risk Assessment, ExxonMobil, Charleston Ecological Assessment Support, Charleston, SC (Ongoing): Conducting an ecological risk assessment for fuel oil terminal located in Charleston, South Carolina. Using data obtained by the onsite remedial investigation contractor, evaluating the potential for ecological risks to terrestrial and wetland receptors. Sensitive receptors also include a salt marsh bordering the property.

Ecological Risk Assessment, Sauget Area 2 PRP Committee, Sauget Ecological Risk Assessment, Sauget, IL (Ongoing): Project manager responsible for the planning and execution of a large-scale ecological risk assessment on behalf of a multi-company PRP group. Ecological risk assessment includes the evaluation of potential ecological impacts to aquatic resources within 12,000 feet long section of the Mississippi River and to terrestrial receptors in adjoining floodplain areas. Project began with the development of work plans in 2001. In 2002, terrestrial sampling (soil sampling, earthworm bioassay sampling, plant tissue collection and ecological description), and aquatic sampling was conducted. Other project activities include long-range planning and budgeting, interaction with the PRP committee at meetings and conference calls, and negotiations with regulatory agencies.

Ecological Risk Assessment, Geosciences, Inc, Rhodia Ecological Support, Charleston, SC (Ongoing): Conducting an ecological risk assessment for a small environmental engineering firm at a Rhodia plant located in Charleston, South Carolina. Using data obtained by the onsite remedial investigation contractor, evaluating the potential for ecological risks to terrestrial and wetland receptors in large estuarine wetlands adjacent to the Site.

Ecological Risk Assessment, U.S. Army Corps of Engineers, Philadelphia District, Gaunts Brook BEE, Fort Dix, NJ (Ongoing): Under contract to the U.S. Army Corps of Engineers through Cape Environmental, responsible for the preparation of a Baseline Ecological Evaluation of Gaunt's Brook downstream and off-site of the Hanover Lake remediation area. Preparation of the BEE included sediment, surface water and surface soil sampling, collection of benthic invertebrate samples, and detailed biological descriptions of the brook and the wetlands community through which it flows. The BEE will be used in discussions with the State of New Jersey regarding the potential for off-site adverse ecological risks to have arisen as a result of the deposition of lead contaminated soil Fort Dix property.

Ecological and Human Health Risk Assessment, Connecticut Air National Guard, Orange Air Station, West Haven, CT (Ongoing): Project manager for the completion of an ecological and human health risk assessment for this Air National Guard Station located in West Haven, CT.

Sediment Assessment, U.S. Army Corps of Engineers, New York District, Gowanus Canal, Brooklyn, NY (Ongoing): Under contract to the U.S. Army Corps of Engineers through David Miller Associates, providing ecological risk modeling support as part of a Habitat Evaluation Procedure assessment of the Gowanus Canal. The evaluation included the review of data collected by the Corps as well as the collection of surface and deep sediment samples within the Canal. The resulting data will be incorporated into a food-chain modeling evaluation for assessment of impacts to higher trophic level organisms. The risk modeling will be used to assist the Corps in their New York Estuary restoration decision making process.

Ecological Risk Assessment, GPU, Cape May MGP Support, Cape May, NJ (Ongoing): Project manager for the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in Cape May, NJ. The BEE is used to quantitatively determine the potential for ecological impacts. The preparation of this BEE included the collection of surface sediment and surface soil samples from a tidal creek system in a coastal marsh. Additionally, flora and fauna found within the coastal marsh were surveyed and inventoried.

Forensic Environmental Liability Study, ExxonMobil, Olean Historical Research, Olean, NY (Completed 2006): Project manager for research into the environmental conditions and history of a former refinery located in Olean, NY. The New York State Department of Environmental Conservation (NYSDEC) has identified the location as a hazardous waste site due to the results of a state sponsored remedial investigation. Responsible for managing research into all historic processes and practices of the former refinery. Working with the client to develop a strategy to address the NYSDEC concerns and plan for future environmental assessments.

Forensic Environmental Liability Study, ExxonMobil, ExxonMobil – Rochester, Rochester, NY (Completed 2005): Project manager for research into the environmental conditions and history of a former refinery located in Rochester, NY. The New York State Department of Environmental Conservation (NYSDEC) has identified the location as a hazardous waste site due to the results of a state sponsored remedial investigation. Responsible for managing research into all historic processes and practices of the former refinery. Responsible for preparing the report and managing the input from two AMEC offices into the submitted work product. Working with the client to develop a strategy to address the NYSDEC concerns and plan for future environmental assessments.

Ecological Risk Assessment, Beazer East, Inc., Garwood Ecological Evaluation, Garwood, NJ (Completed 2005): Project manager for the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in Garwood, NJ. The BEE is used to quantitatively determine the potential for ecological impacts.

Ecological Risk Assessment, Dartco, Dartco BEE, North Branch, NJ (Completed 2005): Project manager for the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in North Branch, NJ. The BEE is used to quantitatively determine the potential for ecological impacts.

Ecological Risk Assessment, Applied Earth Solutions, Applied Earth Solution Eco Support, Bergenfield, NJ (Completed 2005): Project manager for the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in Bergenfield, NJ. Client was a small environmental engineering firm. The BEE is used to quantitatively determine the potential for ecological impacts.

Ecological Risk Assessment, Hatch Mott MacDonald, PVSC North Arlington Site, North Arlington, NJ (Completed 2004): Working for a small environmental engineering firm, managed the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in North Arlington, NJ. The BEE is used to quantitatively determine the potential for ecological impacts.

