# DAVID KEITH, Ph.D., R.G., C.H.G.

**Partner, Project Manager/Sediment Scientist**

## PROFESSIONAL HISTORY

Anchor QEA, Partner, 2009
Anchor Environmental, Partner, 2006 to 2009
Anchor Environmental, Associate, 2002-2006
19 Years Total Environmental Consulting Experience

## EDUCATION

Colorado School of Mines, Golden, Colorado, Ph.D., Geochemistry, 1994
University of Southern Mississippi, Hattiesburg, Mississippi, M.S., Geology, 1991
North Carolina State University, Raleigh, North Carolina, B.S., Geology, 1983

## EXPERIENCE SUMMARY

Dr. Keith has directed and participated in numerous projects involved in remediating sites environmentally impacted by contaminated surface water, groundwater, soils, sediments, and other geologic materials, and in addressing problems associated with nonpoint source pollution in stormwater runoff. He has conducted hydrogeologic investigations at local and regional scales, geochemical evaluations of contaminated sediments, soils, industrial wastes, and mining wastes, and developed data analysis tools using geographic information system technology. Dr. Keith has led remedial investigations and feasibility studies at RCRA/CERCLA sites, preparation of Environmental Impact Statements/Environmental Assessments as required by NEPA, and in the design of reclamation and closure plans for mine and other industrial sites.

Dr. Keith has worked on several projects involved in evaluating the distribution and the potential ecological impacts of contaminated sediments in lakes, streams, and estuaries throughout the United States. He has exceptional expertise in the use of numerical geochemical models for determining the fate and transport of contaminants in aquatic environments, and in source identification. He has performed water quality evaluations in regards to dredging, capping, natural recovery, and disposal options for a variety of contaminants. Contaminants of concern have included metals and a variety of organic chemicals (polychlorinated biphenyls, polyaromatic hydrocarbons, dioxins and furans, and pesticides). He has provided litigation support and expert witness services on several projects.

## REPRESENTATIVE PROJECT EXPERIENCE

### Patrick Bayou Remedial Investigation/Feasibility Study, Patrick Bayou Joint Defense Group

Dr. Keith is the technical lead/project manager for superfund site investigations of tributary to the Houston Ship Channel that is surrounded by three major industrial manufacturing facilities. The project involves multiple potential contaminant phases and sources, and significant hydrodynamic concerns. Specific tasks involve development of site conceptual model, and development and implementation of remedial investigation and feasibility study workplans, including ecological and human health risk assessment.



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### Bayou d'Inde Site, Calcasieu River and Estuary in Lake Charles, Louisiana, Bayou d'Inde PRP Group

Dr. Keith is the technical reviewer/advisor on the project team providing FS, remedial design, and integrated natural resource damage (NRD) services to group of PRPs on Bayou d'Inde of the Calcasieu River/Estuary located in Lake Charles, Louisiana. EPA previously performed a RI and risk assessment of the larger river/estuary area, and identified Bayou d'Inde as a primary area of concern. A group of PRPs with facilities on Bayou d'Inde entered into an agreement with the State of Louisiana to conduct follow-on FS and remedial design activities at the Site. Anchor is providing a wide range of project management and technical services for the project, including further development of the site conceptual model, delineation of areas of interest, development of remediation goals and objectives, detailed risk assessment and NRD assistance.

### San Jacinto Waste Pits, Houston, Texas

Dr. Keith is providing expert technical consulting services for two potentially responsible parties to identify sources of dioxins in the San Jacinto River and Houston Ship Channel following receipt of special notice letters from USEPA Region 6. To date, services have involved interpretation of site sediment chemistry data and hydrodynamic information, evaluation of aerial photographs, determination of dredging impacts from sand mining operations in the area, and development of potential source control remedies and cost estimates for the waste pits and surrounding area.

### Bayou Texar, Pensacola, Florida

Dr. Keith is conducting expert fate and transport evaluations to identify attenuation mechanisms for fluoride-bearing groundwater as it enters sediments in Bayou Texar for industrial clients. The evaluation has involved developing work plans to understand the distribution of fluoride in surface water, pore water, and sediments and applying geochemical modeling techniques to interpret those data. The results showed that fluoride precipitates as an inert mineral as groundwater interacts with the surface water in Bayou Texar in transitional sediments and the ultimate ecological impact of the groundwater discharge is minimal.

### Campbell Shipyard Remedial Design, Port of San Diego, California

Dr. Keith was the project manager for Site remedial alternatives analyses, technical analyses for the site Environmental Impact Report, and for preparing engineering design documents for the San Diego Unified Port District remediation project at the former Campbell Shipyard. The design involves placing a clean habitat cap over contaminated sediments that contain constituents of concern (COCs) at concentrations greater than cleanup levels. The habitat cap will isolate contaminated sediments from the marine environment, and provide clean habitat for flora and fauna. Specific team tasks included providing design specifications for construction of the habitat cap, upgrading the shoreline (bulkhead) structures, re-locating a storm drain that currently discharges to the site, designing the dredge and fill portions of the project, providing support in obtaining all necessary State and Federal permits, designing and documenting habitat

enhancement opportunities, and providing construction oversight. There is a large component of agency and public outreach associated with the project.

### NAPL Water Quality Evaluation, Vancouver Shipyard, British Columbia

Dr. Keith was the principal environmental scientist for the evaluation of water quality impacts associated with dredging sediments contaminated with non-aqueous phase liquids (NAPL) in an active shipyard. The project involved characterization of sediments containing up to 1.3% polycyclic aromatic hydrocarbons, developing dredge management units and developing dredge elutriate test procedures to account for NAPL behavior. Modified U.S. Army Corps of Engineer DREDGE modeling procedures were also developed to predict water quality at the point of dredging, and for areas downstream. Best management practices for dredging were developed and analyzed in the DREDGE model. These data were used to evaluate potential ecological responses that could result from NAPL release under different scenarios.

### Stege Marsh Toxic Hot Spot Evaluation in Richmond, California, Stauffer Management Company

Dr. Keith was the project manager/principal environmental scientist for assessment of site impacted by weathering by-products of pyrite cinder landfill, fuels, proprietary pesticides, solvents, and alum generated at a former chemical processing facility undergoing site closure and redevelopment on San Francisco Bay. This work was done for a large industrial client under the direction of *de maximis* serving as a project coordinator. Dr. Keith led the development and implementation of field investigations of soils, sediments, and waters in upland chemical plant property and areas within Stege Marsh, recreated a site history spanning a period of 85 years using aerial photographs and company documents, and performed detailed geochemical and hydrogeologic analysis to develop a site conceptual model. The model explained the generation and migration of sulfuric acid, metals and other contaminants into Stege Marsh. The conceptual model was utilized to develop performance specifications for a passive bio-reactor treatment system for groundwater. A comprehensive remedial system design, including excavation and neutralization of reactive cinder landfills materials, was developed and successfully presented to the governing Regional Water Quality Control Board.

### Halby/Potts Site Investigation in Wilmington, Delaware, U.S. Borax

Dr. Keith was the project manager/principal environmental scientist for evaluation of contaminant sources and migration pathways in adjacent State Superfund/chemical processing facilities undergoing site closure and redevelopment near the Port of Wilmington, Delaware. The investigation consisted of developing and implementing a comprehensive site investigation to evaluate sediments and groundwater in an estuarine marsh system. The primary purpose of the investigation was to evaluate contaminant distribution and develop a contaminant source allocation for the responsible parties. Primary contaminants of concern included arsenic, lead, carbon disulfide, petroleum coke, and other petroleum product derivatives. He utilized detailed sediment sampling techniques and advanced geochemical analysis of materials including x-ray

diffraction, scanning electron microscopy, and stable isotope analyses, along with bulk geochemical analyses to identify specific phases associated with waste from each of the former chemical processing facilities. Contaminant allocation negotiations and subsequent remedial actions were successfully completed.

### San Diego River and Santa Margarita River Watershed Management Plans, County of San Diego, California

Project Manager and technical lead for assessing water quality issues associated with the San Diego River and Santa Margarita Watershed Management Plan projects for the County of San Diego. The projects involve determining and describing existing conditions in the watershed in regards to land use, water quality, habitat quality, hydrology, and developing a priotized strategy for the future management and improvement of the watershed resources through stakeholder involvement.

### San Diego County Stormwater Monitoring Program, San Diego County Co-permittees

Project Manager for design and implementation of 5-year stormwater monitoring plan for the City and County of San Diego and 19 Co-permittees based on requirements of California Regional Water Quality Control Board San Diego Region Order 2001-01. Program elements include design and installation of mass loading stations for chemical and toxicological testing, urban stream bioassessments, coastal outfall monitoring, dry weather-illicit connection/discharge investigations, and ambient bay, lagoon, and coastal receiving water monitoring. Recommended program design involves a phased and adaptive approach that moves towards watershed-based monitoring and reporting programs that allow determination of annual and long-term trends of ecological health in receiving waters of the county based on chemical, physical, and biological evidence.

### 303(d) Impaired Water Body Listings Support, Port of San Diego, the City of Coronado, City of Oceanside, California

Project Manager for analysis of 303(d) listings for bacteria, TDS and chloride. Analyses focused on defining temporal and spatial impacts and identification of sources of the listed constituents. Also Project Manager and lead technical representative for San Diego County Copermittee 303(d) group for TDS, chloride, and sulfate in 11 water bodies throughout the County. Evaluated and reported on the sources of TDS included natural loading, loading from imported water and agricultural practices, and loading from urban runoff. Dr. Keith outlined issues involving Regional Water Quality Control Board Basin plan objectives and is involved in a focused scientific and political effort to amend water quality objectives for TDS to more appropriate levels. Reports were and are being submitted to the State and Regional Water Quality Control Boards as part of formal comment period. Analyses were well-accepted by the Regional Water Quality Control Board, with one water body recommended for de-listing to date.

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### America's Cup Harbor Dredging Monitoring and Reporting in San Diego, California, Port of San Diego

The San Diego Regional Water Quality Control Board (RWQCB) issued Cleanup and Abatement Orders directing the cleanup of America's Cup Harbor sediments in the vicinity of leasehold operations of Kettenburg Marine Corporation, Bay City Marine, Inc., Koehler Craft Company, Mauricio & Son, Inc. (currently operated as Nielsen Beaumont Marine, Inc.), and Driscoll Custom Boats, Inc. Each remediation plan was to comply with water quality objectives (WQO) adopted by the Board as described in the California Ocean Plan, Water Quality Control Plan, Ocean Waters of California (Ocean Plan).

