

*Curriculum Vitae:*  
**Paul M. Craig, P.E.**  
WATER RESOURCES & HYDRODYNAMICS

**EDUCATION:**

B.E. Environmental & Water Resources Engineering, Vanderbilt University, 1979  
M.S. Civil/Water Resources Engineering, University of Tennessee, 1989

**EMPLOYMENT HISTORY:**

1999 –Pres. Dynamic Solutions-International, LLC.  
Edmonds WA/Hanoi, Vietnam  
Senior Consultant

1998 -1999 Advanced Technology Systems, Inc.  
Knoxville, TN  
Senior Vice-President

1985 -1998 P-SQUARED Technologies, Inc.  
Knoxville, TN  
President/Senior Consultant

1980 -1985 Sanders Engineering & Analytical Services, Inc.  
Mobile, AL  
Environmental Engineer

1979 -1980 State of Georgia  
Atlanta, GA  
Environmental Engineer

**TECHNICAL SPECIALTIES:**

Hydrodynamics; Hydrology; and Hydraulics for Lakes, Reservoirs, Rivers, Estuaries and Coastal Zones; Water Resources Management; Solid/Hazardous Waste Management; Water Quality, Multimedia and Multidimensional Fate and Transport of Contaminants in the Environment; Sediment Transport; Acoustic Doppler Current Profilers (ADCP's); Project Management & Planning; Environmental Regulatory Compliance and Permitting; Geographical Information Systems; Hydropower; Computer Model Development; Model Results Visualization.

**PROFESSIONAL BACKGROUND:**

Mr. Craig is a registered Professional Engineer with over 37 years of experience in Engineering in the areas of *hydrology & hydraulics* (H&H), *hydrodynamics*, *sediment transport*, *contaminated sediments*, *water quality*, *water resources* and *hydropower*. He has conducted or been in direct oversight of over 100 engineering and analysis projects covering a wide range of conditions and client needs. Mr. Craig has extensive experience in solid and hazardous waste management and design support. Mr. Craig has managed and conducted numerous engineering design analyses and water resource studies of many types of water systems including rivers, lakes, reservoirs, and estuaries. His technical and *project management* skills have produced or supported hundreds of planning documents, feasibility studies, system performance standards and design specifications.

Mr. Craig has extensive experience with a large number of H&H and environmental models, analysis tools and techniques. In addition to expertise in the application and analysis of standard models, such as HEC1/HMS, HEC2/RAS, GeoRAS, HEC6, UNET, FLDWAV, QUAL2e, HSPF and

SWMM, Mr. Craig has specialized experience conducting multi-dimensional environmental hydrodynamic modeling and analysis studies. He has been involved in the development and testing of several 2D and 3D hydrodynamic models with sediment and toxics transport and water quality, including the EFDC, Delft3D, ECOMSED, ADH, POM and many others. Mr. Craig's understanding of both the theory and practice of how and why hydrologic and hydraulic systems work the way they do provides him with unique insights into how to help his clients achieve their goals and objectives.

Since forming his first business in 1985 Mr. Craig has worked as a businessman and company manager. This first hand business and management experience has provided him with a deep appreciation and understanding of what it takes to make projects and ventures successful. Mr. Craig is the founder and current President of Dynamic Solutions-International, LLC.

## **SELECTED PROJECT EXPERIENCE: Model Development**

### **Development of EFDCPlus (EFDC+)**

Senior consultant in the conversion of the EFDC\_EPA model to the EFDC+ version which included, dynamic memory allocation, conversion of the code from Fortran 77 to Fortran 90, cleaning/optimizing the original code, adding an "age of water" feature and the implementation of multi-threading using the OMP technology. The dynamic memory allocation and OMP have produced a major new version of EFDC+ with that is significantly more stable and faster than prior versions of EFDC.

### **Implementation of the SIGMA-ZED Vertical Layering Model for EFDC+**

Senior consultant and team leader for the implementation of a new approach for treatment of the vertical layering system of EFDC. EFDC+ has been enhanced by allowing for the number of vertical layers to vary over the model domain, thereby reducing the traditional pressure-gradient error associated with the normal implementation of the Sigma stretch vertical layering system. The new version is computationally more efficient than a similarly configured sigma stretch grid, thus making models with 20 to 50 layers or more practical for typical projects. A new version of EFDC\_Explorer has been developed to pre/post process this new vertical layering system.

### **Implementation of a Rooted Plant and Epiphyte Model (RPEM) for EFDC+**

Senior consultant and team leader for the implementation of a Rooted Plant and Epiphyte Model (RPEM) into the EFDC+ modeling system. The RPEM model was implemented with optional coupling to the internal EFDC water quality model. The RPEM uses a carbon tracking approach for shoots and roots with growth and die off. EFDC\_Explorer (EE) pre/post processor was updated to include a graphical user interface to define/specify RPEM inputs as well as visualization of RPEM output.

*Client: Alberta Environment Sustainable Resources Division (AESRD), Edmonton, Alberta, CA.*

### **Implementation of a Lagrangian Particle Tracking (LPT) Sub-Model for EFDC+**

Senior consultant and team leader for the implementation of a Lagrangian Particle Tracking (LPT) code into the EFDC+ modeling system. The LPT model was implemented with 3D particle movement with/without diffusivity, neutrally buoyant particles or with settling/floating behavior or fixed depth for drogue calibration. To improve computational performance, the LPT model was implemented with multi-threaded capabilities. EFDC\_Explorer (EE) pre/post processor was updated to include a graphical user interface to easily seed the model domain, a user interface to specify particle behavior by LPT group, specify particle release dates/times and duration of tracking and 2D visualization of particle positions, their tracks and animations.

*Client: St. Johns River Water Management District, Palatka, FL*

### **Implementation of Wind Wave Sub-Model for EFDC+**

Senior consultant and team leader for the implementation of a new internally coupled sub-model of EFDC+ for wind generated waves. Wave action optionally impacts bed shear stress as well as wave induced currents due to the wave generated radiation shear stresses. The entire model or any subset of cells can have the wind wave feature enabled. Enhanced the EFDC\_Explorer (EE) utility to be able to provide a graphical user interface for input and output, including wave height, direction, period, length and bed shear stress due to wave action.

### **EFDC\_Explorer Development, Athens GA**

Senior Consultant for the development of a pre/post processor for the EFDC model. This utility is part of the EPA strategy for the release and technical support of the EFDC model, as part of the Center for Environmental Assessment Modeling (CEAM) and Total Maximum Daily Load (TMDL) Programs. The utility's features include the normal set of pre/post processing capabilities but also many high-level features. For example, the utility can build EFDC grids quickly using either Cartesian (regular and telescoping) grids or curvilinear grids for many rivers and estuaries. This utility enables the user to develop new and/or modified applications for simple to complex systems in very short times compared to typical 2D/3D applications.

*Client: EPA, Athens GA.*

### **EFDC Training and Support, Various Locations**

Provided the U.S. Environmental Protection Agency (EPA) and their contractors with Environmental Fluids Dynamics Code (EFDC) training and support. EFDC is a 1D/2D/3D hydrodynamic water quality model that has been developed under funding provided by EPA. Worked with EPA and contractor researchers and engineers to assist in model development for a range of applications including estuaries, lakes and rivers. The scope of these models included 2 and 3D applications of hydrodynamics, salinity, sediment dynamics (erosion/scour, deposition and transport), toxics and water quality.