Ecological and Human Health Risk Assessment, Bethlehem Steel, Lackawanna Risk Assessment, Lackawanna, NY (Completed 2004): Project director for the completion of the human health and ecological risk assessment for this abandoned steel mill facility located in Lackawanna, New York. The ecological activities include the preparation of a detailed ecological risk assessment that was submitted to USEPA Region II. To support the completion of the ecological risk assessment and to address comments made by the agency on the draft assessment, conducted supplemental surface water and sediment sampling, macroinvertebrate community assessment, surface soil sampling, wetlands delineation and description of terrestrial biological communities.

Sediment Evaluation, General Motors, Technical Support to Redevelopment, Tarrytown, NY (Completed 2004): Task manager responsible for the planning and implementation of a sediment evaluation project for a former GM plant located in Tarrytown, NY. Responsibilities included the evaluation of historic sediment data from the site and the design of a comprehensive sediment sampling program to address data gaps. Additionally, oversaw the implementation of the sampling program and the presentation of the collected data.

Sediment Evaluation, U.S. Army Corps of Engineers, New York District, Gowanus Canal and Bay Restoration, Brooklyn, NY (Completed 2004): Under contract to the U.S. Army Corps of Engineers through NEA, completed an evaluation of sediment data collected from the Gowanus Canal. The evaluation included the review of data collected by the Corps and the development of a hierarchical evaluation process to focus future investigation and restoration on areas of greatest concern. In support of the Corps, attended one public meeting to outline the results of the project.

Ecological Risk Assessment, Federal Pacific Electric, FPE Baseline Ecological Evaluation, Newark, NJ (Completed 2004): Project manager for the completion of a Baseline Ecological Evaluation (BEE) under New Jersey's Technical Requirements for Site Remediation at a site located in Newark, NJ. The BEE is used to quantitatively determine the potential for ecological impacts.

Ecological Risk Assessment, Kerramerican, Kerramerican, Inc, - Blue Hill Risk, Blue Hill ME (Completed 2003): Managed the risk assessment activities (both ecological and human health) in support of a remedial investigation/feasibility study being conducted by the AMEC Mississauga, Ontario office. Conducted a screening level ecological risk assessment at a former zinc mine site in coastal Maine. Project included the detailed biological assessment of terrestrial, wetland and aquatic

ecosystems along the two mile stretch of an upper order stream flowing past the mine site, the preparation of a WET functional evaluation of local wetlands, and the evaluation of surface water, sediment and biological samples.

Sediment Evaluation, Pfister Chemical Site, Supplemental Sediment Evaluation, Ridgefield, NJ (Completed 2002): Project manager for the evaluation of contaminated sediments located in Overpeck Creek adjacent to the site located in Ridgefield, NJ. The creek, located in the Hackensack Meadowlands, was evaluated to determine the potential for ecological impacts and potential remediation/NRD costs associated with site-related constituents of concern.

Ecological Risk Assessment, U.S Army, Fort Dix – ERA, Fort Dix Military Reservation, NJ (Completed 2001): As part of the preparation of an Environmental Assessment for the restoration of a dam supporting Hanover Lake, conducted an screening-level ecological risk assessment on the impacts of the deposition of lead-contaminated soil in Gaunt's Brook leading from the lake. The ecological risk assessment included the collection of sediment samples for lead and various parameters such as AVS/SEM and the collection of benthic macroinvertebrates, as well as the analysis of historic surface water and sediment samples. Results of the assessment indicated the potential for ecological impacts to sediment organisms from exposure to lead.

Environmental Impact Assessment and Environmental Permitting

Sensitive Biological Resource Management, Gamesa, Gamesa Schaffer Mountain Wind Farm, Somerset County, PA (Ongoing): Task manager for the identification and delineation of wetland associated with projected access roads, transmission line corridors, and turbine locations at this planned wind farm located in Pennsylvania. Additionally responsible for the assessment of the potential for impacts to threatened and endangered species identified by the Commonwealth of Pennsylvania and the U.S. Fish & Wildlife Service as possible at risk from the construction of the wind farm. T&E species of concern included five plant species, the Indiana bat, the eastern woodrat, and the timber rattlesnake. Wetland activities included reconnaissance visits to identify project wetland areas, coordination of wetland delineation activities, preparation of Jurisdictional Determination applications to the U.S. Corps of Engineers, and strategic planning with the client regarding approaches to wetlands permit and alignment of roads, corridors and turbines. Assisted with the field evaluation and preparation of the Critical Issues Report that identified preliminary environmental impediments to the planned wind farm.

EIS Support, AES Sparrows Point LNG Project, FERC Third Party EIS, Sparrows Point, MD (Ongoing): Part of the AMEC technical team assisted the AES Sparrows Point LNG, LLC and Mid-Atlantic Express LLC to perform third-party services to the Federal Energy Regulatory Commission (FERC) regarding the Sparrows Point Project. AMEC is the third-party consultant to FERC for the preparation of a National Environmental Policy Act (NEPA) compliant documents (the Draft Environmental Impact Statement [DEIS] and the Final EIS) for LNG facilities and related pipelines. Specific responsibilities include the review and assessment of the Resource Reports related to Water Resources and preparation of those particular segments of the EIS in accordance with the 2002 FERC Guidance Manual for Environmental Report Preparation.

Sensitive Resource Management, NedPower Mt. Storm Wind Farm, Grant County, WV (Ongoing): Task manager for the identification and delineation of wetland associated with projected access roads, transmission line corridors, and turbine locations at this planned wind farm located in West Virginia. Activities included reconnaissance visits to identify project wetland areas, coordination of wetland delineation activities, preparation of Jurisdictional Determination applications to the U.S.

Corps of Engineers, and strategic planning with the client regarding approaches to wetlands permit and alignment of roads, corridors and turbines.

