

# U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

## BACKGROUND

The research and development (R&D) laboratories of the U.S. Army Corps of Engineers (USACE) have served the Corps, the Army, and the Nation with technical accomplishments in a variety of engineering and scientific fields for almost 80 years. From its beginnings in 1929 as a small hydraulics laboratory established in Vicksburg, MS, to assist in developing a comprehensive plan for flood control of the Mississippi River, the Engineer Research and Development Center (ERDC) has evolved into a world-class R&D organization with the expertise needed to solve complex civil engineering and environmental science challenges for the Corps. ERDC is headquartered in Vicksburg, MS, and offers a centrally managed center of seven unique laboratories located in Illinois, Mississippi, New Hampshire, and Virginia.

At the close of FY 2007, ERDC had 1661 full-time permanent employees of whom 992 are highly trained engineers and scientists. The full-time permanent professional staff encompassed 278 Ph.D. and 426 Master's degrees.

In FY 2007, ERDC executed a Civil Works program totaling \$120.3 million. Of this total, \$90.4 million was executed in direct-allotted programs, with \$39.1 million in R&D programs and \$51.3 million in data acquisition, demonstration, study, and technical support programs. The remaining \$29.9 million was executed in support of USACE District and Division offices.

## LABORATORIES

The diverse civil engineering and environmental quality R&D center consists of seven centrally managed laboratories located at Alexandria, VA; Champaign IL; Hanover, NH; and Vicksburg, MS. With world-renowned expertise and facilities, each laboratory adds a unique perspective and set of capabilities to the overall ERDC team. Following are brief descriptions of the ERDC laboratories.

### Coastal and Hydraulics Laboratory

The Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS, is the Nation's center for engineering and scientific R&D in the coastal, hydraulic, and hydrologic engineering and sciences. CHL conducts research and supports the Corps of Engineers in conducting its navigation, flood and coastal storm damage reduction, environmental restoration, and military engineering missions. CHL is comprised of nationally and internationally recognized experts that perform research and site-specific investigations in the fields of erosion control design; navigation engineering; channel design; fisheries engineering; sediment transport; estuarine engineering; dredging; hydrodynamics; groundwater, watershed, surface water, coastal, and ocean modeling; coastal storm and flood damage protection; harbor design and modification; coastal and hydraulic structures; physical processes associated with water resources; environmental problems; military logistics-over-the-shore; wave climatology; and hydroinformatics.

### Cold Regions Research and Engineering Laboratory

The Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH, maintains the finest research and engineering staff and facilities in the world for the study of cold regions science and technology. CRREL is recognized for its internationally known experts in the field of ice jam flooding and ice-hydraulics; ice control at locks, dams, and other navigation channels; snowmelt modeling and simulation; and other areas ranging from geotechnical aspects of frozen ground to new admixtures for placing concrete in the winter. CRREL's specialized research facilities include a complex of cold rooms, an Ice Engineering Facility housing three special-purpose research areas; a large low-temperature towing tank, a refrigerated flume for modeling rivers, and a large hydraulic model room. CRREL is also home to the U.S. Army Corps of Engineers Center of Expertise for Civil Works Remote Sensing/Geographic Information Systems.

### **Construction Engineering Research Laboratory**

The Construction Engineering Research Laboratory (CERL), Champaign, IL, provides construction research to address the entire spectrum of issues within military construction. This research supports sustainable military installations and encompasses construction, operations, and maintenance as well as environmental and safety concerns. These technologies have universal application and are of value in the Civil Works arena as well. Civil Works efforts are in the areas of corrosion control, high-performance protective coatings (including overcoating of lead-based paint), management tools for Operation and Maintenance optimization, environmental compliance, and environmental sustainment.

### **Environmental Laboratory**

The Environmental Laboratory (EL), Vicksburg, MS, conducts multi-disciplinary research in environmental quality and ecosystem restoration. EL's research activities consist of evaluating and projecting the consequences of water resources development, navigation, and dredging on the environment; assessing and restoring wetlands; evaluating and modeling inland and oceanic water quality; guiding stewardship of natural resources; and developing tools for cleanup of contaminated groundwater and soils.