Dr. Keith provided project management of water and sediment quality issues related to Cleanup and Abatement Orders at the Kettenburg, Driscoll, and Nielsen Beaumont boatyards during dredging operations. The program consisted of receiving water monitoring of ambient bay waters where dredging operations were in effect, and confirmation testing of sediments to insure cleanup was effective. Based on the receiving water monitoring and confirmation testing performed at the Kettenburg Marine Corporation, Driscoll Custom Boats, and Nielsen Beaumont Sites, dredging operations remained in compliance with the requirements of Order No. 94-102. The San Diego Unified Port District and the boatyards were released of their Cleanup and Abatement Orders as a result of the analysis and reporting directed by Dr. Keith.

### Switzer Creek PCB/PNA Sampling and Analysis in San Diego, California, Port of San Diego

Dr. Keith served as the lead scientist for the collection of stream and bank sediment sampling in Switzer Creek Channel above outfall at Campbell Shipyard. The primary purpose of the sampling was to provide stream sediment and soil samples for screening source identification analysis of polychlorinated biphenyls and polynuclear aromatic hydrocarbons. Testing also included metals, and chlorinated and phosphoric pesticides for future Toxic Hot Spot evaluations. The data analysis will include evaluating potential future impacts to San Diego Bay sediments as a result of ongoing discharge and re-suspension of any potentially contaminated sediments.

### Rose Creek Trestle Fire Sampling and Remediation, Confidential railroad client

Project manager and lead scientist for determining the extent of polynuclear aromatic hydrocarbon, phenol, and metal contamination potentially associated with a burned railroad trestle treated with creosote. This investigation involved determining the ambient concentrations of contaminants in stream bed compared to concentrations following the fire over a 1.1 mile linear area, mapping areas where fire byproducts had accumulated, and supervising the eventual cleanup of the stream bed.

### Environmental Impact Statement Analysis of Proposed Tailings Impoundment Expansion in North Central Idaho, U.S. Forest Service

Dr. Keith was the principal environmental scientist for U.S. Forest Service in analyzing long-term downstream effects of tailings seepage from molybdenum mine on downstream waters containing

endangered species. Environmental impacts of proposed tailings impoundment expansion project action alternatives were evaluated for low-flow and high-flow stream conditions. Involved estimating the long-term evolution of tailings impoundment pore water chemistry in unsaturated and saturated materials by utilizing groundwater and surface water flow modeling, mixing calculations, geochemical equilibrium calculations, and chemical adsorption/desorption modeling. He worked closely with representatives from the mine, Forest Service, U.S. Fish and Wildlife, and public groups to develop recommendations within the final Environmental Impact Statement. Final recommendations were approved and implemented.

**Geochemical Evaluation of Proposed Solution Mining Project - White Pine Mine, Michigan**

Principal geochemist in the evaluation of the long-term effects of fluid/rock interaction for a proposed solution mining project in support of the Environmental Impact Statement required as required by NEPA. This involved analysis of groundwater and mining fluid flow and mixing in a large underground mine, prediction of equilibrium chemistry based on theoretical geochemical reaction-path modeling, laboratory bench-scale testing, and pilot testing. Long-term predictions were developed for local and regional groundwater flow/chemistry, potential environmental impacts were identified, and appropriate alternatives were developed to minimize the impact of the proposed project. An Environmental Impact Statement was successfully submitted and approved by appropriate agencies.

**Boulder Creek Background Metals Evaluation in Iron Mountain, California, Stauffer Management Company**

Project manager/principal environmental scientist for estimation of natural background metals concentrations in soils, sediments, groundwater, and surface water in the Boulder Creek Watershed, Iron Mountain Superfund Site, California. The project involved development of extensive field programs including stream sediment sampling, monitoring well/piezometer network design and installation, mine waste sampling, stream flow measurement station design and installation, automated stream water quality monitoring network design and installation. Background metals concentration ranges were established based on geochemical evaluations, literature review, and statistical analyses to focus remedial investigation and feasibility study investigations.

## PUBLICATIONS

### Peer-Reviewed Publications

1996 "Geochemical Responses of Mixed-Siliciclastic Carbonate Reservoirs to Steamflood Enhanced Oil Recovery." *Applied Geochemistry*, vol. 13, no. 4, pp. 491-507 (with W.J. Harrison, R.F. Wendlandt, A.B. Carpenter, and E.J. Daniels).

1997 Geochemistry of Abandoned Fluids Associated with the Proposed Underground Solution-Mining Project at the White Pine Mine. *Mining Engineering*, April, pp. 62-67 (with G.A. Doyle, D.D. Runnells, and J. Tilk).

2001 Geochemical Models of the Impact of Acidic Groundwater and Evaporative Sulfate Salts on Boulder Creek at Iron Mountain, California," *Applied Geochemistry*, vol. 16, p. 947-961 (with D.D. Runnells, K.J. Esposito, J.A. Chermak, D.B. Levy, S.R. Hannula, Malcolm Watts, and Larry Hall).

2003 "Estimating Ground Water Discharge by Hydrograph Separation" *Groundwater* v. 41 no. 3 pp. 289-400 (with S.R. Hannula, K.J. Esposito, J.A. Chermak and D.D. Runnells).

## Proceedings Papers and Abstracts

1993 "Laboratory and Numerical Simulation of Fluid-Rock Interactions During Steamflood EOR of a Volcaniclastic Reservoir," *Preprints Symposia, Division of Petroleum Chemistry, Inc, American Chemical Society*, vol. 38, no. 1, pp. 176-180 (with H. Semimbar, R.F. Wendlandt, W.J. Harrison, and D. Beaty).

1994 "Steam-Induced Alteration of Mineralogy and Permeability in Kaolinitic Siderite-Bearing Sandstones," Poster and abstract, American Association of Petroleum Geologist Annual Convention, June, 1994 (with W.J. Harrison, R.F. Wendlandt, A.B. Carpenter, E.J. Daniels, and G.S. Orton).

1996 "Experimental Simulation of Waste Rock Weathering Under Unsaturated and Saturated Conditions at Iron Mountain, California," *Proceedings of the Third International Conference on Tailings and Mine Waste, '96,* January 16–19, Fort Collins, Colorado, Balkema Publishing Co., Rotterdam, p. 351–360 (with D.D. Runnells).

1996 "Geochemical Investigations of the Fate of Abandoned Raffinate in a Proposed In-Stope Solution Mining Project, with Applications to Predictions of Ground Water Quality," Proceedings of the Society of Mining Engineers Annual Meeting, Phoenix, Arizona, March 11-14. (with G.D. Doyle, D.D. Runnells, and J Tilk).

1998 "Geochemical and Geotechnical Evaluation of the Bulldog Mine Tailings Impoundment," *Tailings and Mine Waste '98*, A.A. Balkema, Fort Collins, Colorado, January 26—28, pp. 539—548 (with C. Strachan, T. Kelley, and A. Cox).

1998 "Chemistry, Mineralogy, and Effects of Efflorescent Sulfate Salts Acid Mine Drainange Areas," Abstracts of the Geological Society of America 1998 Annual Meeting, October 26-29, Toronto, Canada (with D.D. Runnells).

1998 "Methodology for Determining Natural Background Chemistry at a Former Mining Site, Iron Mountain, California," Abstracts of the Geological Society of America 1998 Annual Meeting, October 26-29, Toronto, Canada (with J.A. Chermak, D.D. Runnells, K.J. Esposito, and S.R. Hannula).

1999 "Estimating Groundwater Discharge by Hydrograph Separation, Iron Mountain, California," *Proceedings of the Sixth International Conference on Tailings and Mine*

*Waste '99*, January 24-27, Fort Collins, Colorado, AA. Balkema/Rotterdam/Brookfield, p. 581-589 (with S. R. Hannula, D.D. Runnells, K. J. Esposito, and J. A. Chermak).

1999 Methodology for Determining Natural Background Chemistry at a Former Mining Site, Iron Mountain, California. Preprints of the SME 1999 Annual Meeting, March 1-3 (with D.D. Runnells, J.A. Chermak, and K.J. Esposito).

1999 "Geochemical Modeling of the Impact of Evaporative Sulfate Salts on Boulder Creek at Iron Mountain, California." Tailings and Mine Waste '99, A.A. Balkema, Fort Collins, Colorado, January 24-27 (with D.D. Runnells, and M.L. Watts).

2003 "Total Dissolved Solids in San Diego County," H2O Headwaters to the Ocean Conference, Long Beach California, October 23, 2003.

2006 Geochemical Analysis of Fluoride Solubility in a Fresh Water/Saltwater Mixing Zone, Intalco Aluminum Corporation, Ferndale, Washington, Fourth International Conference on Remediation of Contaminated Sediments, Savannah, Georgia (with R. Desrosier and M. Stiffler) January, 2006.

2007 Effects of Hurricane Rita in Bayou d'Inde, Lake Charles, Louisiana, Optimizing Decision-Making and Remediation at Complex Sediment Sites (with D. Haury) January 8-10, 2008—New Orleans, LA.

2009 Evaluation of Sediment Stability and Natural Attenuation in Patrick Bayou, Texas, Fifth International Conference on Remediation of Contaminated Sediments, Jacksonville, Jacksonville, Florida (with K. Zeigler and D. Nagju), January, 2009.

## Other Publications

1991 "Ground Water Models, Depositional Environments, and Facies Relationships of the Neogene Aquifer System in Marion County, Mississippi." Master's thesis, University of Southern Mississippi, Hattiesburg, Mississippi.

1994 "Geochemical Response of Kaolinitic, Carbonate-Bearing Siliciclastic Reservoirs to Enhanced Oil Recovery" *Ph.D. dissertation*, Colorado School of Mines, Golden, Colorado.