*Client: EPA, Athens GA.*

### **W2-Tool Development of a Pre- and Post- Processor for CE-QUAL-W2**

Developed a complete pre- and post-processor for the CE-QUAL-W2 model. Also developed a dynamically allocated version of the W2 model to allow the user to use the standard Version 3 for any application without recompilation. The preprocessor provides user a Windows interface to change any parameter and edit the model grid, including adding and deleting branches. The post processor provides the ability to rapidly view model results, including animation of results for multiple parameters simultaneously. 3-D perspectives of the model grid can also be generated.

*Client: Portland State University, Portland, OR.*

## **SELECTED PROJECT EXPERIENCE: Coastal/Estuarine Systems**

### **3-D Hydrodynamic/Sediment Transport Model of the Sacramento-San Joaquin Delta, Sacramento, California**

Senior consultant for a 3-D hydrodynamic and sediment transport model for the Sacramento-San Joaquin Delta. The Sacramento San Joaquin River Delta (Delta) is the largest estuary on the west coast and covers more than 738,000 acres. The model uses the Environmental Fluid Dynamics Code (EFDC). The model grid includes Yolo Bypass, the Sacramento River to Verona, approximately ten miles of the American River, the San Joaquin River system to Vernalis, and Suisun Bay to the Carquinez Strait. Physical processes simulated in the model include hydrodynamics governed by currents and wind waves, temperature, salinity, and cohesive and non-cohesive sediment transport, deposition, and erosion. The model was calibrated and validated to observed data from the years 2003 and 2004. Due to the importance on wind generated wave resuspension of sediments, a coupled wind wave sub-model was added to EFDC and EFDC\_Explorer.

*Client: USACE, Sacramento District, Sacramento, CA*

### **Coastal Hydrodynamic Model of the Kotzebue Sound for the Kotzebue Shoreline Protection Design, Kotzebue, AK**

Senior Consultant for the development of a 2D depth averaged hydrodynamic sediment transport model of the near field region impacting the shoreline development. Analyzed short term and long-term scour and deposition patterns to set the minimum sheet pile depths. Processed 3D velocity data collected at two bottom mounted ADCP data collection platforms.

*Client: Coastline Engineering, Anchorage, AK.*

### **Hydrodynamic Modeling for the Biological Evaluation of the Effects of NPDES Permit Reauthorization on Cook Inlet Beluga Whales**

Senior consultant for a 3D hydrodynamic, sediment transport, toxics model of the Upper Cook Inlet. The Anchorage Water and Wastewater Utility (AWWU) renewal of the Asplund WWTP NPDES permit and associated 301(h) waiver, required a biological evaluation (BE) for the Beluga whale and other species protected by the ESA. Numerical modeling was used to quantify Emerging Pollutants of Concern (EPOC) effluent concentrations in receiving waters and sediments affected by the discharge. EFDC was used for the farfield model to address the mixing, fate, and transport of the EPOC. The hydrodynamic and transport processes included tidal forcing; fresh water/snow melt, glacial till, density effects; wind generated currents on open water and iced-over conditions. An integrated nearfield plume sub-model dynamically coupled to the farfield circulation model.

*Client: CH2MHill, Inc., Seattle, WA and AWWU, Anchorage, AK*

### **Water Quality Model for the Caloosahatchee Estuary and San Carlos Bay, Ft Myers, FL**

Senior Consultant for the development of a 3D hydrodynamic water quality model of the Caloosahatchee Estuary and San Carlos Bay. Developed a calibrated and validated model for the development of a Total Maximum Daily Load (TMDL) for nutrients and dissolved oxygen. Supported the development of the HSPF model for flows and nutrient loads for the Caloosahatchee basin. Linked the flows, temperature and water quality parameters from the watershed model HSPF to the EFDC model. Developed a submerged aquatic vegetation (SAV) tool for EFDC\_Explorer.

*Client: Florida Department of Environmental Quality, Tallahassee, FL.*

### **Coastal Hydrodynamic Model of St. Paul Harbor and Womens Bay for the Kodiak Airport Expansion Environmental Impact Statement, Kodiak, AK**

Senior Consultant for the development of a 2D depth averaged hydrodynamic coastal circulation model of the coastal region around the existing Kodiak Airport. Developed a regional scale model with a nested detailed model for near field mixing and bed shear analyses. Processed 3D velocity data collected at four buoy mounted ADCP data collection platforms. Calibrated both models to the ADCP. Conducted an alternative analysis using a range of runway extension options identified during the EIS process.

*Client: Coastline Engineering, Anchorage, AK.*

### **Perdido Bay Hydrodynamic and Water Quality Model, Pensacola, FL**

Developed a 3D hydrodynamic and water quality model (EFDC) of Perdido Bay located in the Northern Gulf of Mexico. Developed a calibrated and validated model for the development of a Total Maximum Daily Load (TMDL) for inorganic solids, nutrients and dissolved oxygen. Supported the development of the HSPF model for flows and nutrient loads for the Perdido River watershed. Linked the flows, temperature and water quality parameters from the watershed model HSPF to the EFDC model. Extended EFDC\_Explorer to work with the sediment diagenesis submodel in EFDC.

*Client: Florida Department of Environmental Quality, Tallahassee, FL.*

### **Río Grande de Arecibo Estuary Hydrodynamic Water Quality/Salinity Model, San Juan Puerto Rico**

Senior Technical Consultant for the water quality modeling component of the Río Grande de Arecibo (RGA) estuary study. A CE\_QUAL-W2 (Version 2 of a COE maintained model for 2 dimensional hydrodynamic and water quality simulation) model was developed for the evaluation of possible impacts of a proposed 100 MGD water supply facility would have on the water quality of the estuary. The RGA is a highly stratified estuary with pulsed discharges from an upstream hydroelectric generation dam. Assisted in the development and application of the model, providing guidance and direct modeling support to the other team members. Developed a revised version of the code to better treat vertical eddy viscosities and diffusivities.

*Client: CSA Group, Inc., San Juan, Puerto Rico.*

### **Operational Hydrodynamic Model for Caloosahatchee Estuary, Mt Myers, FL**

Senior Consultant for the development of an operational hydrodynamic model for Lake Okeechobee Lake freshwater releases. Fresh water released from Okeechobee can have a negative impact on the biological community of the Caloosahatchee Estuary. A 3D hydrodynamic model, with salinity & temperature, was developed of the Caloosahatchee Estuary to provide the COE with an operational support tool to assist in making decisions on how and when releases can be made and what impact these releases will have on the estuary.

*Client: Corps of Engineers, Jacksonville, FL.*

### **Operational Hydrodynamic Model for St. Lucie Estuary, Stuart, FL**

Senior Consultant for the development of an operational hydrodynamic model for Lake Okeechobee Lake freshwater releases. Fresh water released from Okeechobee can have a negative impact on the biological community of the St Lucie Estuary. A 3D hydrodynamic model, with salinity & temperature, was developed of the St. Lucie Estuary and the C44 canal to provide the COE with an operational support tool to assist in making decisions on how and when releases can be made and what impact these releases will have on the estuary.