EIS Support, U.S. Army, Biological Assessment, Fort Dix Military Reservation, NJ (Completed 2001): Prepared a biological assessment (BA) for the use of graphite containing smoke obscurants on four firing ranges on base. The BA evaluated the potential for short-term and long-term effects to sensitive receptors from exposure to graphite and fog oil. The BA was prepared based on an evaluation of current literature on the use of the material, a scientific review of the sensitivities of wildlife and plants to the materials, and an estimation of potential exposure patterns.

EIS Support, Monsanto/DowElanco, Preparation of Generic EIS: While an employee of McLaren/Hart, wrote a Generic Environmental Impact Statement for the use of fluridone and glyphosate in the waters of the State of New York. The clients were seeking NYSDEC authorization for the use of their products in the state to control aquatic weeds and required a GEIS under 6 NYCRR Part 617 (SEQRA) to assist local applicators with needed permits. Activities to prepare the GEIS included collection and review of ecotoxicological data on the two chemicals, description of uses and potential ecological settings, identification of environmental impacts, and determination of mitigation measures and alternatives. Document was prepared and submitted to the NYSDEC on behalf of the clients. After responding to NYSDEC comments, attended three public hearings on the GEIS in support of the clients. Document was finally approved by the NYSDEC in 1995 and became the first GEIS accepted for aquatic herbicides since a Department generated GEIS was approved in 1981.

EIS Support, Blue Circle Atlantic Cement Company, Ravena, NY: While an employee of McLaren/Hart, under a Part 316 permit application to burn hazardous waste as a supplemental fuel, assisted the facility with the preparation of an EIS under the New York state SEQRA process. Responsibilities consisted of the identification of baseline ecological resources at the site, and using air-modeling support to project future emission and deposition rates, identified potential risks to ecological resources from the hypothetical burning of hazardous waste.

Wetlands Delineation and Mitigation

Wetlands Management, U.S. Army, Hanover Lake Wetlands Monitoring, Fort Dix Military Reservation, NJ (Ongoing): Managing a project to monitor the progress of a wetlands mitigation project at the Hanover Lake remediation area. Responsibilities include field monitoring to measure planting success, preparation of progress reports and coordination of required corrective measures.

Wetlands Management, Act Engineers, Princeton Theological Seminary, Princeton, NJ (Completed 2006): managed a project to delineate wetlands and submit a Letter of Interpretation to the NJDEP for a theological seminary.

Wetlands Management, North Carolina National Guard, Camp Butner – Wetlands Assessment, Raleigh, NC (Completed 2004): Provided peer-review support and technical guidance on project to delineate/identify all of the wetlands located on this 1,000 acre National Guard facility. Activities included site reconnaissance to identify wetland areas and provide guidance to technical staff on delineation techniques.

Wetlands Management, Commonwealth of Pennsylvania, Jackson Ceramix Wetlands Delineation, Jefferson County, PA (Completed 2002): As part of a remedial investigation in Jefferson County, PA, delineated and evaluated the wetlands that are to be addressed in Operable Unit 2. Additionally, provided conceptual wetlands restoration design support to the Project Engineer.

Wetlands Management, Honeywell, Inc., Honeywell Chrome 2002, Perth Amboy, NJ (Completed 2002): As part of a remedial action being planned for a chromium residue site adjacent to Newark Bay, prepared a comprehensive wetlands permitting package for State freshwater and coastal wetlands, State waterfront development, and Federal Nationwide Permit 26. Additional, supervised the preparation of a soil erosion and sediment control plan for the planned activities at the site.

Wetlands Management, Sayreville Landfill III PRP Committee, Sayreville Wetlands Support, Sayreville, NJ (Completed 2002): Project manager for the oversight of RD/RA activities, including the management of wetlands issues at an abandoned landfill that is almost entirely surrounded by wetlands. As part of the wetlands management process, delineated the wetlands around the 32-acre landfill, developed and obtained all state and Federal wetland permits, and prepared detailed wetland mitigation plans for compensatory mitigation as a result of landfill capping.

Wetlands Management, U.S. Army, Wetlands Delineation and Mitigation, Fort Dix Military Reservation, NJ (Completed 2001): Delineated wetlands at the Pemberton parcel as part of the preparation of an Environmental Assessments (EAs). Wetlands were delineated using the 1989 Interagency Manual. Detailed delineation reports were prepared as part of the EAs.

Wetlands Management, U.S. Army, Wetlands Delineation and Mitigation, Fort Dix Military Reservation, NJ (Completed 2000): Delineated wetlands at the Hanover Lake Dam restoration site as part of the preparation of an Environmental Assessments (EAs). Wetlands were delineated using the 1989 Interagency Manual. Detailed delineation reports were prepared as part of the EAs. Provided wetland mitigation design support as part of the excavation of contaminated stream sediments and wetland soils. Support included development of all associated NJDEP and Pineland permits and research into the presence of endangered species.

Wetlands Management, U.S. Army, Wetlands Delineation, Wetlands Delineation, Fort Devens, MA (Completed 2000): Delineated wetlands as part of the preparation of an Environmental Assessments (EAs). Wetlands were delineated using the 1989 Interagency Manual. Detailed delineation reports were prepared as part of the EAs.

Natural Resource Damage Support

NRD Defense Support, Soha & Lang, NRD Litigation Support, Tacoma, WA (Completed 2006): Served as expert witness in the settlement of natural resource claims at the Commencement Bay CERCLA site in the state of Washington, between the City of Tacoma and its insurance carrier. The City was seeking to be reimbursed for NRD settlement costs from its insurance carrier, which feels the reimbursement is unwarranted due to prior knowledge of the action that led to the claim. In support of the carrier, reviewing site-related NRD documents, participated in depositions, and prepared trial presentation material.