The laboratory has developed resource management technologies to: guide Corps stewardship at projects; improve stream and riparian restoration; accelerate growth of desirable vegetation/habitat; implement risk and decision frameworks in planning; apply biological, chemical, and physical control agents to manage nuisance and invasive aquatic plants; apply risk-based contaminated sediment and soil toxicological assessment protocols; perform upland disposal testing and assessment for dredged material; and apply innovative environmental engineering solutions to water systems that supply irrigation needs, water supply, and other low-flow requirements.

### **Geotechnical and Structures Laboratory**

The Geotechnical and Structures Laboratory (GSL), Vicksburg, MS, conducts research in soil and rock mechanics, earthquake engineering and

geophysics, tunneling and trenchless technology, engineering geology and seismology, vehicle mobility and trafficability, unexploded ordnance detection, and pavement technology. The laboratory also determines the response of structures to weapons effects and other loadings, investigates methods for making concrete and other materials more durable and economical, studies the application of explosives technology to military and civilian engineering, and investigates the behavior of earth/structure systems subjected to blast loading and projectile penetration. GSL is a world leader in research on effects of earthquakes on embankment dams and the evaluation, maintenance, and rehabilitation of mass concrete and steel and reinforced structures.

### **Information Technology Laboratory**

The Information Technology Laboratory (ITL), Vicksburg, MS, advances, applies, and delivers information technologies that address a wide range of engineering, scientific, and management challenges. ITL manages one of the four High Performance Computing Major Shared Resource Centers formed under the auspices of the DoD High Performance Computing Modernization Program. ITL also manages the Computer-Aided Design and Building Information Modeling (CAD/BIM) Technology Center, a multi-agency vehicle to coordinate CAD/BIM activities within DoD. ITL is highly recognized for its expertise in the areas of Facilities Management technologies required by Army Civil Works projects; computer-aided interdisciplinary engineering and analysis; software engineering and informatics; scientific visualization; support to R&D and application efforts requiring sensor and instrumentation technologies; and library and information systems science services and collaborative technologies.

### **Topographic Engineering Center**

The Topographic Engineering Center (TEC), Alexandria, VA, provides new topographic capabilities in geospatial science to the Corps of Engineers to ensure superior implementation of the Nation's civil and environmental initiatives through research, development, and application of remote sensing; geographic information: global positioning; and topographic, hydrographic, and information technologies. TEC scientists and engineers continue to develop faster, more accurate, and cost-effective

ways to use new remote sensing technologies to describe, characterize, and analyze the surface of the earth. Remote sensing technologies form an essential part of a new national approach to infrastructure engineering and environmental stewardship.

## **ARMY CIVIL WORKS R&D PROGRAMS**

The Army Civil Works R&D Program is formulated to directly support the established business lines of the Civil Works Program, including flood and coastal storm damage reduction, inland and coastal navigation, environment (including natural resources, compliance, mitigation, and restoration), water supply, hydropower, recreation, emergency management, and regulatory.

Civil Works R&D needs and requirements are identified based on the current Civil Works Program Strategic Plan, Corps Division and District input, and existing authorities under the Water Resources Development Act. The R&D effort is a problem-solving process by which the Corps systematically examines new ideas, approaches, and techniques and develops field-ready products to reduce costs and improve quality of its planning, design, construction, and operations and maintenance (O&M) activities in an environmentally sustainable manner. In order to most effectively use the limited R&D resources and to avoid unnecessary duplication of research effort, the Civil Works R&D Program maintains external technical exchange and technology transfer efforts with other federal and major water resource agencies, International Boundary Water Commission, International Joint Commission, the Navy, and state and local governments.