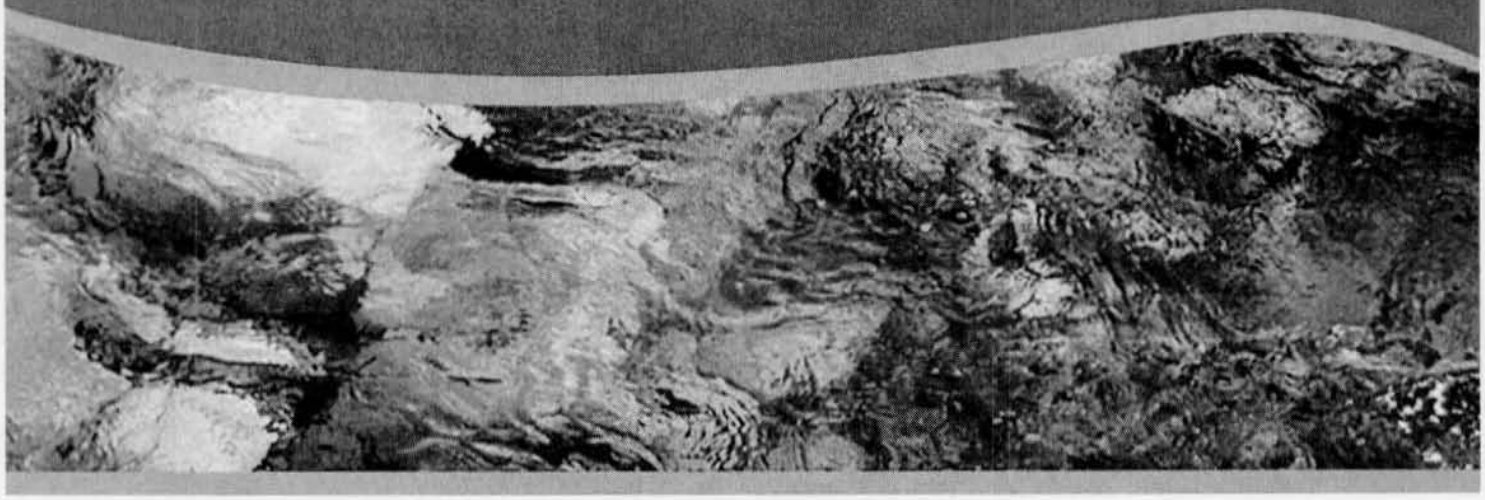
1997 Short Course Notes: "Geochemistry at Mining and Milling Sites Workshop." International Tailings and Mine Waste Conference, January, 1997, Fort Collins, CO (with D.D. Runnells, G. Doyle, M. Shields, K.J. Esposito, and J Chermak).

2008 Short Course Notes: Best Practice Group Annual Meeting. *Conceptual Site Models for Sediment Sites*, August 2008, Houston, Texas.

2009 Short Course Notes: Best Practices Group Annual Meeting. *Innovative Remedial Investigation and Feasibility Study Approaches at Sediment Sites*, August 2009. Houston, Texas.

STATEMENT OF QUALIFICATIONS

ANCHOR QEA



# ENVIRONMENTAL SERVICES FOR CONTAMINATED SEDIMENT SITES AND WATER QUALITY EVALUATIONS

**Prepared for**

USEPA Region 6

**Prepared by**

Anchor QEA, LLC
2113 Government Street, Suite D3
Ocean Springs, Mississippi 39564

**September 2009**

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# OVERVIEW OF ANCHOR QEA, LLC

Anchor QEA, LLC (Anchor QEA), is a nationally recognized environmental and engineering consulting firm that specializes in aquatic, shoreline, and water resource projects. With more than 200 employees in 11 states across the United States, Anchor QEA has extensive experience and expertise in water resources, surface and ground water quality, coastal development, habitat restoration, and contaminated sediment management. Anchor QEA provides clients with a full range of science and engineering services, including planning, scientific investigation, engineering design, and construction management. We work with both public and private sector clients on some of the most challenging sites in the nation, and our completed projects are among the most successful in the industry. The strength Anchor QEA brings to each and every project reflects our core values of technological leadership, integrity, superior product quality, and client satisfaction.

Our staff, which includes a mix of sediment scientists; chemists; toxicologists; risk assessors; fisheries biologists; civil, geotechnical, environmental, and coastal engineers, as well as construction specialists, have designed a wide range of cleanup solutions in a variety of aquatic environments (marine and freshwater). We apply our understanding of the front-end of site investigations and future site restoration or development plans to evaluate how cleanup measures will fit with the nature and extent of contamination and restoration needs. Anchor QEA has unique waterfront experience with the following assessment, engineering, design, habitat restoration, and construction tasks:

- Aquatic risk assessments
- Source evaluations
- Remedial Investigations (RI)
- Habitat evaluations
- Feasibility Studies (FS)
- Natural Resource Damage (NRD) assessments
- Habitat creation/restoration assessment, design, and implementation
- Construction/bid documents
- Geotechnical engineering
- Coastal engineering
- Constructability review
- Dredging and disposal planning
- Cap erosion analysis and design
- Equipment selection and evaluation
- Confined disposal facility design
- Sediment dewatering and upland transfer analysis
- Construction cost estimating
- Bid evaluation/contractor selection
- Construction management
- Compliance monitoring

Anchor QEA provides these services during all phases of project development and implementation, from initial planning through construction support, and has worked for private industries, public agencies and utilities, port authorities, architectural and engineering firms, and law firms. This qualification package describes our firm's experience in sediment management, shoreline design and habitat restoration, NRD assessment, Brownfield redevelopment, sediment management and remediation, and water quality and total maximum daily load (TMDL) evaluations.

## Sediment Management and Remediation

Anchor QEA is home to many of the leading sediment management experts in the United States. Many of Anchor QEA's waterfront projects are associated with either in-water or upland contaminant source areas.

We advise a variety of clients whose issues range from dredged material management to cleanup strategies on superfund sites. Anchor QEA's success with completing sediment management and cleanup projects—projects that have been constructed and are performing as designed—has been the basis for our reputation as leaders in this field.

### Integrated Shoreline Design and Habitat Restoration

A key element to designing shoreline projects is balancing human needs and natural processes. Successful projects involve creating places where people and the environment mutually benefit. Anchor QEA's emphasis on shoreline and water resource projects provides diverse opportunities to create an integrated shoreline design. Staff in a range of disciplines (such as landscape architecture; environmental planning; coastal, geotechnical, and civil engineering; fisheries; wetland biology; and water quality) support Anchor QEA's shoreline design expertise. This range of knowledge and experience allows our clients to use our services as a tool to help untangle and resolve seemingly conflicting goals, such as habitat restoration and recreational access, on shoreline and water resource projects. Highlights of our shoreline design services include:

- Habitat mitigation/restoration design for wetlands, streams, estuaries, and lake and marine shorelines
- Shoreline public access design
- Parks and recreation facilities design
- Americans with Disability Act (ADA) compliance
- Site planning
- Site suitability/feasibility analysis
- Master planning and conceptual design
- Final design, construction documents, cost estimating, bidding, and construction administration
- Public involvement

### Natural Resource Damage Assessment

Anchor QEA provides a wide range of services related to NRD assessment, including injury assessment, damage determination, and restoration design. Our focus is on providing strong technical and strategic skills to work toward a restoration-based solution. Anchor QEA's expertise includes analyzing contaminant data, evaluating exposure pathways and injuries to natural resources, and scaling compensatory restoration projects. Restoration-based solutions may involve the use of responsible party-owned real assets as part of a restoration project. Conserving and/or restoring these assets may represent the highest and best use for these lands. Anchor QEA staff are particularly experienced in the use of scaling methodologies, such as Habitat Equivalency Analysis (HEA), to integrate injury assessment and damage determination. Anchor QEA staff are involved in many collaborative, restoration-based settlements, which entails assisting with Natural Resource Trustee negotiations and maintaining active communication with the trustees throughout the process.

### Water Quality and Total Maximum Daily Load Evaluations and Experience

Anchor QEA also has extensive expertise and experience in water quality assessments and modeling, waste load allocation and TMDL assessments, NPDES permit evaluations, and associated negotiations with

regulatory agencies. Anchor QEA teams with both municipal and industrial clients applying quantitative approaches to support sound water quality decision making.

### *National Total Maximum Daily Load Experience*

Anchor QEA is a member of the consultant team selected by the USEPA to conduct TMDL-related services across the country. This selection acknowledges Anchor QEA's water quality experience and expertise. As a member of this team, Anchor QEA has gained intimate knowledge with the TMDL process, development, and application of state-of-the-science tools within this process, and an understanding of the future direction of TMDL-related regulations and policies. Anchor QEA has completed numerous TMDLs in Arkansas, Florida, and South Carolina and has guided several industrial and municipal clients through the often tortuous TMDL process, representing their interests before the agencies through insightful and technically sound assessments of permitted discharges and their associated impacts on receiving water quality.

For more detailed information on individual clients and project experience, please see the following matrix and project descriptions.

## Summary of Representative Sediment Project Experience

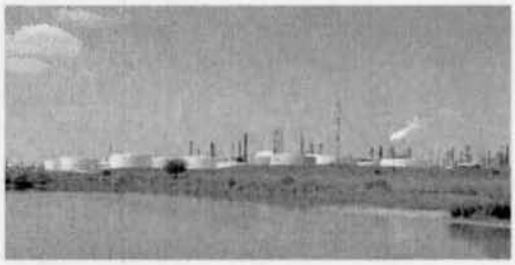
| Project Name | Investigation | Screening Level Risk Assessment | Feasibility Study | LA/Habitat Restoration | Design | Natural Resource Damages | Restoration Analysis | Natural Recovery | Capping | Dredging and Confined Disposal | Source ID and Evaluation | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Patrick Bayou | • | • | • | | | • | • | | | | • | |
| Bayou d'Inde | • | • | • | | • | • | • | • | • | • | • | • |
| Lavaca Bay | • | • | • | | • | • | • | • | • | • | • | |
| St. Louis River/Interlake Duluth Tar Site | • | • | • | | • | • | • | | • | • | • | |
| Fox River Sediment Cleanup Design | • | | | | • | | | | | | | |
| Willamette River | • | • | • | | | | | • | • | • | • | |
| Newtown Creek Remedial Investigation/Feasibility Study | • | | • | | • | • | | | | | | |
| Middle Waterway | • | • | • | | • | • | • | • | • | • | • | • |
| Onondaga Lake Feasibility Study | | | • | | • | • | • | | • | | • | |
| NW Natural "Gasco" MGP Site Remedial Investigation/Feasibility Study | • | • | • | | • | • | • | | • | • | • | • |
| Whatcom Waterway | • | • | • | | • | • | • | • | • | • | • | |
| Island End River | | | • | | | | | | | • | | |
| Grasse River | | | • | • | • | | | | | | | |
| Olympic Sculpture Park Shoreline Design | | | | | • | | | | | | | |
| Holly Street Landfill/Whatcom Creek Estuary Restoration | • | | | • | • | • | • | | | | | • |
| Natural Resource Damage Assessment Site | | | | | | • | • | | | | | |
| Holston River Mercury Fate and Transport Study | • | | | | | | | • | | | | |
| Hudson River Remedial Design | • | | • | • | • | | • | • | • | • | • | • |
| Centredale Manor Restoration Project | • | | • | | | | | | | | | |
| Housatonic River PCB Assessment | • | | • | | | | | • | • | | • | |
| Tittabawassee and Saginaw River Segment Cleanup | | | • | | • | • | | • | • | | | |