NRD Defense Support, Lucent, Lucent NRD, NJ (Completed 2005): Providing support to a corporate client seeking to resolve state natural resource damage claims under New Jersey regulations. Support includes evaluation of distribution of chemical contamination in surface water and sediments at 9 different locations in the State to determine the potential for an NRD claim. Future activities will include negotiations with the NJDEP over the potential claims and technical efforts to restore impacted resources.

NRD Defense Support, Morris County Dump NPL Site, NRD Expert Witness Support: While an employee of McLaren/Hart, served as an expert witness in defense of claims of injuries to natural resources made by the Department of Interior against National Gypsum. This case set precedence because it was the first time a Natural Resource Damage Claims case was argued in bankruptcy court. Following a review and critique of the government's case and oral arguments before the bankruptcy court by the government and the defense team, the judge decided that the trustee had not adequately proven damages to natural resources and issued a ruling favorable to the PRP.

NRD Defense Support, Consolidated Edison Co., Arthur Kill Generating Plant Site, NRD Defense Support: While an employee of McLaren/Hart, managed a project to provide NRD defense support to a power company in Staten Island, New York. The company released PCB-contaminated dielectric fluid into the Arthur Kill from its generating station. Activities include the evaluation of potential impacts to natural resources from the spill and providing guidance to the client on defense strategies.

NRD Defense Support, Robinson Silverman, NRD Defense Support: While an employee of McLaren/Hart, managed a project that provided NRD consulting support to a law firm in New York City. The ultimate aim was to evaluate potential liabilities associated with the release of PCBs by a major industrial company into the New York Harbor and lower Hudson River, and to plan strategic defensive moves in anticipation of USEPA examination of the PCB issue.

NRD Defense Support, Kirkpatrick and Lockhart, NRD Defense Support: While an employee of McLaren/Hart, managed the preparation of an expert report in support of the legal defense of a steel company in Pittsburgh, PA that was sued by the USEPA for claimed violations of the Clean Water Act. Part of the suit claimed ecological impacts to natural resources located in the Allegheny and Kiskiminetas Rivers from discharges from four of the company's steel mills. Preparation of the report included interaction and coordination with the law firm and the steel mill, collection and evaluation of data, preparation of the draft document, and interaction with the expert witness to ensure technical accuracy. Report has been submitted to the Agency and is awaiting review.

Ecological Restoration

Ecological Restoration, General Electric, First ½ Mile Restoration, Pittsfield, MA (Ongoing): Developed stream bank restoration plans in advance of the excavation of floodplain soil and sediments of the Housatonic River. Following excavation of the soils and sediments from the streambank, the area was graded, stabilized to prevent future erosion, and replanted to the extent necessary to restore the vegetative community to its pre-excavation habitat value. Additionally, providing monitoring support to determine whether the streambank restoration activities are successful.

Ecological Restoration, JCP&L, Streambank Restoration: While an employee of McLaren/Hart, managed the streambank restoration for a manufactured gas plant (MGP) site. The presence of the material required extensive excavations of soils along the bank of the Delaware-Raritan Canal. As a result of the excavations, extensive restoration to the banks and to exotic plant species existing at the Site was required. Responsibilities included the documentation of baseline vegetative conditions and the preparation of vegetative restoration plans. Extensive bio-restoration material was used to stabilize the canal slopes to allow for planted sugar maples and herbaceous vegetation to become established.

Ecological Restoration, J&J Health Care Systems, Pond Restoration: While an employee of McLaren/Hart, managed a project to restore the ecological and aesthetic balance of an 8,000 square foot pond. Restoration began with drainage of the pond followed by removal of the accumulated sediment. The bottom contour of the pond was restored to facilitate passage of new sediment through the pond. Riprap along the banks was restored to control erosion. To enhance water quality, a new

aeration device was installed and banks of water lilies were built. At the completion of restoration activities, the pond was stocked with bluegill, yellow catfish, smallmouth bass, and fathead minnows.

Publications

Barnthouse, L., C. Harman, W. Landis, and L. Tannenbaum. 2006. Integrated Environmental Assessment and Management's Commitment to Scientific Discourse. Editorial, Integrated Environmental Assessment and Management, 2:3.

Interstate Technology Regulatory Council (ITRC). 2006. *Design of Ecological Land Re-use of Remediated Sites.* Ecological Enhancements Team, Participant and Contributing Author.

ITRC. 2005. *Guide for Characterization, Design, Construction and Monitoring Mitigation Wetlands.* Mitigation Wetlands Team, Participant and Contributing Author.

C.R. Harman, W.R. Alsop, and P.D. Anderson. 2004. Ecological Risk Assessment Applied to Energy Development. *in Encyclopedia of Energy. ed.* C.J. Cleveland. Elsevier Science, San Diego, CA.

ITRC. 2003. *Technical and Regulatory Guidance Document for Constructed Treatment Wetlands.* Constructed Wetlands Team, Participant and Contributing Author.

ITRC. 2003. *Characterization and Remediation of Soil at Closed Small Arms Firing Ranges.* Small Arms Firing Range Team, Participant and Contributing Author.

P.J. Sheehan, F.J. Dombrowski, M.J. Ungs, and C.R.Harman. 1999. Ecotoxicological Risk Assessment for Hazardous Waste Incineration: A Case Study. *in Hazardous Waste Incineration, Evaluating the Human Health and Environmental Risks. eds.* S.M.Roberts, C.M. Teaf, and J.A. Bean. Lewis Publishers, Boca Raton, Florida.

Sheehan, P.J., E. Algeo and C.R. Harman. 1993. Ecotoxicology and Economics. *McLaren/Hart Reporter.*

Harman, C. R., W. M. Romaine and C. P. D'Alleinne. 1993. Wetlands Management at CERCLA Sites, *Current and Future Priorities for Environmental Management.* NAEP 18th Annual Conference Proceedings. Raleigh, North Carolina: 113-124.