*Client: Corps of Engineers, Jacksonville, FL.*

### **Water Quality Model for Stevenson Creek, Pinellas County, FL**

Senior Consultant for the development of a 3D hydrodynamic water quality model of the Stevenson Creek estuary that discharges to Clearwater Harbor. Developed a calibrated and validated model for the development of a Total Maximum Daily Load (TMDL) for nutrients and dissolved oxygen. Linked the flows, temperature and water quality parameters from the watershed model HSPF to the EFDC model.

*Client: Florida Department of Environmental Quality, Tallahassee, FL.*

### **Near Shore Plume Model, Ocean Pointe, Hawaii**

Developed a near shore 3D model of a storm water outfall to assess impacts of fresh water on sensitive & endangered aquatic & benthic organisms. Utilized the EFDC model to develop an assessment tool of a 7-kilometer section of the coastal zone. Assessed the impacts due to fresh water discharges to the ocean from an urban area. Impacts due to tides, wind, and waves were included. Developed a linkage for EFDC to wave generation models to better assess beach/near shore bottom stress & vertical mixing.

*Client: SEA Engineering, Honolulu, HI.*

### **Hydrodynamic Study of the Dickinson Bayou, Dickinson, TX**

Developed a 3D hydrodynamic model using EFDC, with full temperature and salinity effects for a 30-kilometer long estuary. Dickinson Bayou is a tributary to Galveston Bay, TX. Worked on a coupling of the hydrodynamic model to WASP. Calibrated the model for water levels, temperature and salinity with 3 years of data.

*Client: Texas Commission of Environmental Quality, Austin, TX.*

### **Impact Study of Oil-Based Drilling Fluids, Mobile, AL**

Environmental Engineer for the determination of impact of oil-based drilling fluids discharged to Mobile Bay, AL. Performed monitoring plan development, sediment coring and sampling, biological specimen collection, waste quality monitoring (soundings and profiles and tidal current monitoring). Performed post cleanup sampling to determine and certify final "clean" state.

*Client: Mobil Exploration & Producing, U.S., Houston, TX*

## **SELECTED PROJECT EXPERIENCE: Contaminated Sediments**

### **Newtown Creek Contaminated Sediment RI/FS Support, New York, NY**

Senior Technical Consultant and Expert Witness supporting the development of hydrodynamic, sediment transport, and toxics fate modeling for the Newtown Creek Superfund site. Supported data assessments and helped develop approaches to address data gaps in subsequent data collection phases. Provided reviews of reports and plans prepared by the group's common consultant. Provided technical support to the client's legal and project teams.

*Client: Confidential*

### **Gowanus Canal Contaminated Sediment RI/FS Support, New York, NY**

Senior Technical Consultant and Expert Witness supporting the allocation process for the Gowanus Canal Superfund site. Supported data assessments and reviewed existing Delft3D hydrodynamic, sediment transport and contaminant transport models and their application to support the allocation process. Provided technical support to the client's legal and project teams.

*Client: Confidential*

### **Portland Harbor Contaminated Sediment Assessments, Portland, OR**

Senior Technical Consultant/Expert Witness for the evaluation of the EPA funded hydrodynamic and sediment transport model of the Lower Willamette River/Portland Harbor system. Identified model grid and boundary issues that impacted the model results and usefulness. Developed improved 2D and 3D versions of the river system using EFDC in order to conduct plume tracking and resuspension studies. Used Lagrangian Particle Tracking (LPT) to evaluate plume excursion maximums under a range of tidal and flow conditions. Provided technical support to the client's legal and project teams.

*Client: Confidential*

### **Newark Bay/Passaic River Contaminated Sediment Assessments, Philadelphia, PA**

Senior Technical Consultant/Expert Witness for the data evaluation, conceptual model development for contaminated sediment transport and sediment mass balance of the Newark Bay. Developed a salt mass balance model of the Newark Bay.

*Client: Confidential*

### **Housatonic River Contaminated Sediment Remediation, Pittsfield MA**

Senior Technical Consultant for the hydrodynamic modeling and sediment/PCB transport study portion of a major multi-year contaminated sediment remediation project directed by EPA (<http://www.epa.gov/region01/ge/index.html>) for a 13-mile reach of the Housatonic River, MA, USA. The study is using the HSPF model to provide upstream and tributary flow boundary conditions, the 3D EFDC model for hydrodynamic sediment transport with coupled PCB three-phase partitioning transport and fate, and a bioaccumulation model for ecological risk. Performed detailed testing and of the EFDC code and collaborated with the author to incorporate corrections and new bed mechanics, armoring and toxic transport sub-models. Developed a series of coupled 2-D and 3-D models of the river/pond reaches of the Housatonic River, including floodplains. Working with the EPA/COE contractor to collect detailed supplemental data for a detailed 0.5 mile Test Reach including bedload/suspended load and geomorphology. Directed a COE Sedflume study and integrated the data into the modeling effort. Directed, analyzed and interpreted a flow and velocity study using an Acoustic Doppler Current Profiler (ADCP).

*Client: Weston Solutions, Inc., West Chester, PA.*

### **Port of Augusta Mercury Contamination, Sicily, Italy**

Mercury concentration in the sediments in the Port of Augusta has been found to be very high. The Italian Government has initiated a range of studies to investigate the extents of contamination and how to remediate the contamination found. Supported a study of the evaluation of water circulation around Augusta harbor and the levels of water exchanges between water inside and outside of Augusta harbor. An EFDC model was built and calibrated using ADCP velocities.

*Client: Sea Engineering, San Jose, CA.*

### **Little Lake Butte des Morts Conceptual Model of Sediment Dynamics, Menasha, WI**

Developed a multidimensional hydrodynamic model of the Little Lake Butte des Morts (LLBdM) on the Lower Fox River. The objective was to support the development of a conceptual model of sediment and PCB transport dynamics in the LLBdM (Operable Unit 1) and releases downstream. The insights gained in the modeling provided an enhanced conceptual understanding of sediment dynamics in LLBdM. This in turn impacted the interpretation of historical and ongoing studies. DSLLC conducted a field program using an Acoustic Data Current Profiler (ADCP) to collect flow and bathymetry data for the LLBdM. Processed and integrated the data into the modeling framework. The Environmental Flow Dynamics Code (EFDC) was setup and calibrated. This model was then used to determine flow patterns and bed shear stresses were evaluated for a range of flow and wind conditions.

*Client: Ballard Sphar, LLP, Philadelphia, PA.*

## **SELECTED PROJECT EXPERIENCE: Surface Water Resources**

### **Lay Reservoir Hydrodynamic-Hydrothermal Model, Birmingham, AL**

Senior consultant for a 3D EFDC hydrodynamic-hydrothermal model of Lay Reservoir, located on the Coosa River. Lay Reservoir is located between Logan Martin Dam at the upstream end and Lay Dam at the downstream end. Lake temperatures and hydrodynamics of this lake are strongly governed by the operation of the hydropower plants at the Logan Martin and Lay dams and Ernest C. Gaston thermal power plant. The model was initially calibrated using intensive data of ADCP flows, water levels and water temperature collected in the period from July to September 2010. It was then further calibrated for 2011 and 2012 data. The model was then used during the summer of 2012 for scenario analyses.