## Summary of Water Quality Evaluation Projects

| Project Name | Field Investigations | Data Analysis | Load Calculations | Fate and Transport Modeling | Load Allocations | Agency Negotiations | Expert Witness Testimony | Development of Management Tools |
|---|---|---|---|---|---|---|---|---|
| Gulf Island Pond | | • | • | | • | • | • | |
| Three Rivers System | • | • | • | • | • | • | | • |
| South Texas Water Quality Study | | • | | | | | | • |
| San Francisco Bay Total Maximum Daily Load Review | | • | • | • | • | • | • | |

## PROJECT EXPERIENCE

### Patrick Bayou, Deer Park, Texas



Anchor QEA is currently providing RI/FS services to the Joint Defense Group for the Patrick Bayou superfund site. Patrick Bayou is a shallow tributary to the Houston Ship Channel, located in a mixed urban, highly industrialized petrochemical area in southeast Harris County, Texas. Anchor QEA is providing a wide range of project management and technical services for the project, including further development of the site conceptual model, RI services, development of remediation goals and objectives, FS services, and detailed risk assessment. The work involves addressing issues related to source control and ancillary TMDLs, in addition to potential contaminated sediment issues. This site has a variety of historical contaminant issues including dioxin/furans, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and mercury. Site data collected by Anchor QEA has shown that the high sedimentation rates around the Houston Ship Channel and its tributaries have contributed to a significant amount of natural recovery to date.

### Bayou d'Inde Site, Calcasieu River and Estuary, Lake Charles, Louisiana

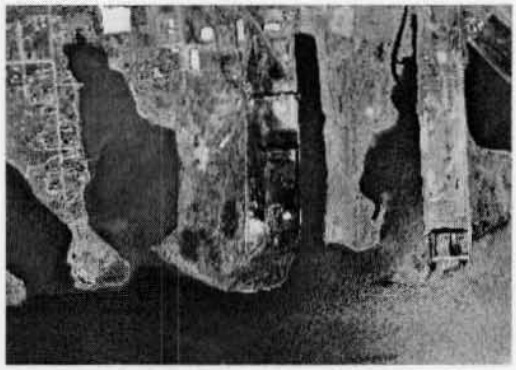
Anchor QEA is the lead consultant providing FS, remedial design, and integrated NRD services to group of Potentially Responsible Parties (PRPs) on Bayou d'Inde of the Calcasieu River/Estuary located in Lake Charles, Louisiana. The U.S. Environmental Protection Agency (USEPA) previously performed a RI and risk assessment of the larger river/estuary area and identified Bayou d'Inde as a primary area of concern. A group of PRPs with facilities on Bayou d'Inde entered into an agreement with the State of Louisiana and USEPA to conduct follow-up FS and remedial design activities at the site. In addition to providing a wide range of project management and strategic services for the PRP group, Anchor QEA staff have develop a unique risk management approach for the site and have conceptualized a number of innovative remedial approaches for different subareas within the site.

### Lavaca Bay Superfund Site, Point Comfort, Texas

Anchor QEA managed the aquatic sediment cleanup of a major superfund site on the Gulf of Mexico, which involved overseeing the aquatic RI as well as preparing the FS, preparing the remedial design, and overseeing implementation of the remedial measures. Activities included focused site characterization, development of an overall cleanup strategy, detailed evaluations of feasible alternatives, and successful negotiations with regulatory agencies. The selected remedy included a cost-effective blend of natural recovery, enhanced natural

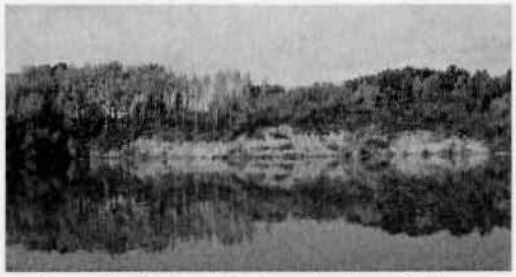
recovery, in situ capping, dredging, and on-site upland disposal. Anchor QEA implemented a pilot study to evaluate the effectiveness of different dredging technologies under varying site conditions, and identified the most cost-effective approach. The final cleanup remedy also integrated NDR elements.

### St. Louis River Interlake Duluth Tar Site, Duluth, Minnesota



Anchor QEA was part of a consultant team that provided FS and remedial design services to a group of PRPs at a former manufactured gas plant superfund site on the St. Louis River in Duluth Harbor, Minnesota. Anchor QEA has led technical evaluations and associated engineering design of capping, dredging, and disposal elements of the project and also participated as part of the PRP's negotiation team with the agencies. Following initial disagreements on the appropriate remedy for the site, an independent Peer Review Team was retained by the state and PRPs to provide third-party consultation. The final cleanup remedy for the site, which has now been accepted by all parties, includes a cost-effective blend of focused dredging in potentially unstable areas of the site, disposal of such sediments in an on-site nearshore/upland facility, and capping of "hotspots," concurrently providing habitat enhancements. Anchor QEA provided key technical evaluations of constructability and long-term effectiveness of different capping and dredging designs, including detailed geotechnical engineering and contaminant transport evaluations. Anchor QEA is continuing as part of the final design team and will provide assistance in developing the construction documents necessary to procure a contractor and implement the remedial action.

### Fox River Sediment Cleanup Design, Green Bay, Wisconsin



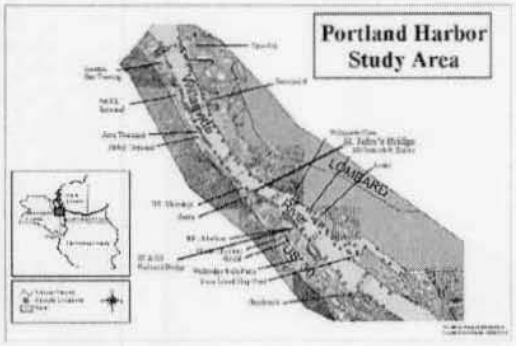
Anchor QEA is currently performing the remedial design of the Lower Fox River sediment cleanup project in Green Bay, Wisconsin. With more than 7 million cubic yard (cy) of PCB-contaminated sediments originally targeted for dredging and upland disposal, the Lower Fox River has been identified as the single largest contaminated sediment cleanup site in the United States. Based on the firm's unparalleled record of successful sediment cleanup projects completed to date throughout the United States, Anchor QEA was selected by a group of PRPs to lead all technical elements of the design effort.

Remedial design is being completed under a cooperative agreement between the Fort James Operating Company, Inc., NCR, Wisconsin Department of Natural Resources, and the USEPA Region 5. The remedial design has included detailed site characterization and is addressing large-scale dredging and transport of PCB-contaminated sediments to suitable upland disposal facilities in the region and, where appropriate, is exploring practicable design alternatives including in situ capping. Based on the initial design documents developed by Anchor QEA, a Record of Decision Amendment to formalize significant cost-saving measures, including dredge residual management and in situ capping strategies, was issued by the regulatory agencies.

The high-profile project is also addressing the timing and sequencing of the remedial action to account for the multi-faceted and multi-year components of the overall cleanup remedy. The project is collaboratively resolving key technical and implementation issues with the regulatory agencies. Anchor QEA assisted the PRPs with the procurement of a contractor to perform the approximately 10-year long remedial action.

In addition to the ongoing remedial design activities, Anchor QEA designed a remedial action within an area along the west bank of the river (the "Phase 1" project area) to address elevated PCB concentrations, which warrant expedited removal in advance of the remainder of the Fox River remedial action. Anchor QEA assisted NCR and U.S. Paper Mills, Inc., with design documentation, contractor selection, and negotiation. Anchor QEA is currently providing construction management and technical support services during implementation of the Phase 1 project. Anchor QEA's work on the Lower Fox River is ongoing.

### Willamette River, Portland, Oregon




Anchor QEA is managing and conducting an evaluation of sediment cleanup options for the Portland Harbor superfund site on the Willamette River in Portland, Oregon. Anchor QEA is working on behalf of the Lower Willamette Group of PRPs in Portland Harbor, including Atofina Chemicals, Chevron, Northwest Natural Gas Company, Union Pacific Railroad, Time Oil, the Port of Portland, the City of Portland, and others. Many of the PRPs have relatively large industrial facilities operating within the study area. Anchor QEA is leading the FS and initial engineering design elements of the project and integrates with the RI and risk assessment teams. Anchor QEA also provides related FS and design services for several PRPs to address source control requirements at their individual facilities. The project site covers the entire Lower Willamette River (more than 12 river miles), which runs through the City of Portland and includes a variety of shoreline uses from parks and commercial developments to heavy industry and port facilities. Anchor QEA has worked with the PRP group to develop innovative sediment remediation approaches to cost effectively address sediment cleanup requirements and fish consumption advisories, while concurrently preserving and enhancing the commercial and natural features of this urbanized waterway. The FS is also being coordinated with a City of Portland's initiative to revitalize the river shoreline. Anchor QEA has also assisted the PRP group in developing cleanup cost-sharing arrangements.

### Newtown Creek Remedial Invstigation/Feaibility Study, Queens, New York

Anchor QEA is the lead consultant providing ongoing RI/FS and remedial design services to the Phelps-Dodge Refining Corporation related to sediment cleanup of the former Laurel Hill Site on Newtown Creek, a branch of the East River located in Queens, New York. Following implementation of separate but coordinated investigations and remedial designs to accomplish source control and cleanup of upland operable units at the site, remedial activities at the site are now focused on sediment

cleanup, coordinated with redevelopment of this former copper smelter and refining facility. The Newtown Creek RI/FS and remedial design is being performed under a Consent Order between Phelps-Dodge and the New York State Department of Environmental Conservation. The extent of historical sediment contamination from prior facility releases has been demonstrated to be buried at depths well below the mudline but nevertheless located within an unused federal navigation channel. Key issues being resolved at the site include potential de-authorization of the federal channel and the appropriate timing of any sediment cleanup actions, given the numerous ongoing stormwater and combined sewer overflow sources of metals and other contaminants that enter the site area. Capping of potential source areas along unstable areas of the shoreline is being performed as an interim action concurrent with the conduct of the RI/FS. Anchor QEA's RI/FS and remedial design (shoreline cap) services at this site are ongoing.