Harman, C. R. 1991. Environmental Liability Assessments of Former Gasoline Service Stations, *Proceedings of the Ninth Annual Hazardous Materials Management Conference/ International.* Atlantic City, New Jersey.

Harman, C. R. 1986. Effects of Rural Development on Avian Community Structure. Southwest Texas State Univ. Master's Thesis, 57 pp.

Professional Presentations

Harman, C.R. and G.R. Biddinger. 2006. Using Ecological Enhancements to Manage Environmental Obligations: Conceptual Approaches and Implementation. Poster Presentation at the 27th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, Quebec, Canada.

Harman, C.R. 2004. A Baseline Ecological Risk Assessment Completed for a Site on a Mississippi River Floodplain. Platform Presentation at the 25th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Portland, Oregon.

Harman, C.R. 2004. Integration of Ecological Re-Use as a Component of Remediation at Hazardous Waste Sites. Platform Presentation at the 25th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Portland, Oregon.

Gneiding, L; C. Calhoun; P. Perhamus; and C. Harman. 2003. An Instream Aquatic Study of a Stream Receiving Treated Groundwater from a Landfill. Poster Presentation at the 24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Austin, Texas.

Gneiding, L.; C. Calhoun; P. Perhamus; and C. Harman. 2003 Low Benthic Macroinvertebrate Numbers: Contamination or Habitat? Poster Presentation at the 24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Austin, Texas.

Harman, C.R. 2003. Technical Approaches to Habitat Enhancement as Part of Remedial Actions. Wildlife Habitat Council on Using Ecological Enhancements at Region V Contaminated Sites. Merrillville, IN.

Harman, C.R., V. Gallo, and S. Posten. 2002. Biodegradation Of Chlorinated Hydrocarbons Discharged Through Ground Water Into a Wetlands. Platform Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Gneiding, L., C. Calhoun, and C. Harman. 2002. The Effects of Channelization on Benthic Macroinvertebrate Populations Within a Contaminated Urban Stream. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Gneiding, L., C. Calhoun, and C. Harman. 2002. A Terrestrial Ecological Risk Assessment Involving Ecologically Virgin Material. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Gneiding, L., C. Calhoun, and C. Harman. 2002. Is There Ecological Risk Within a Man-Made Trench? Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Calhoun, C., L. Gneiding, and C. Harman. 2002. Ranking SWMU Remediation Using a Terrestrial Ecological Risk Assessment. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Harman, C. and C. Calhoun. 2002. An Ecological Risk Assessment Using Multiple Lines of Evidence at a Mine Site in Maine. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, Utah.

Harman, C.R. 2001. The Use of Constructed Wetlands to Manage Stormwater Runoff at Firing Ranges. Presentation at the ITRC Meeting, Falmouth, MA.

Harman, C.R. 2001. Ecological Risk Assessments: Concepts and Methodologies. Hudson/Delaware Chapter SETAC Annual Meeting Short Course, Lyndhurst, NJ.

Harman, C.R. and P.K. Perhamus. 1999. Evaluation of Potential Impacts to Wetland Systems from Groundwater Extraction Systems. Platform Presentation at the 20th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Philadelphia, Pennsylvania.

Baron, L, N.L. Bonnevie, and C.R. Harman. 1998. Application of Approaches for Evaluating the Bioavailability of Chemicals in Terrestrial and Aquatic Environments. Poster Presentation at the 19th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Charlotte, North Carolina.

Sigethy, S., L. Baron, C. Harman, and S. Venkatraman. 1997. Prediction of Metal Bioavailability to Plants using Soil Physico-Chemical Properties: An Approach to Improving Risk Estimates. Platform Presentation at the Society of Risk Analysis Conference, Washington, D.C.

Baron, L., S. Sigethy, C. Harman, and S. Venkatraman. 1997. Use of Soil Physico-Chemical Properties to Predict Metal Bioavailability and Ecological Risks in Terrestrial Environments. Platform Presentation at the 18th Annual Meeting of the Society of Environmental Toxicology and Chemistry, San Francisco, California.

Baron, L.A., S.D. Sigethy, and C.R. Harman. 1997. Ecological Risk Assessment of the Aquatic Community Adjacent to a Steel Manufacturing Facility. Platform Presentation at the at the ASTM Committee E-47 on Biological Effects and Environmental Fate Seventh Symposium on Environmental Toxicology and Risk, St. Louis, Missouri.

Harman, C.R. 1997. Wetlands and Ecological Risk Assessments: An Overview. Hudson/Delaware Chapter SETAC Annual Meeting Short Course, Prallsville, New Jersey.

Baron, L.A. and C. R. Harman. 1996. Screening Ecological Risk Assessment for the Aquatic Community at a Municipal Sewage Treatment Plant. Poster Presentation at the 17th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Washington, D.C..

Baron, L.A. and C. R. Harman. 1996. Evaluation of Chemical Constituents in Sediments Adjacent to a CERCLA Site. Poster Presentation at the 17th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Washington, D.C..

Harman, C.R., C.S. Crockett, C.P. D'Alleinne, P.S. Price, and K. Schild. 1995. Use of Monte-Carlo Analysis to Evaluate Multimedia Ecological Risks and Impacts. Platform Presentation at the Society of Risk Analysis Annual Conference, Honolulu, Hawaii.

Harman, C.R. 1995. Wetlands Restoration at Hazardous Waste Sites in Northern New Jersey. Poster Presentation at the 16th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Vancouver, British Columbia, Canada.

Harman, C.R. and W. Gilchrist. 1995. The Ecological Evaluation of Surface Water Outfalls at a Manufacturing Plant in New Jersey. Poster Presentation at the 16th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Vancouver, British Columbia, Canada.