*Client: Alabama Power Company, Birmingham, AL*

### **Belleville Locks & Dam River Velocities and Outdraft Analysis, Belleville, WV**

Senior Consultant and Expert Witness for a hydrodynamic study of the Belleville Locks & Dam for the M/V Jon J. Strong Accident, on January 6, 2005. During a high flow event, a tow pushing a group of barges broke loose and were swept downstream into the dam's spillway. Built two hydrodynamic models for the upstream and the downstream regions of the dam. Calibrated the models to physical model studies conducted during the design phases of the new hydropower units installed. Used the calibrated models to predict the velocity fields influencing the tows. These flow patterns were then used by barge navigation experts to determine the possible cause of the accident.

*Client: Gault, Marshall & Miller, PLLC, Paducah, KY.*

### **Water Quality Model of Tenkiller Ferry Lake, Tulsa, OK**

Conducted a hydrodynamic and water quality study to support a nutrient Total Maximum Daily Load. Two years of hydrodynamic and nutrient/water quality data were used for the calibration. The model supported interstate litigation over land use, land management and non-point source impacts to Tenkiller Ferry Lake. The lake is nearly 50 kilometers long with very long residence times. HSPF generated nutrient concentrations were coupled to EFDC for nutrient loadings. HSPF was used to evaluate land use impacts on nutrient loadings and resulting water quality impacts to the reservoir. The sediment diagenesis submodel was used to simulate the important coupling of sediment and anoxic conditions to nutrient releases from the sediment.

*Client: Oklahoma Department of Environmental Quality, Oklahoma City, OK.*

### **CE-QUAL-W2 Paint Creek Reservoir and Deer Creek Reservoir Water Quality Model, Huntington, WV**

Senior Consultant and Project Manager for the development of two CE-QUAL-W2 models for the Deer Creek and N. Paint Creek Reservoirs. Developed a calibrated thermal model and preliminary water quality model for each reservoir. Developed a thermal input generator to generate temperature inflow files from meteorological data, when missing actual temperature inflow data.

*Client: Huntington District, US Army Corps of Engineers, Huntington, WV.*

### **Pardee and Camanche Reservoir Modeling, Calaveras County, CA**

Senior Consultant for development of 2-D hydrodynamic water quality models (CE-QUAL-W2) for the Pardee and Camanche Reservoirs on the Mokelumne River in northern California in support of an EIS. The models were used to evaluate management alternatives (primarily plant operation and water supply withdrawals) aimed at protecting the water quality of the river. Worked with ORNL biologists and economists to select optimum minimum required flows and reservoir operations.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

### **Lake James CE-QUAL-W2 Model Setup, Huntersville, NC**

Developed the W2 model bathymetry file for Lake James on the Catawba River and provided training on the use of the W2 model and the W2-Tool Pre and Post Processor. The W2-Tool was modified to interface with ARCINFO/ArcView grid files to allow rapid generation of W2 bathymetry files from GIS structured data.

*Client Duke Power Company, Huntersville, NC*

### **Bad Creek Pumped Storage Project, Clemson, SC**

Senior Technical Consultant for assistance with ADCP data collection and data analysis for circulation patterns in the embayment used for a Duke Power Company pumped storage project. Evaluated the 3D embayment circulation under pumping conditions and under generation.

*Client: Duke Power Co., Huntersville, NC*

### **Little Bow River Hydrodynamic and Water Quality Model, Canada**

Senior Consultant for the development of a 2D/3D EFDC+ coupled water quality model of the Little Bow River, Alberta Canada. The model was calibrated to a 9 year period after the Twin Valley Reservoir (TVR) was built. The validation period covered a seven year period before the TVR was built.. Hydrodynamic and water quality modeling work included accurate accounting for water and mass balance in the system, prediction of ice growth and melt, time series and vertical profile calibration of temperature and water quality parameters such as dissolved oxygen, phosphorus, nitrogen etc., rooted plant model.

*Client: Alberta Environment and Parks, Calgary, Alberta*

### **Oldman River In-Stream Water Quality Model, Canada**

Senior Consultant for model development, calibration and sensitivity testing for the Oldman River water quality model as well providing on-site training using EFDC\_Explorer. Prepared a detailed report documenting the EFDC model development, including hydrodynamic calibration, macrophyte calibration, epilithic algae calibration, temperature calibration, water quality calibration, dissolved oxygen calibration, bacteria calibration. Sensitivity and uncertainty analysis were also performed.

*Client: Alberta Environment and Parks, Calgary, Alberta*

### **Support for the North Saskatchewan River Water Quality Model, Alberta, Canada**

Senior Consultant for calibration support to Alberta Environment and Sustainable Resource Development (ESRD) for the North Saskatchewan River (NSR) water quality model as well providing on-site training using EFDC\_Explorer. Prepared a detailed report documenting the EFDC model calibration including hydrodynamic calibration and validation for: longitudinal and lateral mixing (incorporating new dye study data), total suspended solids, macrophyte, epilithic algae, temperature, water quality nutrients, dissolved oxygen, and bacteria.

*Client: Alberta Environment and Sustainable Resources Development, Edmonton, Alberta*



### **Lower Athabasca River Water Quality Model, Alberta, Canada**

Senior Consultant for updating of EFDC water quality model of the Lower Athabasca River (LAR) in Alberta, Canada for ESRD. Evaluated previous model and performed scoping study of LAR to determine data gaps for sediment and hydrocarbon modules. Recalibrated model using improved bathymetry for 38 WQ indicators and hydrocarbons (PAHs) in support of implementation of Alberta's Water Management Framework.

*Client: Alberta Environment and Sustainable Resources Development, Edmonton, Alberta*

### **COE Sediment Range Studies, Various Locations**

Principal-in-Charge of several sedimentation studies and the Cumberland River, including Old Hickory Reservoir and Lake Barkley. These studies determined the incremental volume of sediment deposited in the reservoir since the previous resurveys and the total volume of sediment deposited since impounding the reservoirs. Conducted an update to the standard Monument Description Forms for each sediment range survey monument for the reservoirs.

*Client: US Corps of Engineers, Nashville, TN.*

### **K-25 Site Plant Storm Drain Analysis, Oak Ridge, TN**

Principal-in-Charge of a feasibility study of upgrading several K-25 Plant drainage systems using the 24-hour duration, 25-year frequency rainfall as the design criteria. Determination of the adequacy of the drainage system in the design was facilitated by using the EPA's Storm Water Management Model (SWMM). Directly linked the SWMM model to the various GIS physical characteristics databases of the pipes, junctions and catch basins. Developed a SWMM-GIS interface program, SWMM\_Set for data and SWMM analysis.

*Client: Lockheed Martin Energy Systems, Oak Ridge, TN.*

### **Y-12 Weapons Plant Storm Drain Analysis, Oak Ridge, TN**

Principal-in-Charge of a feasibility study of upgrading several Y-12 Plant drainage systems. Determination of the adequacy of the drainage system in the design was facilitated by using the EPA's Storm Water Management Model (SWMM). Directly linked the SWMM model to the various GIS physical characteristics databases of the pipes, junctions and catch basins.