### Middle Waterway Area Cleanup, Tacoma, Washington

Anchor QEA was the lead consultant retained by a group of PRPs to perform Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) design and construction support services for this federal contaminated sediment site in Tacoma, Washington. As the construction manager for the project, Anchor QEA chose a "partnered" approach to the project with the contractor, Manson Construction Company. The Anchor QEA team completed the project within the established timeframe and within the client's budget parameters with no claims.

The project consisted of dredging/disposing over 100,000 cy of contaminated sediment, placing 40,000 tons of cap/backfill material, installing a new bulkhead, demolishing 70,000 square feet of overwater structures, and enhancing shoreline fish habitat. The work was complicated by the need to comply with restricted fisheries work windows and to keep the owners' active ship repair and tug boat operations open during construction. The results of the project have been considered successful by the PRPs and regulatory agencies. Anchor QEA won an award of merit from the Construction Management Association of America, Pacific Northwest Chapter for our construction management work on the project.

In addition to construction management services, Anchor QEA was the project coordinator for the Middle Waterway Cleanup and had involvement throughout the cleanup process, beginning with strategy development (in response to the Record of Decision) and negotiation of an Agreed Order on Consent and Statement of Work. Anchor QEA also completed a biological assessment, remedial design (including bid documents), and obtained necessary permits for construction. Anchor QEA is continuing project services by providing long-term monitoring of the constructed project amenities.

### Onondaga Lake Feasibility Study, Syracuse, New York

Anchor QEA is assisting Honeywell is preparing the FS for Onondaga Lake. Onondaga Lake is an urban lake located in Syracuse and is roughly 4 square miles in size. Millions of cy of sediment have been impacted by past industrial activities at and around the lake. Contaminants of concern include mercury from a former chlor-alkali plant, multiple organic contaminants, and Solvay waste. Nonaqueous phase liquids (NAPLs) have been identified in some locations of the lake. Impacted sediments possess very unique physical characteristics affecting the evaluation and design of remedial measures. Anchor QEA managed and directed the technical studies for the FS and authored portions of the FS. The extensive technical studies completed included development of sediment and fish tissue remedial goals, detailed evaluations of capping, dredging, upland disposal, natural recovery, and aeration and integration of habitat restoration into lake-wide cleanup. Anchor QEA also provided strategy during FS development and participated in multi-agency presentations and discussions.

### NW Natural "Gasco" MGP Site Remedial Investigation/Feasibility Study, Portland, Oregon

Anchor QEA is leading an RI/FS and cleanup of the NW Natural "Gasco" site in Portland, Oregon, on the Willamette River. The site, a former coal gasification facility, is impacted with metals and carcinogenic PAHs in the soils and groundwater. The potential for groundwater migration to the Willamette River and associated ecological and human health risks were evaluated and remediation alternatives developed.

A pilot dredge and capping study was conducted in 2005/2006 to test one of the remediation alternatives. Current studies are focusing on evaluating the pilot capping study and refining the Remedial Action Plan for the site. Other studies are designed to test for groundwater migration from the upland areas into the Willamette River. If migration is found to occur at levels that cause potential human health and/or ecological risks, a groundwater capture and treatment system will need to be designed and installed.

### Whatcom Waterway, Bellingham Bay, Washington

Anchor QEA managed a range of RI/FS and engineering design tasks for Georgia-Pacific West, Inc. (G-P), at the Whatcom Waterway site, a 2 million cy sediment cleanup site located in Bellingham Bay, Washington. The project has included successful agency negotiations, appropriately focused investigations and contaminant transport modeling, detailed engineering design, and construction of cost-effective interim remedial actions. The remediation plan for the Whatcom Waterway includes the following elements:

- Hydraulic dredging of approximately 400,000 cy of sediment from the federal navigation channel and disposal into an adjacent upland facility owned by G-P, concurrently increasing G-P land values
- Capping of contaminated sediments located outside of the federal navigation channel (the effectiveness of capping was demonstrated in an early interim capping action of "hotspot" sediments at the site)
- Monitored natural recovery of more marginally contaminated sediments and anticipated dredging residuals (natural recovery has already achieved cleanup standards throughout most of the site)
- Integration of habitat restoration elements into the overall cleanup plan, cost effectively addressing potential NRD liabilities and concurrently streamlining permitting/agency approvals

The total estimated cost of the Whatcom Waterway remediation plan is approximately $15 million. Anchor QEA has assisted G-P in developing cost-sharing arrangements to further reduce this cost, such as through U.S. Army Corps of Engineers (USACE) maintenance dredging/beneficial reuse and Water Resources Development Act authorities, and tipping fees for co-disposal of other parties' contaminated sediments into the upland disposal facility.

### Island End River, Everett, Massachusetts

Anchor QEA provided (as part of the Island End River team) assessment, FS, permit support, and remedial design services at a former MGP site located on the Island End River in Everett, Massachusetts. The 10-acre site contains about 80,000 cubic yards of affected sediments with dense nonaqueous phase liquid (DNAPL). Current cleanup plans call for cost-effective dredging and disposal of these sediments in an on-site nearshore confined disposal facility. Anchor QEA 's services included development of an overall strategic direction for the project, participation in agency negotiations; dredge plans, detailed evaluation of cleanup alternatives, and development of measures to cost effectively mitigate water quality and sediment residual impacts during dredging.

### Grasse River Hydroelectric Project and Ice Control Facility, Massena, New York

The Grasse River is a major tributary to the Saint Lawrence River. Massena is a historic mill town in upstate New York whose current main employer is Alcoa, which operates two aluminum plants there. The city's electric utility, Massena Electric, is proposing to construct a hydroelectric dam on the Grasse River downstream from the town center. An important component of the project is also control of destructive ice jams that periodically occur during the spring thaw. Alcoa is interested in controlling the high velocity flows that result from these ice jams, which can negatively affect sediment remediation on the river bottom. Anchor QEA is working on two aspects of this project. The first aspect includes the engineering input on some aspects of the ice control components. The second aspect involves the development of recreation amenities associated with the project to benefit the Messena community. Amenities include a waterfront trail system, water access facilities such as boat ramps and docks, and aesthetic treatments of the levees, such as vegetation screening and re-grading.

### Olympic Sculpture Park Shoreline Design Support and Permitting, Seattle, Washington

Olympic Sculpture Park has transformed a 9-acre former industrial site into a nationally acclaimed public park featuring outdoor sculpture exhibits from the Seattle Art Museum. The park links Seattle's Belltown neighborhood with Myrtle Edwards Park and the shoreline, significantly enhancing public access and providing important habitat restoration for Elliott Bay fisheries and wildlife. The restoration included 1,200 linear feet of shoreline improvements featuring stabilization of the existing seawall and conversion of a riprap revetment to beach and nearshore habitat for migrating salmon. Anchor QEA's restoration design included the formation of a new kelp forest as part of the improved shallow-water corridor. Anchor QEA obtained aquatic permits for the project and played a key role in developing a successful urban shoreline design that was both salmon-friendly and feasible. The project, completed in January of 2007, has gained local and national attention and recognition for several aspects, including integration of habitat restoration and human use of the shoreline. Most recently, the park was named one of the 2008 Best Restored Beaches by the American Shoreline & Beach Preservation Association.

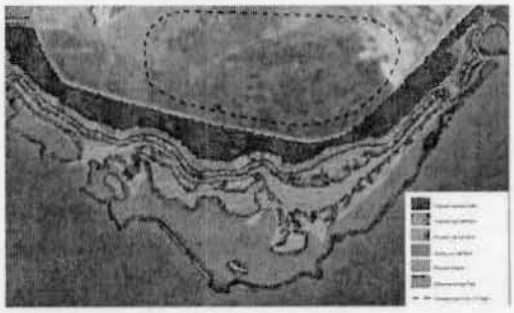
### Holly Street Landfill/Whatcom Creek Estuary Restoration, Bellingham, Washington

Anchor QEA worked with the City of Bellingham as the prime consultant for the Holly Street Landfill/Whatcom Creek Estuary Restoration, a former municipal waste disposal landfill located on former tideflats of Bellingham Bay. The project, overseen and grant funded by both the Washington Department of Ecology (Ecology) and the USEPA, included a site characterization of affected soil, groundwater, and sediment media at the site. Landfill remediation plans

were integrated with habitat restoration and shoreline public access, with the goal of revitalizing this area of the city's business district. The complex urban project included both landscape architecture and geotechnical engineering services and was integrated with adjacent park and public access facilities, such as Maritime Heritage Park, the Fish Hatchery, and the Whatcom Creek Trail. Public access elements included extending a new boardwalk along the north side of Whatcom Creek and providing viewing and fishing areas at the water's edge. Public safety concerns, such as views through restored habitat areas, were also integrated into the project design.

The site cleanup was performed in conformance to a Consent Decree issued in compliance with the Model Toxic Control Act administered by Ecology. Anchor QEA's construction services included project management, contract administration, and field inspection. As much of the landfill excavation and capping work was done below ordinary high water in the tidally influenced waterway during limited fish protection construction windows, much of the work was performed during nighttime low tides. Construction was completed in 2005.

### Natural Resource Damage Assessment Site, Northeast United States



A complaint filed by State Natural Resource Trustees against one of Anchor QEA's clients alleged that historical and ongoing discharges of hazardous substances from the client's facility to surface waters and sediments may be posing unacceptable risks to the environment and may have caused and are continuing to cause injuries to natural resources. Our client was interested in assessing the feasibility of reaching settlement with the State to resolve its alleged NRD liability. Anchor QEA performed an initial NRD assessment that analyzed the spatial extent, duration, and severity of injury to sediments and surface water potentially caused by site-related releases of hazardous substances, and evaluated the technical feasibility and cost-effectiveness of an on-site restoration project as compensation for these estimated injuries.

A degraded intertidal salt marsh area is present along the southern boundary of the site. This area comprises 8 to 10 acres. The marsh is in close proximity to several planned marsh restoration projects and has the potential to provide habitat links among these projects. In an area where high quality marsh habitat is scarce, it thus affords a promising and distinctive opportunity to reclaim salt marsh habitat. The marsh is overrun by the invasive reed (*Phragmites australis*) to the exclusion of other marsh vegetation.
Parts of the marsh have been filled and there is potential contamination in the marsh sediments. Potential restoration opportunities are based on removing this invasive plant community, inhibiting it from future growth, and restoring a tidal elevation that will support native marsh vegetation. Anchor QEA prepared a conceptual restoration plan and cost estimate for the marsh and determined that the increased ecological services provided by the restored marsh would compensate for alleged injuries to natural resources.