Harman, C.R., F.G. Brockerhoff and C.P. D'Alleinne. 1995. Evaluation of Potential Ecological Impacts Associated with a POTW Located on Hempstead Bay, New York. Poster Presentation at the 16th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Vancouver, British Columbia, Canada.

Harman, C.R. 1995. Risk and Natural Resource Damage Assessments. Presentation at the 1995 Mid-America Safety, Health & Environmental Conference. Lake of the Ozarks, Missouri.

Harman, C.R. and C.P. D'Alleinne. 1994. Distribution of Mercury Residues in Domestic Chicken (*Gallus domesticus*) Samples Collected From a Hazardous Waste Site. Poster Presentation at the 15th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Denver, Colorado.

Harman, C.R. 1994. The Use of an Ecological Receptor Evaluation to Select a Remediation Strategy at a Hazardous Waste Site. Poster Presentation at the 15th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Denver, Colorado.

Harman, C.R. and T.J. Lusardi. 1994. Interrelationship of Sediments, Surface Water and Groundwater in a Connecticut Stream. Poster Presentation at the Ninth Annual Contaminated Soils Conference, University of Massachusetts, Amherst, Massachusetts.

Schmitt, L.M. and C.R. Harman. 1994. The Use of Air Modeling in a Predictive Ecological Risk Assessment for a Hazardous Waste Incinerator. Poster Presentation at the 87th Annual Meeting of the Air & Waste Management Association, Cincinnati, Ohio.

Harman, C.R. 1994. Designing a Good Ecological Sampling/Analysis Plan. Presentation at the New Jersey Water Pollution Control Association Tech Transfer Ecological Risk Assessment Seminar, Somerset, New Jersey.

Harman, C.R. 1994. The Use of Ecological Risk Assessments in Defining Remediation Approaches. Hudson/Delaware Chapter of the Society of Environmental Toxicology and Chemistry Annual Meeting, West Chester, Pennsylvania.

Harman, C. R., C.P. D'Alleinne, P.J. Sheehan, and F.J. Dombrowski. 1993. The Use of a Predictive Ecological Risk Assessment in Support of a Hazardous Waste Incinerator Siting Permit. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas.

Harman, C. R. 1993. A Review of the Natural Resource Damage Claims Case at the Asbestos Dump Superfund Site, Morris County, New Jersey. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas.

Romaine, W. M. and C. R. Harman. 1993. Utilization of Diversity and Biotic Indices in Defense of Natural Resource Damage Claims. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas.

Schmitt, L.M., C.R. Harman and C.P. D'Alleinne. 1993. The Consideration of Phytotoxicological Factors in Ecological Risk Assessments. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas.

Harman, C. R., W. M. Romaine and C. P. D'Alleinne. 1993. Wetlands Management at CERCLA Sites. Platform Presentation at the National Association of Environmental Professionals 18th Annual Conference, Raleigh, North Carolina.

Harman, C. R. and C. P. D'Alleinne. 1993. Trace Element Concentrations in Guinea Grass (*Panicum maximum*) Collected From a Hazardous Waste Site in Juncos, Puerto Rico. Poster Presentation at the ASTM Committee E-47 on Biological Effects and Environmental Fate Third Symposium on Environmental Toxicology and Risk Assessment, Atlanta, Georgia.

Harman, C. R. 1991. Environmental Liability Assessments of Former Gasoline Service Stations. Platform Presentation at the Ninth Annual Hazardous Materials Management Conference/International, Atlantic City, New Jersey.

Corporate Presentations

Harman, C.R. 2002. Environmental Impact Statements/Ecological Risk Assessments. Air Force Mentor-Protege Training Program to Zambrana Engineering. St. Louis, MO.

Harman, C.R. 2001. Mitigation and Constructed Wetlands: Technical Approaches and Requirements. Air Force Mentor-Protege Training Program Technical Presentation to Zambrana Engineering. St. Louis, MO.

Harman, C.R. 2000. Using Risk Assessment to Manage Environmental Liabilities. Presentation at the 2000 Pennsylvania Environmental Conference, Harrisburg, Pennsylvania.

Harman, C.R. 2000. Natural Resource Damage Claims: The Next Big Thing? Presentation at the 2000 Prudential Roundtable Meeting, Boston, Massachusetts.

Harman, C.R. 1998. Principles of Natural Resource Damage and Ecological Restoration. Technical Presentation to Lucent Technologies Inc., Bell Laboratories, Murray Hill, New Jersey.

Harman, C.R. 1998. Ecological Assessments and NRD Evaluations Under the Tech Regs. Technical Presentation to Riker, Danzig, Sherer, Hyland & Perretti, Morristown, New Jersey.

Harman, C.R. 1997. Ecological Risk Assessments - What Are They & What Will They Mean To Your Company. Presentation at the Chemical Industry Council of New Jersey Spring Environmental/Regulatory Conference, New Brunswick, New Jersey.

Harman, C.R. and T.J. Iannuzzi. 1997. Ecological Risk Assessment: Applications and Advances. Technical Presentation to Merck & Co., Whitehouse Station, New Jersey.

Harman, C.R. 1997. Ecological Risk Assessment: Applications, Advantages and Advances. Technical Presentation to Hercules, Inc., Wilmington, Delaware.

Harman, C.R. 1996. Ecological Risk Assessments: Protocols and Procedures. Technical Presentation to the law firm of Sidley Austin, Washington, D.C.

Harman, C.R. 1996. Overview of the Natural Resource Damage Assessment Process. Technical Presentation to the law firm of Manko, Gold & Katcher, Philadelphia, Pennsylvania.

Harman, C. R. 1992. Ecological Risk Assessments, Concepts and Methodologies. Technical Presentation to the Superfund Response Group, Mobil Oil Corporation, Princeton, New Jersey.