*Client: Lockheed Martin Energy Systems, Oak Ridge, TN.*

### **White Oak Dam Spillway Adequacy, Oak Ridge, TN**

Senior Consultant to evaluate the hydrologic adequacy of the White Oak Dam spillway at the Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee. The study consisted of the generation of a series of design inflow hydrographs, with subsequent flood routings for a variety of spillway gate conditions. Modeling work was completed using the COE's HEC-1. The results of the study determined that the total spillway capacity of White Oak Dam is classified as hydraulically adequate for the 100 year design flood.

*Client: Oak Ridge National Laboratory, Oak Ridge, TN.*

### **Flood Study of Two Drainage Basins, Knoxville, TN**

Project Manager and Senior Technical Consultant for a complete baseline flood study of two major drainage basins located in Knox County Tennessee. The primary streams in each basin were named Third Creek and Fourth Creek. Extensively used and integrated the hydrologic and hydraulic analysis with the existing GIS data base maintained by the City. Linked GIS data to the HEC-HMS models for the hydrologic analysis. Analyzed the 500, 100, 50, 10 and 2 year 24 hour storms. Also linked the GIS data to the HEC-RAS model for the hydraulic modeling to predict the corresponding flood elevations and inundation. For each of the modeled basins, the hydrologic and hydraulic models were used to evaluate a range of flood mitigation alternatives and estimate costs of implementation.

*Client: City of Knoxville, Engineering Department, Knoxville, TN*

**McCaysville-Copperhill Flood Analysis, Knoxville, TN**

Principal-in-Charge for hydrologic engineering investigation of the flood on the Ocoee River in February 1990. A class action lawsuit was filed, alleging that the TVA had operated hydroelectric generation facilities at Blue Ridge Dam on the Ocoee River in such a way as to aggravate downstream flooding conditions. Conducted a thorough hydrologic analysis of the watersheds upstream and downstream of Blue Ridge Dam, to determine the spatial and temporal distribution of rainfall and runoff. This included analyzing streamflow and streamgage data at several gaging stations, and an analysis of precipitation data collected at over a dozen locations. Conducted a review of all documents provided by TVA related to actions taken during the flood, including turbine operations and flood gate operations of Blue Ridge Dam.

*Client: Waycaster, Corn, Murray & Morris, Dalton, GA.*

**Quail Valley Lake Sedimentation Study, Columbia, SC**

Principal Engineer and expert witness in a case involving the erosion and subsequent sedimentation in a small lake. A conceptual level sediment model SEDIMOT II was developed for the watershed above the reservoir. The model was calibrated against a 100-year July storm event and the modified soil loss equation was used to calculate erosion rates. Estimates were made of volumes of deposited sediments within the downstream reservoir. Reviewed client's erosion/sediment control practices and made recommendations.

*Client: Belser, Baker, Barwick, Ravenel, & Bender, Columbia, SC*

**Petro Truck Stop - Walnut Lake Assessment, Tuscaloosa County, AL**

Sr. Technical Consultant in the evaluation of the impact of a Petro oil facility on surrounding terrain, including its sedimentation impact from construction activities on a downstream lake. Lake sediment coring and water quality surveys were conducted. Conducted a screening level ambient air quality monitoring program to evaluate impact on local air quality.

*Client: Porterfield, Bainbridge, Mimms, Harper, Birmingham, AL*

**Lake Oliver Sedimentation Study, Columbus, GA**

Principal Engineer in charge of a study to review client's erosion control practices and to review a Georgia Power Co. (GPCo) subcontractor's report concerning the cause of sedimentation. Estimated the true cause of sedimentation in Lake Oliver. Wrote a review of the GPCo report determining more qualitative efforts were needed to meet the objectives of the report.

*Client: W. C. Bradley Co., Columbus, GA*

**Whittemore Branch Flood Study, Nashville, TN**

Hydrologic and hydraulic modeling study designed to assess the potential of various mitigation measures on reduction of flood profiles on Whittemore Branch in Davidson County, Tennessee. The mitigation measures investigated included constructing detention basins at strategic locations in the drainage basin, channel improvements in reaches particularly susceptible to flooding damage, and bridge improvements in strategic locations. The analyses were performed by using the HEC-1 Flood Hydrograph model to generate flow distributions throughout the watershed. Then, using the generated flood flows, the HEC-2 Water Surface Profile model was used to compute the associated flow profiles. Flow frequencies investigated included the 2, 10, 50, 100, and 500 year events, with particular emphasis on the 100 year frequency.

*Client: Barge Waggoner Sumner and Cannon, Nashville, TN*

**Expert Witness, Hydrologic Study, Kingsport, TN**

Principal Engineer and Expert Witness for a flood damage lawsuit. Involved hydrologic modeling, culvert hydraulics, backwater computations, and sediment transport.

*Client: Fuller & Tunnels, Kingsport, TN*

**Hydrodynamic Model Development and Support Anchorage, AK**

Senior Consultant for the development of several coastal and harbor hydrodynamic models for various projects for Coastline Engineering. EFDC models of Point Hope and several small harbor projects were developed.

*Client: Coastline Engineering, Anchorage, AK.*

### **Douglas Reservoir Water Quality Study, Jefferson County, TN**

Provided oversight and overall project direction as the project's Senior Consultant for a hydrodynamic water quality modeling study to evaluate tailwater quality improvements scenarios. Specific areas of input included modification of the CE-QUAL-W2 code to handle surface water pumps and nutrient and algal constituent calibrations. The study identified several issues including density currents which advected anoxic bottom waters into the turbine withdrawal zone.

*Client: Tennessee Valley Authority*

### **Lake Norman Water Quality Modeling, Lake Norman, NC**

Principal Engineer in charge of a hydrodynamic water quality modeling study of Lake Norman, NC. The reservoir has two large electric generating plants with large cooling water requirements. The CE-QUAL-W2 model was selected, and the model was modified to handle the large tributary flow. Dissolved oxygen (DO) and temperature were modeled and compared to field data.

*Client: Duke Power Co., Huntersville, NC*

### **Plant Daniel Ash Pond Assessment, Pascagoula, MS**

Senior Consultant for the assessment of seepage from the ash ponds at a large, coal-fired electric generating plant. Provided senior technical consultation for the design and installation of a groundwater monitoring well network, groundwater sampling, data analysis, and hydrogeological and geochemical modeling. The study concluded that high pH water was leaking into the groundwater system, but that capping the pond would reduce the pH in the system to acceptable levels. Presented the results of the study to State regulators and defended the recommended closure plan. Plan was subsequently approved by the State.

*Client: Mississippi Power Company, Gulfport, MS*

### **North Mouse Creek Assimilative Capacity Study, Athens, TN**

Senior Technical Consultant for an intensive water quality study and modeling effort to determine the waste assimilative capacity and general water quality of the North Mouse Creek for a proposed sewage treatment plant. Work included designing and implementing a monitoring plan to include sediment oxygen demand, stream reaeration, longitudinal dispersion and water quality, chemical, and biological characterization.

*Client: Allen & Hoshall, Inc., Knoxville, TN*

### **Poplar Creek Water Quality Modeling, Oak Ridge, TN**

Project Manager for the study of a saline discharge into Poplar Creek at the K-25, Gaseous Diffusion Plant. Involved two phases, a hydrodynamic study of the discharge into the Poplar Creek embayment and a near field plume model to determine the diffuser design. Used DS' version of the CE-QUAL-W2 model to model flow, flow reversals, and total dissolved solids (TDS).