### Holston River Mercury Fate and Transport Study, Saltville, Virginia

Historic discharges from a chlor-alkali facility that operated at Saltville, Virginia, from 1950 to 1972, have resulted in elevated mercury concentrations in the sediment bed of the Holston River system, which is located in southwestern Virginia and northeastern Tennessee. The 175-mile study area encompasses the North Fork Holston River and the Holston River, including the Cherokee Reservoir.

The objective of this study was to evaluate sediment transport and mercury fate and transport within the study area so as to develop an understanding of the primary processes affecting bed mercury concentrations, especially in Cherokee Reservoir. Anchor QEA conducted a combination of data-based and modeling analyses to assess mercury fate and transport. Data were compiled and analyzed related to hydrodynamics, sediment transport, and mercury fate and transport within the study area. A wide range of graphical and statistical analyses of the data were used to develop a comprehensive Conceptual Site Model (CSM) for the North Fork Holston River and Holston River. This CSM formed the basis for additional data-based and modeling tasks that are planned to be conducted during future phases of the project. Additional sediment cores are being collected to aid in understanding sediment dynamics, geochronology, and rates of natural recovery in Cherokee Reservoir. Water column sampling during flood events will be conducted to develop a better understanding of transport processes during floods. Hydrodynamic models of Cherokee Reservoir will be developed and used to evaluate the potential effects of floods on bed scour.

### Hudson River Remedial Design, Hudson Falls and Fort Edward, New York

The sediments of the Upper Hudson River contain PCBs originating from wastewater discharges from two General Electric Company capacitor manufacturing plants located in Hudson Falls and Fort Edward, New York. These sediments have been the subject of numerous investigations and proposed remedial action plans over the past 30 years and were placed on the Superfund National Priority List in 1983. In 1984, a USEPA study considered the feasibility of remediating PCBs within the Hudson River system. The study recommended no action for the sediment deposits. In 1990, the USEPA began to re-evaluate its no action decision, and in 2002, issued a new Record of Decision specifying dredging as the preferred remedy for the sediments of the Upper Hudson River.

Since 1990, Anchor QEA personnel have been working with the General Electric Company on the RI/FS and remedial design phases of this project. Work prior to the Record of Decision involved investigating the origin, fate, and transport of PCBs within the Upper and Lower Hudson River to facilitate the development of technically sound and cost-effective remedial strategies. Following release of the Record of Decision, Anchor QEA led the General Electric Company's pre-design sediment characterization efforts, which included collection of over 8,000 sediment cores, management of data generated by over 50,000 chemical

analyses, and the design and execution of a comprehensive baseline water column monitoring program. Design phase services have included dredge area delineation based upon the pre-design sediment characterization, assessment of dredging resuspension using the mathematical models developed for the system, delineation of in-river and shoreline habitats impacted by the dredging, and design of habitat replacement and reconstruction following dredging. All of this work has entailed close cooperation with General Electric, the USEPA, and its oversight contractors, both in the field and in the decision-making process.

Anchor QEA developed numerous computer applications to facilitate the efficient design, execution, and management of the pre-design sediment and water column characterization program. Anchor QEA's detailed understanding of the physical, chemical, and biological characteristics of the system enabled an efficient use of company resources to design the sediment remedy, including the delineation of dredging areas, specification of dredging depth contours, and design of an effective habitat restoration strategy.

### Housatonic River Assessment, Pittsfield, Massachusetts

Operations at a former transformer manufacturing facility owned by the General Electric Company in Pittsfield, Massachusetts, resulted in the release of PCBs to the Housatonic River. Numerous investigations conducted by General Electric and government agencies since the 1970s have detected PCBs in surface water, sediment, soils, and biota of the Housatonic River and its floodplain. As a result, a Consent Decree (CD) was issued for the site in October of 2000, detailing the terms of an agreement reached between General Electric, the USEPA, and other government agencies regarding cleanup of the Housatonic River downstream of the General Electric facility. As part of the CD, General Electric was required to develop a Resource Conservation and Recovery Act of 1976 (RCRA) Facility Investigation (RFI) Report pursuant to a RCRA permit reissued to General Electric by the USEPA. The purpose of the RFI report was to delineate the nature and extent of PCBs in the Housatonic River downstream of the General Electric facility, utilizing available data collected since the 1970s. As part of the RFI report, Anchor QEA conducted extensive analyses of the site data forming the basis for a conceptual site model.

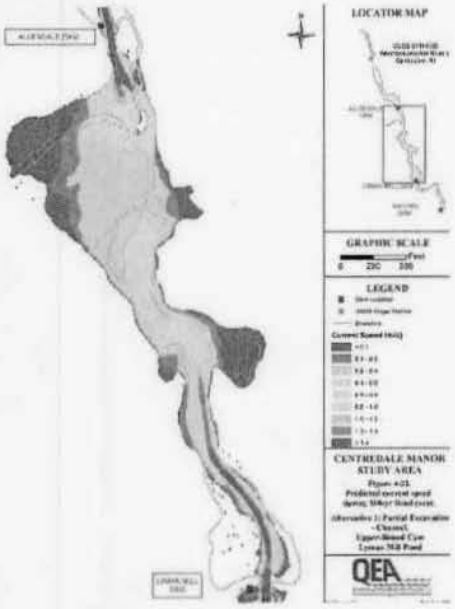
Understanding PCB dynamics in the Housatonic River system is complicated by a number of factors, including the presence of several impoundments within the study area; significant meandering of the river channel; large backwater areas; and a significant floodplain that is inundated frequently. Anchor QEA has adopted a multi-disciplinary approach to studying the PCB dynamics of the system, including: 1) conducting baseline analyses of PCB data for water, sediments, floodplain soils, and fish to discern temporal and spatial trends in PCBs and to gain a quantitative understanding of PCB dynamics; and 2) evaluating several process-specific data sets collected by both General Electric and the USEPA to develop a better understanding of hydrodynamics, sediment transport, and PCB fate, transport, and bioaccumulation within the system.

These studies included a sediment bed load sampling program, a river meander study, water column and sediment PCB partitioning studies, bank erosion surveys, channel bathymetric studies, and cohesive sediment erosion experiments.

Anchor QEA's analysis and interpretation of the site data provided General Electric with a quantitative conceptual model of the system, which identified the significant mechanisms that affect PCB mass transport and bioaccumulation within the river and its floodplain.

### Centredale Manor Restoration Project Superfund Site, North Providence, Rhode Island

The Centredale Manor Restoration Project Superfund site includes two dammed ponds (Allendale and Lyman Mill Ponds) on the Woonasquatucket River, which is located near North Providence, Rhode Island. One potential remedial alternative being considered at this site includes removal of the Allendale and Lyman Mill dams. Anchor QEA conducted a study to evaluate the effects of the dam removal remedial alternatives on the hydrodynamic behavior of the river, both within the site and in the region downstream of the site.




The hydrodynamic model that was applied in the study was an enhanced version of the Environmental Fluid Dynamics Code (EFDC). A rectangular numerical grid was developed for the 2.3-mile long site. Floodplain areas in the model were delineated using aerial photographs of the study area. A high-resolution square grid was used to provide sufficient flexibility to evaluate a wide range of channel designs for post-dam removal conditions.

The hydrodynamic model was used to predict future conditions in the study area after the dams are removed and the channel reconfigured. Thus, use of the model as a prognostic tool for evaluating future conditions introduces uncertainty into the model results. This uncertainty was minimized through the use of bounding simulations to develop reliable conclusions from model predictions. The model was used to evaluate several post-dam removal channel configurations for river flow conditions ranging from low-flow (7Q10 flow) to 100-year flood. For each channel configuration and river flow condition, model results were used to determine extent of channel and floodplain inundation; water depth and surface water elevation; current velocity; bed shear stress; and stable bed particle size.

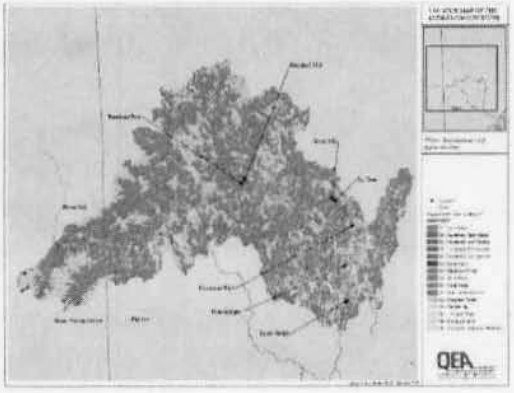
### Tittabawassee and Saginaw River Segiment Cleanup, Midland, Michigan

Anchor QEA is currently leading engineering evaluation/cost analysis (EE/CA), FS, and remedial design tasks of the Tittabawassee and Saginaw River sediment cleanup project, starting at the Dow Chemical facility in Midland, Michigan, and extending downstream on the Tittabawassee and Saginaw Rivers and into Saginaw Bay and Lake Huron in Michigan. The project is currently streamlining studies and accelerating remedial

design to initiate response actions more rapidly, reducing exposures and associated dioxin and related chemical risks at the site, and concurrently limiting overall response costs.

The Tittabawassee and Saginaw River sediment cleanup project is one of the highest profile sediment dioxin cleanup projects in the United States. Anchor QEA was selected by Dow Chemical to lead all technical elements of the EE/CA, sediment transport modeling, FS, technical communication, and remedial design efforts based on the our unparalleled record of successful sediment cleanup projects completed to date throughout the United States.

### Gulf Island Pond, Jay, Maine




Gulf Island Pond, a large impoundment on the Androscoggin River, is on Maine's 303(d) list of impaired water bodies due to non-attainment of dissolved oxygen standards. At issue is a 4-mile segment of the river directly above Gulf Island Dam, which has experienced historical algal blooms due to excessive phosphorous. The State of Maine issued a TMDL for carbonaceous biochemical oxygen demand (CBOD), total phosphorous, and total suspended solids (TSS) for the pond in 2005. The TMDL states that "paper mills located in Berlin, NH; Rumford, ME; and Jay, ME are the major source of most of the pollutants." Anchor QEA conducted an assessment of the TMDL on behalf of the Verso Paper Mill in Jay, Maine, to assess if the TMDL provides a reasonable basis for establishing waste discharge limits.