Most of the activities that comprise R&D are funded out of the Investigations Appropriations. Other R&D activities are funded out of the Operations and Maintenance Appropriations and Construction Appropriations. Under the Investigations R&D program, the primary business lines supported by R&D include Navigation, Flood and Coastal Storm Damage Reduction, and Environmental Restoration. Additional research serves to cut across and support all business lines. In particular, the System-Wide Water Resources Program serves multiple business needs. The major R&D program areas are described in further detail below.

Other activities performed by ERDC are in the category defined as technical support, technology transfer, data collection and processing, or demonstration activities. These efforts play a vital role in the overall R&D process by ensuring new technologies are validated and fully deployed to the primary users, the Corps Districts. Descriptions of the major efforts in this category follow the R&D program descriptions.

### **Navigation Systems Research Program**

The Corps provides inland and coastal navigation capability essential to the national economy and defense. Corps projects also provide 25% of the Nation's hydropower. The Navigation research area is funded under the Investigations appropriation. Navigation research, which includes hydropower, delivers tools and guidance essential for improved reliability, increased efficiency, and sustainable increased capacity of the complex and aging transportation/power network. The Navigation research framework integrates water dynamics, infrastructure mechanics, advanced materials, power physics, economics, innovative construction, coastal and riverine processes, automated control and monitoring, remote sensing, operations research, stochastic processes, and emerging technologies to produce effective solutions for the multiple demands, requirements, and constraints of real world commodity transport and power production problems. Research efforts target navigation channels, locks, jetties, breakwaters, dams, and power plants to facilitate improved asset management of navigation and hydropower infrastructure. Research includes techniques for optimizing life-cycle and reliability trade-offs (ensuring defensible economic assessment), providing better investment decision tools for predicting performance and deterioration with time, and scheduling and prioritizing maintenance and repairs balanced with the consequences of delays.

Accomplishments in FY 2007 include:

- Reduced potential for loss of life and loss of navigation at navigation locks during high flow conditions by demonstrating wireless display of real time current measurements at lock approaches to towboat captains.
- Increased safety and reduced dredging costs through improved ship simulations for optimum design of wider channels to accommodate larger vessels.

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS FOR FY 2007

- Evaluated concrete repair technology for cost-effective application to navigation structures with reduced impacts on navigation throughput.
- Released beta version of improved coastal structure condition index tool to assist in risk-based decision making for major rehabilitations.
- Improved barge impact predictions for flexible lock walls using two new engineering methodologies, lowering costs of new locks.
- Unified coastal structures condition assessment through release of a beta version of a revised condition index system that uses global positioning system (GPS) and digital technology for more quantitative measurements.
- Facilitated use of consistent methodologies across Corps Districts for evaluating deep-draft waterway improvements by fielding the deep-draft version of HarborSym, including training through the Deep Draft Center of Expertise.
- Improved capability to model intermodal transportation through time, understanding mode, source and destination switching resulting from changed transportation system attributes, through release of a beta version of a Regional Routing Model.
- Improved ability to evaluate non-structural as well as structural inland waterway improvements by fielding the beta version of Navigation System Simulation Model.
- More accurately predicted shipper response to changes in waterway attributes by users of the Ohio and Mississippi River transportation network through completion of shipper response studies on the Upper Mississippi and Ohio Rivers.
- Developed acoustic technology to measure tension and corrosion in steel tainter gate embedded tendon rods that will reduce maintenance costs by eliminating the unnecessary replacement of the rods (U. S. patent application no. 11/727,644A entitled "Device for Measuring Bulk Stress via Insonification and Method of Use Therefore").
- Improved ability to compute reliability of coastal structures, compute life-cycle costs, optimize section alternatives, and determine asset risk by developing coastal structure life-cycle simulator RMDAMRisk.

- Developed capability to model complex nearshore wave-structure interaction, wave run-up and overtopping, and wave forces on structures in the surf zone with new version of COBRAS, a coupled Boussinesq-Navier-Stokes numerical model.