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

### **Water Quality Monitoring, Atlanta, GA**

Environmental Engineer conducting numerous intensive water quality monitoring and field surveys for model database development, calibration and verification of water quality models, river water quality, NPDES source sampling, time-of-travel studies, etc.

*Client: State of Georgia, Atlanta, GA*

### **Water Resources Planning, Ocmulgee River, GA**

Project Manager for intensive water quality monitoring effort to collect data to conduct waste assimilative capacity study of the lower reaches of the Ocmulgee River. Analyses included dissolved oxygen profiles, time-of-travel studies, flow monitoring, water surface profile elevations, water quality parameters, including carbonaceous BOD's, nitrogenous BOD's, ammonia, and other nitrogen species. Using the collected riverine water quality data, conducted assimilative capacity modeling analysis supporting the water management planning by the Georgia Board for Economic Development to assist in industrial plant "green field" studies.

*Client: State of Georgia, Atlanta, GA*

## **SELECTED PROJECT EXPERIENCE: Solid, Hazardous and Radioactive Waste Management**

### **Massachusetts Military Reservation Design Support-Groundwater Modeling, Cape Cod**

Senior Technical Consultant for groundwater modeling of the CS-10, FS-12 and SD-5 plumes in support of the plume containment system designs. These models are large numerical modeling (>700,000 nodes) of flow and particle tracks. Also provided technical direction for refinements of the systems and helped develop an improved conceptual model of the overall Western Cape Cod groundwater and surface water system.

*Client: Jacob's Engineering*

### **Sullivan County Landfill Design & Operational Support, Blountville, TN**

Senior Technical Consultant and Project Manager providing technical and regulatory assistance for an existing Municipal (US EPA Subtitle D) landfill in a Karst geologic system. Developed and implementation of a groundwater quality assessment plan, a leachate collection and treatment system, gas migration control, and an erosion control plan. Assisted in the design of a landfill expansion with hydrogeologic characterization, landfill siting and cover designs to minimize infiltration and manage leachate. Supported waste collection planning

*Client: Sullivan County Landfill, Inc., Piney Flats, TN*

### **LLWDF Site Characterization, Oak Ridge, TN**

Sr. Technical Consultant for site characterization activities for a 5-7 km<sup>2</sup> Class I Low-level Radioactive Waste Disposal Facility at West Chestnut Ridge. This included monitoring well network design, well development techniques, and continuous data acquisition systems installation and data processing for water level data. Supported the engineering design of the disposal facility for waste handling, hydrology, erosion control, borrow area and cover design.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

### **LLWDF Conceptual Design Support, Oak Ridge, TN**

Sr. Technical consultant for the feasibility study and conceptual design of two major low-level radioactive waste disposal facilities. Developed cover designs, erosion control plans, determined leachate volumes and flow rates, and designed the groundwater and surface water monitoring plans. Also supported borrow area identification & development and waste transportation, collection and disposal planning.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

### **Portsmouth X-749 Interim Remedial Measures Support, Portsmouth, Ohio**

Principal-in-Charge of the CERCLA Interim Remedial Measure groundwater modeling and hydraulic characterization for the X-749 site at the Portsmouth Gaseous Diffusion Plant. Work included two long-term pumping tests, slug testing, conceptual model development, and calibration and predictions using numerical groundwater flow and transport models. Ensured implementation of the H&S and Waste Management Plans.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

### **Tumulus Disposal Demonstration Project (TDDP), Oak Ridge, TN**

Principal-in-Charge of developing and implementing groundwater, surface water, and meteorological monitoring plan for the Tumulus and below-grade silos low-level waste disposal demonstrations. Included groundwater monitoring network design, surface water monitoring design, real-time data acquisition, monitoring well installation, etc. Worked with various regulatory bodies concerning NPDES, RCRA, 40 CFR 103 (proposed), and DOE orders.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

**WAG 6 Remediation/Postremediation Monitoring Strategy, Oak Ridge, TN**

Senior Consultant for development of a comprehensive monitoring strategy for Interim Remedial Actions at Waste Area Grouping 6 (WAG 6) at the Oak Ridge National Laboratory (ORNL). Developed an environmental monitoring strategy representing a consensus of the ORNL technical community, obtained through a series of working sessions. The strategy included the monitoring of surface water, seeps and springs, groundwater, sediment, airborne particulates, and vent gas (from beneath impermeable caps).

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

**K-25 RCRA Facility Investigation Plans (RFI), Oak Ridge, TN**

Environmental Engineer in charge of developing the environmental characterization section within numerous RFI plans for the Oak Ridge Gaseous Diffusion Plant. Provided input to environmental pathways analysis, environmental monitoring, appropriate geophysical techniques, etc.

*Client: Martin Marietta Energy Systems, Inc., Oak Ridge, TN*

**Exxon Valdez Groundwater Modeling, Prince William Sound, AK**

Sr. Technical Consultant for a groundwater modeling research project addressing the circulation of applied nutrients for bioremediation of oil-contaminated beaches. This work included density-dependent flow analysis of salt water/fresh water interface in an unconfined aquifer below the beach and evaluation of the SUTRA, MOC DENSE and FEMWATER code models, as they applied to the problem.

*Client: U.S. Environmental Protection Agency, Athens, GA*

**Yellow Freight Groundwater Tracer Test, Nashville, TN**

Senior Technical Consultant and Project Manager in the planning, implementation, and analysis of a groundwater tracer test for evaluating the hydraulic retention time and potential contaminant transport times for an induced gradient petroleum recovery system from an underground storage tank site for a Karst system.

*Client: International Technology Corp., Knoxville, TN*

**Loring AFB RI/FS Modeling Support, Loring AFB**

Project Manager and Principal-in-Charge of a two prong multi-phase modeling effort to support feasibility studies of remedial actions. These studies focused on minimal action scenarios such as intrinsic remediation/natural attenuation and monitor only options. Groundwater modeling involved multiple sites of fractured bedrock and solvents and fuels. Surface water modeling focused on the Flightline Drainage Ditch and addressed organic and inorganic contaminated sediments.

*Client: HAZWRAP for Lockheed Martin Energy Systems, Inc.*

**SELECTED PROJECT EXPERIENCE: Vietnam Projects****Interim Measures for Dioxin Hot Spots at the Da Nang Airport, Hanoi, Viet Nam**

Senior Consultant for the characterization, contaminant transport and Interim Mitigation Option evaluations for three Agent Orange/Dioxin contaminated Hot Spots within Northern Area of Da Nang International Airport. Managed the data collection efforts at the Da Nang airport, working with the Government of Vietnam's (GoV) Ministry of Defense (MoD) and Office 33. Determined the dioxin transport patterns, estimated contaminated sediment volumes and helped integrate this information into the Interim Measures selection process. Designed the Sen Lake inlet structure to help minimize localized resuspension of contaminated sediments.