Anchor QEA critically examined the assumptions that went into the TMDL model and conducted analyses using available data to examine the basis of the TMDL.

TSS and algae contribute to sediment oxygen demand (SOD), a major source of oxygen depletion in the deeper areas of Gulf Island Pond. Anchor QEA conducted a series of calculations to examine the importance of non-point source TSS and phosphorous to the pond. Non-point source TSS and phosphorous loadings to Gulf Island Pond were estimated using the export coefficient method and a second, independent, modeling method based on a rating curve was used to obtain a second estimate for non-point TSS loads. These calculations showed that non-point TSS and phosphorous loadings to the pond are much more important than indicated by the TMDL modeling. Deficiencies of the technical analyses that formed the basis for the TMDL for phosphorous and biochemical oxygen demand (BOD) have led to loading reductions and oxygen injection requirements that are unwarranted and may be ineffective in achieving the goal of maintaining dissolved oxygen levels at state standards.

Anchor QEA provided Verso Paper with a sound, technical analysis of the TMDL model and elucidated several inconsistencies that were presented to the State Environmental Protection Board in written and oral testimony at hearings held on appeal of TMDL-based discharge permits. Anchor QEA demonstrated that

the inaccuracy of the predictions of the TMDL modeling invalidated the wasteload allocations set by the Gulf Island Pond TMDL.

### Three Rivers System, Onondaga County, New York

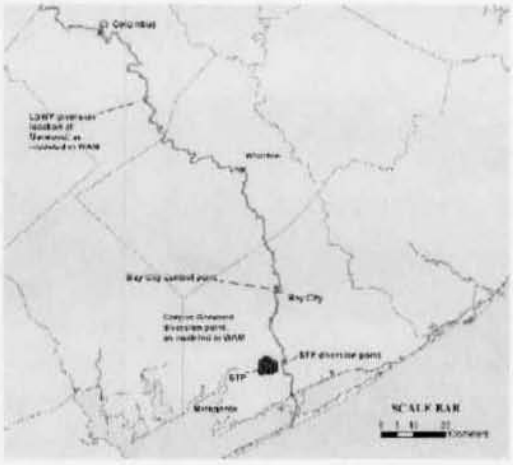
On behalf of the Onondaga County Department of Water Environment Protection (OCDWEP), Anchor QEA developed of a state-of-the-science water quality model of the Three Rivers System (containing portions of the Seneca, Oneida, and Oswego Rivers). The Seneca River is on New York State's 303(d) list of impaired water bodies. The 26-kilometer segment of the Seneca River (from Cross Lake to the Onondaga Lake outlet) is one of the state's highest priorities for TMDL development, and a TMDL for oxygen demanding substances is scheduled for completion in 2007. Moreover, under a consent judgment, Onondaga County was required to evaluate the feasibility of diverting the 85 MGD Syracuse Metropolitan Treatment Plant (Metro) effluent from Onondaga Lake, New York, to the Seneca River to mitigate Onondaga Lake water quality excursions.

Anchor QEA developed a water quality model describing the oxygen dynamics of the river system to guide decisions regarding the Metro diversion and ultimately the TMDL. The model includes mechanistic descriptions of nutrient and phytoplankton dynamics, SOD, and bioenergetics-based zebra mussel respiration. The water quality model was calibrated using 6 years of monitoring data. Prior to evaluating diversion and other management scenarios, Onondaga County and the Onondaga Lake Partnership (a consortium of local, state, and federal agencies) conducted an independent review of the model in 2003. The performance of the model was favorably reviewed, as evidenced by the peer review panel comments such as "The model can be used to help establish a TMDL for oxygen resources in the Seneca River" and "The Anchor QEA staff are highly-qualified, in that they have much experience in developing and testing water-quality models in a variety of environmental settings." In addition to the successful peer review, the sediment flux submodel has undergone an independent evaluation by USEPA Region 4 and has been adapted by USEPA for incorporation into its Water Quality Analysis Simulation Program (WASP) modeling framework. The Three Rivers Model is currently being integrated with a model of Onondaga Lake water quality to facilitate future management of the lake and river system.

The Three Rivers Model provides Onondaga County with a state-of-the-science water quality management tool to evaluate the technical feasibility of whole or partial diversion of the Metro effluent from the lake into the river, an estimated $250 million capital works project. The model will also facilitate New York State's development of a dissolved oxygen TMDL for the Seneca River.

## South Texas Water Quality Study, San Antonio, Texas

The Lower Colorado River Authority (LCRA) and the San Antonio Water System (SAWS) have proposed a joint LCRA-SAWS Water Project (LSWP) to satisfy long-term water needs in both the Colorado River basin and the San Antonio area, while being a steward of the environment. The proposed project would develop new water in the region through off-channel reservoirs, conjunctive use of groundwater, and agricultural conservation. A portion of the water would be transferred to SAWS; the remainder would be used to benefit the Colorado Basin. The LSWP will likely change the timing and magnitude of the water releases from the reservoirs upstream of the City of Austin to the Lower Colorado River.




These timing changes in river flow may ultimately affect the flow over the most downstream dam (Bay City Dam) on the Colorado River and effectively impact the movement of the salt wedge in the tidally-influenced portion of the river, which is just downstream of this dam. The South Texas Project Nuclear Plant (STP) relies on the water from this tidally-influenced reach for cooling water for their plant operations. They prefer to draw in less saline water to avoid impacts to their infrastructure; however, the salinity of their diversion water may change, if the timing of the river flows due to the LSWP change.

Anchor QEA is leading a team to understand the impact of the LSWP on the quantity and quality (i.e., salinity) of water at the STP diversion point. This effort includes a detailed analysis of the future water available at STP's diversion point, using projected flows with the LSWP simulated by the state's Water Availability Model (WAM), provided by an independent contractor. The analysis entails advanced programming that allows for the application of multiple diversion criteria based on the permit requirements, and efficient updating, given new projections from the WAM. The second phase of the project entails empirical modeling of the water quality at STP's diversion point (specifically the salinity), which will change as the movement of the salt wedge changes due to changes in freshwater flow coming over the downstream dam.

The water quantity analysis program developed by Anchor QEA provided the LCRA and SAWS with a fast and efficient tool that has the ability to quickly update projected flows at STP's diversion point, given new WAM output. This program allowed for the WAM modelers to provide output to Anchor QEA "on the fly" and see results of changes in the WAM modeling to the STP diversion water almost instantaneously. For the water quality modeling, advanced statistical tools were applied, allowing the client to see the impact of the LSWP on the quality of the diversion water into the future.

## San Francisco Bay Total Maximum Daily Load Review, San Francisco, California

The San Francisco Bay is on California's 303(d) list for impaired waters due to fish consumption advisories related in part to PCB contamination. As a result, the California Regional Water Quality Control Board (RWQCB) has developed a TMDL for the San Francisco Bay to address this impairment. The TMDL incorporates previous evaluations of the sources of PCBs to the bay as well as the fate of PCBs and the food web structure of the bay. The General Electric Company was identified as one of many sources of PCBs to the San Francisco Bay.

Parallel to this effort, Anchor QEA has reviewed the TMDL and evaluated the models and methods behind the TMDL development in order to assess their limitations, uncertainty, and applicability. Anchor QEA's responsibilities have included:

- Critical evaluation of the PCB mass balance model developed for the bay including a detailed understanding of all processes included and absent from the model
- Data analysis and mass balance calculations to understand the sources and loadings of PCBs to the bay and identify data gaps
- Critical evaluation of the RWQCB TMDL development methods
- Review of issues related to PCB load allocation and target concentrations for fish and sediment
- Meetings with RWQCB to discuss the TMDL and technical issues
- Critical evaluation of the food-web model being used to understand the fate of PCBs in the fish

The review of the TMDL by Anchor QEA provided the client with the information necessary to understand the implications and limitations of the proposed TMDL load reductions.

## KEY STAFF

Our staff of more than 200 engineers, environmental planners, scientists, landscape architects, and construction managers enjoy every opportunity to apply their technical skills and creativity on a wide range of projects nationwide. Anchor QEA has a strong history of developing effective solutions for our clients' projects, and our staff has gained national recognition for their technical contributions. The following staff members have extensive experience with sediment sites.

### David Keith, Ph.D., Partner/Senior Scientist

David Keith has directed and participated in numerous projects involved in remediating sites environmentally impacted by contaminated surface water, groundwater, soils, and sediments and in addressing problems associated with nonpoint source pollution in stormwater runoff. Dr. Keith has conducted hydrogeologic investigations at local and regional scales, geochemical evaluations of contaminated sediments, soils, industrial wastes, and mining wastes and developed data analysis tools using geographic information system technology. Dr. Keith has led RI/FS at CERCLA sites, helped prepare of Environmental Impact Statements/Environmental Assessments as required by National Environmental Policy Act (NEPA) and assisted in the design of reclamation and closure plans for mine and other industrial sites. He has also worked on sites that required close coordination between CERCLA and TMDL evaluations and actions to develop a unifying solution that satisfies regulatory concerns under each program.

Dr. Keith has worked on several projects involved in evaluating the distribution and the potential ecological impacts of contaminated sediments in lakes, streams, and estuaries throughout the United States. He has exceptional expertise in the use of numerical geochemical models for determining the fate and transport of contaminants in aquatic environments. Dr. Keith has performed water quality evaluations in regards to dredging, capping, natural recovery, and disposal options for a variety of contaminants. Contaminants of concern have included metals and a variety of organic chemicals (NAPLs, PCBs, dioxins and furans, and pesticides).

### David Glaser, Ph.D., Partner/Senior Scientist

David Glaser provides technical expertise in the solution of contaminated sediment and water quality problems. For the past 20 years, his work has been directed towards evaluating remediation options; planning remedial activities; and supporting allocation at multiparty sites, risk assessment, and habitat restoration.

Dr. Glaser's work has focused on quantitative approaches to environmental problems, including statistical analysis as well as the development and application of computer models. For example, he has developed and applied computer bioaccumulation models of contaminant transfer in aquatic food webs and birds. His work in eutrophication has included the development of a model quantifying the impacts of zebra mussels on water quality. Uncertainty analysis for computer models has been a particular focus of his efforts.

Dr. Glaser has been a peer reviewer for the USEPA as well as a reviewer for the journals *Microbial Ecology, Environmental Toxicology and Chemistry* and *Environmental Science and Technology*.