### **Flood and Coastal Storm Damage Reduction Research Program**

This R&D activity is funded under the Investigations appropriation. As part of its "Flood and Coastal Storm Damage Reduction" mission, the Corps of Engineers is responsible for more than 600 dams, operates over 400 major lakes and reservoirs, maintains 8,500 miles of levees, and has over 100 coastal storm damage reduction and related projects. Flooding that occurs in the United States costs about \$4 billion annually. Despite all efforts, annual damages in the flood plain continue to rise due to continued urban development. In addition, the 2000 census showed that more than 50% of the U.S. population lives within 50 miles of a coast and is vulnerable to dangerous coastal storms and costly flooding. Consequently, over the past several years, federal coastal storm damage reduction expenditures increased to more than \$100 million per year to protect the public and related economic investments.

In managing flood and coastal storm damage reduction projects around the country for the public's safety and benefit, the Corps is challenged to simultaneously optimize additional requirements for navigation, hydropower, water supply, environmental stewardship, and recreation while maintaining sustainable and adaptable watersheds. The Corps must have the most advanced capability to conduct risk-based assessments of alternative project designs and operational scenarios; those capabilities must be robust, reliable, and comprehensive; and they must lead to sustainable solutions.

R&D delivers efficient and effective capabilities to plan, design, construct, operate, maintain, and improve water resources projects in all climates and settings, from warm to ice-affected, and from inland to coastal. Capabilities to prevent loss of life, minimize property damage, and reduce the life-cycle costs of projects are critical. Capabilities include advanced processes and design models, economic models and decision support software, infrastructure condition and risk assessment tools, infrastructure design guidance, innovative operation and maintenance technologies, flood-alert instrumentation, expedient emergency response

capabilities, and the capability to take advantage of new real-time data sources (e.g. precipitation radar) to accurately forecast real-time flow and stages.

Accomplishments in FY 2007 include:

- Increased dam safety risk assessment technologies and improved determination of dam performance probabilities.
- Improved the Dam Portfolio Risk Assessment Screening Software Tool being used to prioritize dam safety investments until full Portfolio Risk Assessment Process and Tools are fielded in FY 2010.
- Improved the Corps' capability to support rapid emergency response assessments of inland and coastal flood control structures by integrating geophysical, remote sensing, and geospatial applications with data collection instrumentation.
- Released the IWR Planning Suite decision support software, a decision support tool for formulating alternative plans and evaluating ecosystem restoration alternatives.
- Improved analysis methods for flood damage reduction by identifying key social factors, data sources, and methods for use in project evaluation, and demonstrated the effectiveness of a combined social and geographic vulnerability assessment technique.
- Improved reliability of water management project design and operations by providing outlet structure computational methods and soil moisture parameter adjustment capabilities for real-time forecasting of complex water allocation systems.
- Developed guidance for use of ice-related parameters that will improve design of ice-affected river channel restoration projects.
- Improved the Corps' methodology for statistical analyses in flow-frequency curve computations.
- Improved visualization tools that provide a view of velocity, ice thickness, and flooding depths and boundaries.
- Initiated the Snow Information Management System development that will provide a standardized approach to collecting, processing, maintaining, displaying, and utilizing snow data for applications such as estimating total watershed snow water equivalent volumes.
- Improved methods for determining uncertainties related to graphical frequency

analyses that impact the computation of expected annual damages and project performance including determining certifiable levee heights.

- Enhanced the Corps' capability to implement risk-based design and formulation of shore protection projects by release of operational guidelines and beta version of model to estimate cost and benefits and associated risk and uncertainty of alternatives.
- Conducted joint U.S. and European Union workshop on collaborative flood risk management research and development.

### **Ecosystem Management and Restoration Research Program**

This R&D activity is funded under the Investigations appropriation. Ecosystem Restoration is a growing focus of the Corps' Civil Works program, ranging from large-scale projects such as the Everglades to smaller, localized ecosystem restoration projects. In addition, the Corps carries out environmental and natural resource management and restoration activities on more than 11 million acres of land and water resources. The goal of this R&D is to provide Corps field personnel with cost-effective/innovative technologies for project planning, design, construction, O&M, and regulatory activities. Product lines include: Environmental Benefits Analysis, Ecosystem Functional Evaluation, Ecosystem Restoration, and Environmental Stewardship and Management. Products are concise, how-to guidance documents that provide rapid/low-cost technologies and methods for high-priority field needs. This technology is critical to the success of the Corps' Continuing Authorities Program (CAP) as well as larger Investigations-funded projects.