*Client: BEM / Ford Foundation / Office 33, Hanoi, Vietnam.*

### **Preliminary Contaminant Transport Study of Dioxin in and around the Bien Hoa Dioxin Contaminated Hotspots Hanoi, Viet Nam**

Senior Consultant for the determination of the fate and transport of Agent Orange/Dioxin contamination at the Bien Hoa Airbase. Managed the field data collection efforts, which included DS-INTL staff as well as other Vietnamese contractors. Worked with the Government of Vietnam (GoV) the Ministry of Defense (MoD) and Office 33. Determined the dioxin transport patterns based on estimated historical operations, physical disturbances and sediment transport dynamics. Identified areas of additional study necessary to better characterize the site.

*Client: BEM / Ford Foundation / Office 33, Hanoi, Vietnam.*

### **Tra Khuc Hydrodynamic/Sediment Transport Model, Hanoi, Viet Nam**

Senior Consultant for the development of an EFDC sediment transport model of the Tra Khuc Estuary, Central Vietnam. Worked with researchers from the University of Water Resources in Hanoi conducting the data collection. A major issue is the estuary inlet changes due to flood flows from the estuary inflows and the sand transport along the coastline. Developed wave generated bed stresses which were then integrated into EFDC for a complete sediment transport model of estuary and near shore coastal zone sediment transport. Bedload and suspended load were simulated using 5 sediment size classes. Developed 3D sediment bed model from sediment sampling cores and surface samples. Calibrated the model to scour and deposition patterns determined from bathymetry data collected before and after one monsoon season.

*Client: University of Water Resources, Hanoi, Vietnam.*

### **Sedimentation/Erosion Study of the Da River (Son La Hydropower Project), Viet Nam**

Conducted a sedimentation/erosion study of the Da River just downstream of the proposed Son La Hydroelectric Plant and Pa Vinh Dam. The purpose of the study was to assist in the design of the turbines by determining the effect of erosion and sedimentation of the moveable sediment bed on the tailwater levels and the elevation/discharge relationship just downstream. Used the EFDC model to conduct a detailed study of the hydrodynamics and sediment dynamics. Developed a more accurate and detailed 3D sediment bed from coring data that provided a more realistic predictions than provided by standard 1D models. Worked with the Institute of Hydrometeorology as part of their team supporting the project.

*Client: PECC1, Electricity of Vietnam, Hanoi Vietnam.*

### **Hoa Binh Reservoir Hydrodynamic/Water Quality Demonstration Model, Hanoi, Viet Nam**

Senior Consultant for the development of a CE\_QUAL\_W2 (W2) hydrodynamic model application to the Hoa Binh Reservoir, near Hanoi Vietnam. A preliminary study of the potential impacts due to raising or lowering the elevation of the withdrawals to the Hoa Binh hydroelectric generators was conducted. Internal reservoir hydrodynamics were simulated with temperature, sedimentation and residence time dynamics as model results. Temperature and suspended sediments for the outflow from the dam's generators was also estimated. A seminar was given on the Demonstration Model, including the model's scientific basis and the specific Hoa Binh application development and results. The seminar was held at Vietnam's Institute of Hydrometeorology to invited participants.

*Client: Institute of Hydrometeorology, MoNRE, Hanoi Vietnam.*

### **Flood Alert Warning System, Hue City, Viet Nam**

Provided program and engineering support for the implementation of a real time Flood Alert Warning System of the Huong River, located in central Vietnam. The flood warning system included 5 remote rainfall and flow monitoring stations with telemetry back to the base station in Hue. Responsible for the final calibration and operation of the flood warning system. Provided staff training for the Vietnam partners and operators.

*Client: Disaster Management Unit, Ministry of Agriculture & Rural Development & UNDP-Vietnam, Hanoi, Vietnam.*

## **SELECTED PROJECT EXPERIENCE: Lao PDR Projects**

### **Hydrologic and Hydraulic Design of NG8 Saddle Dam, Khammouane, Lao PDR**

Senior Consultant for the hydrologic and hydraulic design of the principle and emergency spillway and low level outlet. Estimated the Probable Maximum Precipitation (PMP) from a regional study and then developed the range of design storms from Mean Annual Flood (MAF) up to the Probable Maximum Flood (PMF). Designed a labyrinth weir, spillway chutes, energy dissipaters and channel protection. Worked with Vietnamese design engineers from PECC1 to complete the dam design.

*Client: Geotech International, PLLC, Hanoi Vietnam.*

### **Bathymetric Survey and Digital Terrain Model Development for Two Rivers Flowing into the Nam Theun 2 Reservoir, Khammouane, Lao PDR**

Senior Consultant responsible for planning, management, data analysis and reporting of ADCP and ground survey data on the Nam Xot and the Nam Theun rivers. The ground survey data was merged with the ADCP data to generate cross sections to support the development of traditional hydraulic models of the system. Digital Terrain Models (DTM's) were developed of the river channels and floodplains to be used for inundation mapping and 2D hydrodynamic flood analyses.

*Client: Nam Theun Power Company, Vientiane, Lao PDR.*

### **Flood Study of Nam Hai-Upper Nam Hinboun Rivers: Bolikhamxai, Lao PDR**

Conducted a flood study of the Nam Hai and Upper Nam Hinboun River. These rivers receive discharge from the THPC hydropower project. Two 2D hydrodynamic models were developed to study the operations and flooding impacts to the rivers. An in-channel model for evaluating channel dynamics and flow timing and a larger scale floodplain model to evaluate the impacts of current and proposed plant operations on the Mean Annual Flood, 10 Yr, 20 Yr, 50 Yr and 100 Year floods. Developed animations of the flooding and compared natural to project impacted conditions.

*Client: SWECO International AB, Stockholm, Sweden.*

### **Intake Hydraulic Model Study, Forebay Numerical Model, Bolikhamxai, Lao PDR**

Conducted a numerical hydrodynamic modeling study to support the intake design modifications of the existing dam and intake works on the Nam Theun River. The EFDC hydrodynamic model was calibrated to a physical model developed for the original design. Various intake design alternatives were evaluated and recommendations made with respect to the best alternative.

*Client: Theun Hinboun Power Company, Vientiane, Lao PDR.*

### **ADCP Demonstration Study: Khammouane, Lao PDR**

Developed and implemented a study to demonstrate the power and usefulness of the Acoustic Doppler Current Profiler (ADCP) technology for lake process studies, sediment loadings, flow gaging and bathymetry measurement for the operations staff and management of THPC. Specified the appropriate equipment and trained THPC staff in the proper use of the ADCP. Measured the bathymetry and developed updated elevation-volume-area curves for operational use. Evaluated historic cross section data and compared historic data to the ADCP data. Compared ADCP flow gaging to traditional anemometer gaging results.

*Client: Statkraft Energi AS, Vientiane, Lao PDR.*

### **Sedimentation Study for a Proposed Hydropower Reservoir, Khammouane, Lao PDR**

Conducted a reservoir sedimentation study to determine the volume of dead storage, sedimentation patterns and forebay scour patterns due to proposed bottom sluicing operations. Developed erosion estimates for a region heavily impacted by slash & burn agriculture and other activities due to the indigenous population. Conducted a complete water budget analysis with animations and other visualizations for several proposed reservoir operations.