### David Haury, Senior Scientist

David Haury has more than 21 years of experience in the environmental consulting and manufacturing sectors. Mr. Haury is an expert in strategic and technical management of NRD and other environmental liabilities and in the development of risk management strategies and technical approaches to risk assessment and ecological restoration. He has applied this expertise to contaminated sites and oil spills throughout the United States, for a wide range of constituents of concern and impacted resources including surface water, groundwater, sediments, soils, and biota in terrestrial and aquatic (marine, estuarine, riverine) ecosystems. Mr. Haury has a broad background and project experience in engineering, risk assessment, toxicology, and ecological restoration.

In the field of risk assessment, particularly as applied to contaminated sediment sites, Mr. Haury is experienced in the development of conceptual site models focused on describing the fate and transport of contaminants through the physical and biological components of the system, determining the use of these systems by ecological and human receptors, and understanding the resulting risks posed by exposure to these sediment-based contaminants. He is particularly experienced in the interpretation of incremental risks and potential ecological service losses commensurate with these risks as they relate to the development of risk management strategies and approaches.

In the field of NRD, Mr. Haury has worked with clients in a number of different capacities, including assisting in the development of preliminary assessments of potential NRD liability, the development of strategic approaches for NRD-liability management, and the negotiation of NRD settlements with state and federal trustees. He is experienced in the use of technical tools, such as HEA and ecological risk assessments to quantify resource injuries and service losses and scale restoration projects.

### Ram Mohan, Ph.D., P.E., Partner/Senior Coastal Engineer

Ram Mohan has more than 20 years of experience in dredging, capping, sediment remediation, marine geotechnical, and river, coastal, and port engineering projects. He is a past member of the prestigious *National Research Council's (NRC) Ocean Studies Board* and is involved in several national boards and committees related to ocean and coastal systems. Dr. Mohan was part of the NRC panel mandated by the U.S. Congress to peer-review the USACE. An expert in the field of dredging, capping, and coastal engineering, he is frequently retained to provide peer-review and expert analysis of high-profile projects. In 2005, Western Dredging Association (WEDA) named him its "Dredger of the Year."

Dr. Mohan's experience includes planning and design studies, technical reviews, technical evaluations, and project management for a variety of clients including Fortune 500 companies, law firms, the USACE, port and harbor authorities, state agencies, and private firms in the areas of dredging and capping, sediment remediation, coastal and water resources engineering, environmental planning, and port development.

Dr. Mohan serves as a visiting faculty at Texas A&M University's Center for Dredging Studies, where he lectures at the annual Dredging Short Course. He serves as the editor-in-chief for WEDA's *Journal of Dredging Engineering* and is a member of the Editorial Board of the *Journal of Marine Environmental Engineering*. He also serves on the Board of Directors for WEDA and is a past member of the Board of

Directors of the American Shore & Beach Association and the Association of Coastal Engineers. As the author of more than 100 publications in civil, dredging, and coastal engineering, Dr. Mohan brings strong technical/team leadership and motivational abilities to the projects on which he works.

### Clay Patmont, Partner/Senior Scientist

Clay Patmont has more than 29 years of experience in RI/FS, risk assessment, source evaluations, contaminant transport modeling, and design of hazardous substance remediation and habitat restoration projects in aquatic environments—particularly lakes, large rivers, and estuaries. Mr. Patmont has extensive sediment cleanup project experience in both CERCLA and state-led cleanups, and he is a recognized national expert in areas including wood waste cleanup, groundwater/surface water interactions, sediment risk characterization, sediment cleanup design, and integrated cleanup and habitat restoration design.

Mr. Patmont has authored and co-authored numerous peer-reviewed scientific/engineering journal articles on sediment cleanup and lake/river restoration, including several papers developed by the joint USEPA/industry/academia Remediation Technologies Development Forum. He has directed more than 60 peer-, agency-, and stakeholder-reviewed RI/FS, risk assessments, remedial designs, wasteload allocations, and engineering reports for projects throughout the United States. In 2005, Mr. Patmont was selected as one of three national peer reviewers of USEPA's *Draft Sediment Remediation Guidance*. His particular expertise in a wide variety of sediment and water quality assessments and in presenting and evaluating the balance between risk reduction and cost of alternative cleanup remedies (the "practicability" evaluation) and has been instrumental in the success of these efforts.

### Tom Schadt, Partner/Senior Biologist

Tom Schadt has more than 28 years experience in environmental consulting, including nationwide experience with sediment remediation. Mr. Schadt's major area of focus is overseeing sediment cleanup projects, investigating water and sediment quality and biological affects, and developing strategies for sediment remediation and habitat restoration. His sediment project experience includes CERCLA, RCRA, and state-led and voluntary action sites. Much of his project management experience is with sediment management issues, sediment characterization, cleanup strategy development, FS development, long-term monitoring, and NDR assessments. Mr. Schadt has participated in sediment cleanup projects in both freshwater and marine environments, including rivers, lakes, estuaries, bayous, and bays.

### Kevin Russell, Partner/Senior Scientist

Kevin Russell is an environmental engineer with more than 13 years of experience in the field. Mr. Russell has directed and managed numerous projects on behalf of both government and industrial clients in the areas of contaminated sediment management, contaminated groundwater investigation, pollutant fate, transport, and bioaccumulation, surface water quality/eutrophication, and stream hydraulic analysis. Many of these projects have included the development of mathematical models to understand the fate and transport of contaminants in surface water and groundwater systems, and the application of these models to assist in the evaluation and design of remedial alternatives. In addition, much of the work Mr. Russell manages involves the compilation and management of large databases, statistical and graphical analyses of data, development of geographic information system (GIS) applications for spatial data evaluation, and the

design and execution of field sampling programs. Mr. Russell is a member of several professional organizations and has presented numerous technical papers at scientific conferences.

### John Connolly, Ph.D., P.E., BCEE, Partner/Senior Engineer

John Connolly is a nationally recognized expert on contaminated sediments and eutrophication. His work has been directed to surface water and groundwater contamination problems for the purposes of allocation among potential sources, evaluation of remedial options, remedy design or wasteload allocation (TMDLs). Dr. Connolly is an expert in water quality modeling and has been involved in the development of several models commonly applied to real world problems. He is also recognized for his ability to communicate complex technical results to the range of stakeholders typically involved in projects and is frequently called on to make presentations at regulatory hearings, community meetings, and national and regional technical forums. Dr. Connolly has participated in negotiations with regulatory agencies to craft consent decrees governing contaminated sediment sites.

Dr. Connolly is frequently invited to participate in government and industry sponsored workshops. He is a member of the USEPA Science Advisory Board. He has worked throughout the United States, in Latin America, and in Europe. He has served as an expert witness for industry and government agencies and has provided testimony before the U.S. Congress and the New York State Assembly. Dr. Connolly is also a member of the Manhattan College Council of Engineering Affairs.

### C. Kirk Ziegler, Ph.D., P.E., Partner/Senior Engineer

Kirk Ziegler is experienced 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 USEPA, and the model has been used by USEPA on several contaminated sediment studies. Model validation studies on the Upper Hudson River, Lower Fox River (Wisconsin), Pawtuxet River (Rhode Island) and Watts Bar Reservoir (Tennessee) yielded excellent results. The sediment transport model has also been used in conjunction with studies of contaminant transport in the Venice Lagoon (Italy), the Trenton Channel of the Detroit River, the Buffalo River, the Saginaw River, Lake Erie, and the Santa Barbara Channel. Dr. Ziegler is a nationally recognized expert in the area of sediment stability and was a primary organizer of the Sediment Stability Workshop held in New Orleans in January of 2002.

As the result of managing over 15 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 toxics 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.

### Tom Wang, P.E., Partner/Senior Engineer

Tom Wang has more than 18 years of experience managing and designing a diverse range of marine dependent projects, both in the United States and internationally, from the initial planning and permitting

stages through design and construction. Many of these projects were contaminated sediment remediation projects, under either state or federal lead agencies. Mr. Wang has successfully completed over 200 sediment management projects, including over 35 state and federal sediment remediation projects (CERCLA, Model Toxics Control Act [MTCA], Cleanup and Abatement Order [CAO], etc.) involving natural recovery, enhanced natural recovery, in situ capping, mechanical and hydraulic dredging, confined disposal facilities, confined aquatic disposal, landfill disposal, beneficial reuse, and treatment. He is one of very few engineers in the United States to have constructed all of the above remedial actions.

Mr. Wang is an internationally recognized dredging expert and was awarded the WEDA 2004 "Dredger of the Year" honor. He was selected by the USACE to be the United States co-representative to PIANC for developing guidelines for dredging best management practices. He currently manages and designs projects in various disciplines, including dredging, port and harbor development, sediment management, navigation, coastal engineering, habitat restoration, and marine construction management. Mr. Wang has assisted multiple private and public clients on an on-call basis as both project manager and technical advisor. Current port clients include Ports of Seattle, Tacoma, Bellingham, Vancouver, Olympia, Portland, Oakland, San Francisco, Long Beach, Hueneme, and San Diego.

### Wendell Mears, Marine Engineering Specialist

Wendell Mears is a civil, ocean, and coastal engineer with more than 30 years of marine design and construction experience. He was recently responsible for directing the programs for the Houston and Calcasieu Ship Channels and the marine design and construction of six liquefied natural gas (LNG) import terminals in the United States, China, and South America. He has extensive international experience with the USACE, where he was responsible for many aspects of regional and international marine programs.

### John Verduin, P.E., Partner/Senior Geotechnical Engineer

John Verduin has more than 21 years of experience applying innovative engineering approaches to port, harbor, and waterway projects throughout the United States. As a senior engineer, Mr. Verduin is responsible for completing geotechnical engineering studies, analyzing contaminant transport mechanisms, managing structural and hydrographic waterway surveys, developing and evaluating remedial engineering approaches and cost estimates, and designing and implementing remedial actions, including preparation of plans, specifications, support documentation, and construction oversight. Mr. Verduin is uniquely qualified to evaluate the full range of potential contaminated sediment remedial alternatives, being one of the few engineers in the country to actually design and see implemented (during construction) many of the different available remedial alternatives. He has designed remedial alternatives involving natural recovery, enhanced natural recovery, in situ capping, mechanical and hydraulic dredging, confined disposal, and treatment. Mr. Verduin's strong background in geotechnical/civil engineering also allows him to integrate aspects of the potential remedial solution into future development needs.