Accomplishments in FY 2007 include:

- Developed a spatially explicit decision support system for prioritizing wetland restoration areas.
- Developed guidance for implementing avian inventory and monitoring efforts on Corps projects.
- Provided a library of habitat models to evaluate benefits of aquatic restoration projects on fish.
- Evaluated the application of conceptual models to ecosystem restoration.

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS FOR FY 2007

- Developed quantitative and qualitative measurement of riparian and in-stream functions.
- Initiated development of a suite of tools for improved natural resource inventories on Corps lands and waters.
- Provided techniques for restoration of delta streams, including a case history and a conceptual model.

### System-Wide Water Resources Research Program

This R&D activity is funded under the Investigations appropriation. The goal of the System-Wide Water Resources research area is to support all business lines of the Corps of Engineers and its partners by providing the capabilities to balance human development activities with the natural system in a sustainable manner through regional management and restoration of the Nation's water resources over broad temporal and spatial scales.

The capabilities provided herein include science-based water resource management methodologies, implementation guidance, computational frameworks and technologies, and decision support. These capabilities are being built from sound scientific principles reflecting an improved understanding of inter-relationships among key system attributes such as hydrology, geomorphology, chemistry, ecology, and socioeconomic. Capabilities are being served via a seamless, integrated architecture allowing projects to be considered at multiple scales during project planning, design, construction, and operation and maintenance.

Accomplishments in FY 2007 include:

- Delivered eight watershed assessment tools to the field (over 20 Corps applications and Corps-wide use of the watershed notebook).
- Delivered four riverine hydrodynamic and ecological assessment tools to the field (17 Corps applications and extensive dam break analysis).
- Delivered three estuarine and coastal hydrodynamic and morphology assessment models (15 applications including post – hurricane assessments).
- Delivered three ecological systems models for large-scale applications.
- Delivered six data/knowledge management tools with Corps-wide applications, data visualization capabilities, and data tools for Corps partners.
- Advanced the computational structure of both one-dimensional and multi-dimensional hydrology and hydraulics models to accommodate sources and sinks of water for more accurate water budget estimates and applied to large and complex watershed studies and reduced run times by as much as 30% for complex hydrodynamic modeling.
- Improved parameter estimation tools for reducing uncertainty in hydrology and hydraulics models for improved forecasting.
- Improved three-dimensional groundwater and surface water interactions for wetting and drying for more accurate representation of physical and biological response to water level fluctuations in riverine, reservoir, and estuarine environments.
- Beta tested three-dimensional hydrodynamic modeling of salinity using an adaptive hydraulics grid for more accurate predictions of water movement and material transport in estuarine and coastal environments.
- Developed improved sediment transport kinetics for one-, two-, and three-dimensional hydraulic models for more accurate estimates of sediment movement in rivers and estuaries.
- Refined linkages among multi-dimensional hydrodynamic models for a systems approach to sediment and nutrient transport and fate assessments.
- Refined linkages among multi-dimensional hydrodynamic models and selected ecological models for habitat and operational assessments.
- Advanced ecological model applications for fish passage, trophic evaluations, and restoration alternative analysis using linked hydrodynamic, agent-based, and trophic response models.
- Developed innovative approaches (e.g., combined hyperspectral, thermal, and visual) remote sensing technologies for ecosystem assessment and monitoring and applied to evaluation of ecosystem impacts associated with hurricanes.
- Developed innovative spatial monitoring/assessment technologies using isotopes and geochemical markers for sediment and nutrient fate and effects applications and applied to assessment of impacts of freshwater diversions on