Harman, C. R. 1992. Ecological Risk Assessments. Part of NJDEPE Proposed Cleanup Standards Seminar, Sponsored by McLaren/Hart Environmental Engineering Corporation and the law firm Herold and Haines, Warren, New Jersey.

Keenan, R. K. and C. R. Harman. 1992. Ecological Risk Assessment in the 1990's. Technical Presentation to the law firm of Sidley & Austin, New York, New York and Chicago, Illinois.

Justin C. Johnston, MSc.

Biologist

Professional Summary

After completion of his Masters degree, Justin has been working as the lead biologist on a CWA 316b baseline survey project estimating impingement and entrainment of fishes at four First Energy facilities located on the southern shore of Lake Erie and along the Ohio River. He is also involved with 316b activities at three Detroit Edison (DTE) facilities along the St. Clair River, MI.

Justin has worked in the field of aquatics for the past 4 years while completing a Masters Degree in biology at Central Michigan University. While working towards a Masters degree he worked as a Graduate Teaching Assistant, a Computer Technician Liaison, and as a Research Technician for the Michigan Water Research Center. His thesis work included manipulative laboratory experiments to determine the optimal food items for growth and survival of larval yellow perch through the critical period. He also tested the effects of prey contrast, temperature and food density on larval perch growth and survival in the laboratory. He has been involved with various other ecology projects alongside other graduate students including work on the eastern massasauga rattlesnake, eastern milk snake, and the double-crested cormorant. Before his graduate career Justin worked as an undergraduate technician on various research projects including population estimates of lake sturgeon in the Manistee River, MI and of smallmouth bass in two bays in the Beaver Island archipelago in northern Lake Michigan.

Justin is proficient in larval and adult fish identification, aquatic entomology, zooplankton identification and biology, and phytoplankton identification. He has experience in fish studies of population dynamics, and is skilled in data analysis, experimental design, and report writing.

Justin is trained in HAZMAT 1205, First Aid/CPR/Adult AED, Hazcom, ACOE wetland delineation, and project management.

Summary of core skills

Aquatics/Fisheries Research

Justin is an expert in aquatic ecology. Justin has experience in aquatic macroinvertebrate identification, phycological (algae) investigations, fish identification, zooplankton identification, larval fish identification, and population dynamics studies of aquatic environments including associated field work. Justin has also conducted sonic telemetry to tag and track the Michigan state listed Lake Sturgeon (*Acipenser fulvescens*).

Clean Water Act 316(b) Biological Surveys

Justin has managed and/or worked on 316(b) biological surveys for several coal burning power facilities in Ohio and Michigan. These facilities include five First Energy and three Detroit Edison (DTE) power plants.

Education and Training

BS Biology, Central Michigan University, May 2000.

MS Biology, Central Michigan University, December 2004.

AMEC Fundamentals of Project Management short course, June 2006.

Army Corps of Engineers Wetland Delineation & Management Training, September 2006.

First Aid / Adult CPR / AED training, April 2005.

Hazmat 1205 training April, 2005.

Hazcom training May, 2005.

40-hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training, March 2007.

Memberships
American Fisheries Society

International Association for Great Lakes Research

Employment History
AMEC Earth and Environmental, Biologist, March 2005 to Present

Central Michigan University, Michigan Water Research Center

Research technician, May 2001 to December 2004

Central Michigan University, Department of Biology

Graduate Teaching Assistant, August 2001 to December 2003

Central Michigan University, Department of Biology

Undergraduate researcher, April 1999 to August 1999

Detailed Skills by Representative Projects
AMEC Paragon – AES Sparrows Point, BST#768430000, ongoing in 2007. Authored Aquatic Species and Essential Fish Habitat sections of an Environmental Impact Statement (EIS) for a Liquefied Natural Gas (LNG) terminal and interstate pipeline extending from Baltimore, MD to Eagle, PA (near Philadelphia). This project was being conducted by a team of biologists at AMEC Paragon and AMEC Earth & Environmental. AMEC was contracted as 3rd party to the Federal Energy Regulatory Commission (FERC). Tasks included reviewing relevant *applicant resource reports and including pertinent information in the EIS, preparing data* requests to the applicant in order to gain the information necessary to make determinations on potential environmental impacts, and contacting cooperating agencies to determine what requirements would be necessary to avoid or minimize potential environmental impacts.

General Electric – Pittsburgh Depot BST#572260206, completed 2007. Supervised the excavation and closure of a diesel fuel spill. Took soil samples using encore samplers to test for various components of the fuel to ensure that all fuel saturated soil was excavated. Tasks included organizing subcontractor schedules, QA/QC to make sure that proper fill was used and the closure was satisfactorily completed, and documentation of all aspects of the excavation and closure.

Confidential Wind Development – completed 2007. Wetland *delineations* and threatened and endangered species surveys at a linear wind development site in Pennsylvania. Duties included walking proposed development corridors in order to find wetlands and rare floral species. Surveyed the site for raptors during the spring raptor migration.

Kinectrics / First Energy –Bay Shore Plant BST#769360000, completed 2007. Project Manager for supplemental impingement sampling and the assessment of mortality of target species of fish after impingement. Duties included setup of mortality assessment mesocosms

with flow through water to support fish. Determination of discharge temperature dynamics as water flowed out to Lake Erie and application of this knowledge to temperature adjustments in the mesocosms to approximate temperature stresses experienced by fishes after impingement. Collection of additional impingement data for use in estimating impingement at the plant. Financial management of the project.

Kinectrics / First Energy –Eastlake Plant BST#768870000, completed 2007. Project Manager for supplemental impingement sampling and the assessment of mortality of target species of fish after impingement. Duties included setup of mortality assessment mesocosms with flow through water to support fish, collection of additional impingement data for use in estimating impingement at the plant, and financial management of the project.