*Client: Theun Hinboun Power Company, Vientiane, Lao PDR.*

## **SELECTED PROJECT EXPERIENCE: Air Quality Management**

### **Plant Yates Meteorological Data Averaging Study, Atlanta, GA**

Performed a series of analyses to evaluate the impact of performing scalar vs. vector averaging processes of wind direction and wind speeds. The corresponding differences were evaluated with regard to their impact on air quality modeling for regulatory applications. These analyses included both statistical analyses of the two methods, regulatory analyses, and a literature review of the regulatory model development activities.

*Client: Georgia Power Company, Atlanta, GA*

### **Comparison of 60 vs. 100M Meteorological Data, Birmingham, AL**

Reviewed the effect of tall stack regulations as they pertained to plants located in complex terrain under Alabama's state implementation plan. A tower was located near the E. C. Gaston Steam Plant collecting 10 and 60-meter wind data. The Rough Terrain Dispersion Model (RTDM) was used to perform preliminary dispersion estimates in complex terrain utilizing the 60M Gaston data. An analysis was made showing that, generally, the use of 60M data may typically be more conservative than the use of the 100M data.

*Client: Alabama Power Co., Birmingham, AL*

### **State Implementation Plan (SIP) Revision Analysis, Ecusta, NC**

Conducted a complex terrain analysis for this Olin paper plant, located in complex terrain, by applying the modified COMPLEX I model to account for the current calm hour policy and dispersion coefficients. Site-specific meteorological data were collected and processed and later used to make recommendations for future studies. These recommendations were designed to further support the SIP revision.

*Client: Olin Corp., Ecusta, NC*

## **PROFESSIONAL REGISTRATION:**

Professional Engineer: Tennessee, Washington

## **PROFESSIONAL ACTIVITIES AND ASSOCIATIONS:**

American Geophysical Union, Water Resources  
American Society of Civil Engineers  
American Water Resources Association  
National Society of Professional Engineers  
North American Lake Management Association  
Organizing Board Member, Tennessee Water Resources Symposium, 1990-1993  
Tau Beta Pi Engineering Honor Society  
Tennessee Society of Professional Engineers  
Tennessee Section of American Water Resources Association (past President)

## **PAPERS/PRESENTATIONS:**

Craig, P.M., Weems, T. and Ponstein, J., *Multi-Dimensional Approach for Computing and Evaluating Forced Evaporation with Comparisons to EPRI and USGS Approaches*, Fourth Thermal Ecology and Regulation Workshop, EPRI, 2016.



Weems, T. and Craig, P.M., 2015, *Development of a Real-time Thermal Hydrodynamic Model Using EFDC as a Decision Support Tool for Compliance and Operations*, Fourth Thermal Ecology and Regulation Workshop, EPRI, 2016.

Craig, P.M. and Devkota, J., *Sigma-ZED: A Computationally Efficient Approach to Model Highly Stratified Systems with Applications to Lake Washington, WA and Tenkiller Lake, OK*, 35<sup>th</sup> International Symposium, NALMS, 2015.

Craig, P.M., Chung, D.H., Lam, N.T. Son, P.H. and Tinh, N.X., 2014, *SIGMA-ZED: A Computationally Efficient Approach to Reduce the Horizontal Gradient Error In The EFDC's Vertical Sigma Grid*, 11th International Conference on Hydrodynamics (ICHHD 2014), October 19 – 24, 2014, Singapore

Craig, P.M., McAnally, W.E., Wallen, C.M., Maak, E., Sanborn, S., 2012, *Validation of 3D Sediment Transport Modeling in the Delta*, 7th Biennial Bay-Delta Science Conference.

Craig, P.M. and Dang, C.M, 2012, *Wind-Induced Wave Sub-Model Coupled to EFDC*, 4th International Conference on Estuaries and Coasts, Hanoi, Vietnam.

Craig, P.M., Nghiem L.T. and Wallen C.M., 2011, *Lay Reservoir Seicheing and Its Impacts on Thermal Discharges from the E.C. Gaston Plant*, Third Thermal Ecology and Regulation Workshop, Electric Power Research Institute.

Meng, , Craig, P.M., Wallen, C.M., and Stoddard, A.S., 2009, *Numerical Simulation of Salinity and Dissolved Oxygen at Perdido Bay and Adjacent Coastal Ocean*, Journal of Coastal Research, (accepted, in press).

Hayter, E.J., John, C.V., and Craig, P.M., 2005, *3D Modeling of Cohesive Sediment Transport in a Partially Stratified Microtidal Estuary to Assess Effectiveness of Sediment Trap*, Journal of Hydraulic Engineering, ASCE (*in Review*).

Craig, P.M., 2004, *Study Of Hydrodynamic And Sedimentation/Erosion Of The Da River Downstream Of Pa Vinh Dam-Son La Hydroelectric Plant*, Proceedings GEO2004, Hanoi, Vietnam.

León, Roberto and Craig, P.M. 2000, *Preliminary Hydrodynamic and Water Quality Modeling of the Río Grande de Arecibo Estuary*, Proceedings, November, Sixth Caribbean Islands Water Resources Congress.

Craig, P.M., 1997, *Advocating Your Position: Tools and Approaches for Communicating with Stakeholders*, Proceedings, July, Eleventh Annual Environmental Permitting Summer School, Florida Chamber of Commerce, Marco Island, FL.

Black, K.C., Gamliel, A., and Craig, P.M. 1993. *A Fast and Efficient Contouring Algorithm for the Analysis of Numerical Model Output*. Journal of Ground Water.

McKeever, M. M. and Craig, P. E., 1992. *Analysis of Sorption/Elution Dynamics and Its Implication on Tracer Tests in Karst Terrains*. Fifth Tennessee Water Resources Symposium, Nashville, TN.

Clapp, R. and Craig. P.M. 1987. *Oak Ridge Above Grade Disposal Facility Demonstration: Barriers to Groundwater Contamination*. Oak Ridge, TN. Proceedings, June, 1987 meeting, International Congress on Hazardous Materials Management.

Craig, P.M. and Davis, E.C.1985. *Application of the Finite Element Groundwater Model to the Engineered Test Facility*. ORNL/TM-9467, 1985.

Craig, P. M., Black, K. C., and Yager, R. E. 1991. *A Graphical Post-Processor for CE-QUAL-W2*. ASCE Second International Conference on Estuarine and Coastal Modeling, Tampa, FL.

Craig, P. M., 1993. *Helping to Save the Environment by Linking Environmental Simulation Models to GIS*. Civil Engineering Computing Review, Vol. 5, No. 4.

Craig, P. M. and Burnette, G. A. 1993. *Basinwide Water Quality Planning Using the QUAL2E Model in a GIS Environment*. The Second International Conference/Workshop on Integrating Graphics Information Systems and Environmental Modeling, National Center for Geographic Information and Analysis, Breckenridge, CO.

Davis, E.C. and Craig, P.M. 1986. *EPICOR-II: A Field Leaching Test of Solidified Radioactivity Loaded Ion Exchange Resin*. ORNL/TM-985, 1986.

Davis, E.C. and Craig, P.M. 1988. *Application of the Finite Element Groundwater Model FEWA to a Radioactive Disposal Site*. Appl. Math Vol. 12, April, 1988.

Craig, P. M. 1989. *Application of a Finite Element Groundwater Flow Model to an Experimental Low-level Waste Disposal Site*. University of Tennessee Master's Thesis.