- biological communities.
- Developed alpha application of assessment and forecasting technologies for decision making in watershed management, river restoration activities, and implementation of coastal restoration projects.
  - Developed and applied data management retrieval and standard methods for large scale assessments associated with hurricane impacts and Everglades restoration activities.
  - Demonstrated three-dimensional hydraulic modeling for surface and groundwater interactions for complex systems such as South Florida (Everglades).
  - Demonstrated two-dimensional hydrologic modeling with nutrient and sediment transport capabilities for complex watershed with surface and subsurface drainages typical of the upper Mid-West (e.g., Minnesota River Basin).
  - Demonstrated coupled biological habitat and hydrologic models for assessment of water resource management activities on flora and fauna in rivers, reservoir, and estuarine systems.

**Urban Flood Damage Reduction and Channel Restoration Development and Demonstration Program for Arid and Semi-Arid Regions, New Mexico and Nevada**

This R&D activity is funded under the Investigations appropriation as a congressional add. The program purpose is to develop and demonstrate innovative techniques to address severe urban flooding and channel restoration issues unique to the arid and semi-arid regions of the southwestern United States. The program is a collaborative effort between the Corps of Engineers and the Desert Research Institute of the University of Nevada. The topics have been selected with input from Corps field personnel, along with state and local stakeholders.

Accomplishments in FY 2007 include:

- A 1-day technical program was held at the 11th Arid Regions Conference of the Association of State Floodplain Managers (ASFPM). Presentations were made on program work units. An audience of approximately 50 people participated, with opportunities to provide feedback and to suggest additional arid-regions topics to

include in the program. The session was open to all conference attendees, and included representatives from flood control districts, state and federal agencies, and other Corps personnel. Presentations and fact sheets for each project are being reviewed by District personnel prior to being posted on the Web.

- Prepared a draft report that summarized the existing state of the science, identifies knowledge gaps, and discussed research directions on wildfire effects on watershed hydrology. The report material was also presented at the 11th Arid Regions Conference of ASFPM (Breckenridge, CO, Sept 07).
- Developed a simple spreadsheet tool to assist practitioners in estimating resistance coefficients for complex stream systems in arid regions. The tool incorporates multiple predictors for grain, form, and vegetation roughness, and provides multiple algorithms for compositing. Simple statistical outputs aid designers in selecting "most likely" values for resistance, as well as ranges of likely values for situations requiring sensitivity analyses or estimates of uncertainty.
- Issued a technical report on the computation of increased stages at lateral inflows. The conclusions were based on the results of analytical methods, numerical modeling, and physical modeling. This work will extend Corps guidance to cover confluences where the tributary flow is small compared with the main channel, and where lateral inflows occur. These situations are common in urban watersheds throughout the southwestern United States.
- Research concluded that previously-developed bed load equations for sediment transport mechanisms were appropriate to use in the Las Vegas wash. In addition, a new equation was also developed for predicting bed load transport in the wash. The results have been published in the *Journal of Hydraulic Research*.

**Southwest Urban Flood Damage Program, New Mexico**

This R&D activity is funded under the Investigations appropriation as a congressional add. The program purpose is to develop and demonstrate innovative techniques to address severe urban

flooding and channel restoration issues, and is a collaborative effort with the Corps of Engineers, University of New Mexico (UNM), and Sandia National Laboratories.

Accomplishments in FY 2007 include:

- A 1-day technical program was held at the 11th Arid Regions Conference of the ASFPM, where presentations were made on program work units. An audience of approximately 50 people participated, with opportunities to provide feedback and to suggest additional arid-regions topics to include in the program. The session was open to all conference attendees, and included representatives from flood control districts, state and federal agencies, and other Corps personnel. Presentations and fact sheets for each project are being reviewed by District personnel prior to being posted on the Web.
- Conducted a seminar class at the University of New Mexico focused on the state of the knowledge of flooding issues associated with the Middle Rio Grande. This provided an opportunity for outside speakers as well as a collaborative forum for the different Rio Grande projects taking place at UNM. Fifteen speakers participated and, average attendance was thirty.