General Electric – Pittsburgh Depot BST#572260070, completed 2006. Supervised the closure of an excavation after a diesel fuel spill. Tasks included organizing subcontractor schedules, QA/QC to make sure that proper fill was used and closure was satisfactorily completed, and documentation of all aspects of the closure.

First Energy – Ashtabula, Eastlake, Sammis, and Burger Power Plants BST#s 352080001, 352080002, 352080003, and 352080005, completed 2006. Lead Biologist for AMEC on a 316b baseline survey project estimating impingement and entrainment of fishes at four coal-fired First Energy facilities ranging from 200MW up to 2200MW and located on the southern shore of Lake Erie and along the Ohio River. Conducted searches and interviews for well qualified students or recent college graduates to work as interns on the First Energy project. Wrote requests for proposals, negotiated costs, and completed a subcontract with West Virginia University to conduct ichthyoplankton identifications on larval fishes collected at Ashtabula and Eastlake sites. Audited West Virginia University to ensure accurate larval fish identifications. Wrote the Job Safety and Hazard Analysis (JSHA) for each site. Developed a relational database to efficiently compile impingement, entrainment, water quality, weather, and flow data and wrote weekly and quarterly progress reports to inform First Energy executives of the progress and issues arising at these sites. Performed QA/QC on samples to ensure that all technicians were performing tasks properly. Worked with senior engineers and environmental scientists at the facilities to make the studies more efficient and safe. Prepared reports of state threatened/endangered listed species collected while sampling. Prepared bids and proposals for conducting other 316b work along the east coast.

Kinectrics – Detroit Edison (DTE) – St. Clair, Belle River, and Harbor Beach Power Plants BST#575110000 completed 2006. Assisted 316b project managers in correcting problems with staffing and training of AMEC personnel at three Detroit Edison (DTE) facilities along the St. Clair River, MI. He wrote requests for proposals, negotiated costs, and completed subcontracts with Central Michigan University to complete larval fish identification tasks. He conducted audits of activities at sites for safety and proper execution. He led teams of 3 technicians in the field to ensure that measurements and fish identifications were accurate. He performed QA/QC on samples to ensure that all technicians were performing tasks properly. He worked with senior engineers and environmental scientists at the facilities to make the studies more efficient and safe. He prepared bids and proposals for conducting other 316b work along the east coast.

Central Michigan University, Michigan Water Research Center. Processed data using MS excel and Minitab statistical software, and wrote reports using MS word. Presented data to the general public and peers in PowerPoint seminar and poster presentations. Developed techniques for collecting yellow perch eggs and devised and conducted experiments to test environmental characteristics on growth and survival of larval yellow perch. Developed and built a system to continuously culture microalgae (Nannochloropsis sp.). Cultured rotifers for feeding larval fishes and other zooplankton for research purposes. Collected and analyzed

electrochemical data using both Hydrolab and YSI sonde units. Collected zooplankton and phytoplankton samples using micron mesh plankton nets. Developed procedures for estimating biomass of algal taxa over time in Platte Lake MI which helped lead to a contract extension with Platte Lake Association. Operated flat bottom and larger Boston Whaler type research boats. Measured stream discharge using a Marsh-McBerney and floating object techniques. Identified larval fishes, zooplankton, and phytoplankton using dichotomous keys and both compound and dissecting microscopes. Dissected larval yellow perch guts and identified contents, removed larval otoliths and mounted them on slides for examination under high magnification to determine days since hatch of larval yellow perch.

Justin worked as a technician alongside other graduate students conducting diet studies on the double-crested cormorant in the Beaver Island archipelago in northern Lake Michigan. He assisted in tracking eastern milksnakes with radio telemetry. He helped to find and capture eastern massasauga rattlesnakes in Ann Arbor, Michigan for use in a laboratory study of the toxicity of adult and juvenile massasauga rattlesnakes using LD-50 analysis.

Central Michigan University, Department of Biology. Prepared lab materials prior to class including micropipetting reagents, centrifugation, setting water baths, etc. He proctored exams in lecture courses, and corrected assignments. He taught General Biology and Genetics laboratories including the following:

- Introduction to Drosophila
- Probability, chi-square, and Dihybrid crosses
- Ascospore linkage
- Restriction mapping
- Genetic Transformation
- Polymerase Chain Reaction (PCR)
- DNA sequence analysis using Genbank
- Introduction to C. elegans
- DNA sequence analysis – MacVector

Central Michigan University, Department of Biology. Set, retrieved, and over-hauled gill nets used to capture lake sturgeon and trap nets used to capture smallmouth bass. He built, set, and retrieved artificial substrate egg samplers for the capture of lake sturgeon eggs in the Manistee River. He tagged lake sturgeon and smallmouth bass using floy, PIT, and sonic transmitter tags, and tracked sonically tagged fish. He recorded and analyzed data on by-catch of gill nets and trap nets, sonic telemetry, and egg samplers. He calculated Petersen and Schnabel population estimates based on mark and recapture data and included the results in final reports on the projects.

Presentations / Publications

- IAGLR Annual meeting 2004, University of Waterloo...The Effect of Copepod and Nauplii Food Items on Growth and Survival of Larval Yellow Perch (Perca flavescens) Through the Critical Period. (Poster)

- Seminar Series May 2004, Central Michigan University…Food Requirements for Optimal Growth and Survival of Larval Yellow Perch (Perca flavescens) Through the Critical Period.
- Crystal Lake Association annual meeting 2004, Frankfurt MI…Nutrient sources and biological production in the near shore region of Crystal Lake, Benzie Co., Michigan.
- Michigan Chapter of the American Fisheries Society annual meeting 2004, Higgins Lake Michigan… Food Requirements for Optimal Growth and Survival of Larval Yellow Perch (Perca flavescens) Through the Critical Period.