### **Aquatic Plant Control Research Program**

This R&D program is funded out of the Construction appropriation. The Aquatic Plant Control Research Program (APCRP) is the Nation's only federally authorized research program providing the technology to manage invasive aquatic plant species. Millions of acres nationwide are now infested with invasive aquatic plants that create water resource problems. These plants when imported as exotic, have few natural enemies, and rapidly out-compete native aquatic plants. Eurasian watermilfoil, hydrilla, waterlettuce, and other invasive species continue to propagate from local infestations. Many of these plants are interfering with navigation, flood control, hydropower production, water quality conditions, and waterborne recreational uses. They have a very low value to fish and wildlife and contribute significantly to overall environmental degradation. New colonies of invasive aquatic plants continue to be found, including hydrilla in the Potomac River, Chesapeake Bay, the upper Midwest, and the Northwest; Eurasian watermilfoil in the upper

Midwest and Northwest; giant salvinia in Hawaii, Texas, Florida, and other southeastern states; and water chestnut in New York and New England. In addition, hybridization between native and invasive aquatic plant species and the development of herbicide-resistant plant populations have recently been documented and can impact the efficacy of current management practices.

The objective of the APCRP is to develop cost-effective, environmentally compatible aquatic plant control technology, including biological, chemical, ecological, and integrated control methods. APCRP research is producing information on the growth and ecological requirements of invasive aquatic plants and is producing new biological, chemical, and ecological technologies for their control. Specific information on the biology and ecology of invasive aquatic plants, obtained through research in the APCRP, has greatly improved the efficacy and diversity of management options, while minimizing adverse effects on the environment.

Accomplishments in FY 2007 include:

- Documented changes in plant response to aquatic herbicides.
- Developed herbicide resistance management strategies.
- Developed assays to identify hybrid and resistant plant populations.
- Identified environmental factors that influence herbicide efficacy.
- Developed species-selective management capabilities.
- Established techniques for integrating chemicals and pathogens to improve plant control.
- Provided guidance on the use of herbicide combinations.
- Provided guidance for using selective chemical control strategies where Threatened and Endangered species are of concern.
- Developed new species-selective active ingredients.
- Identified overwintering behavior of the hydrilla leaf-mining flies.
- Developed and refined mass-rearing strategies for insect biocontrol agents of water lettuce and giant salvinia.
- Developed and tested beta version of a revegetation site selection model to aid in the selection of sites best suited for aquatic plant revegetation.

## U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

- Evaluated effects of plant nutritional composition on the growth and reproduction of insect and pathogen biological control agents.
- Documented the relationship of Eurasian watermilfoil phenology to fungal endophyte infection.
- Evaluated storage life and effectiveness of dry fungal formulations on hydrilla.
- Developed PDA (hand-held personal digital assistant) version of the Aquatic Plant Information System.
- Documented relationships between hydrilla dispersal in the presence of native plant assemblages with and without the presence of insect herbivores.
- Documented impact of biocontrol agents on monoecious and resistant hydrilla.
- Participated in studies to determine genetic makeup of hydrilla around the world.
- Reared and released over 3.7 million leaf-mining flies for the management of hydrilla in Florida, Georgia, and Texas.
- Provided the South African government with over 100,000 leafing-mining flies and direct technical assistance for hydrilla management.
- Identified effects of nutrients and nutrient depletion on aquatic plant infestations.
- Determined temperature, water chemistry, nutrient, and pH requirements for growth of giant salvinia.
- Conducted comparative analyses of aquatic plant assessment methodologies.
- Developed methodologies for propagating desirable native aquatic plants to enhance aquatic ecosystem restoration efforts.
- Developed best management practices for establishment of preferred aquatic plant species.
- Evaluated phenological differences between two growth forms of hydrilla as applies to current management practices.

### **Aquatic Nuisance Species Research Program**

The Aquatic Nuisance Species (ANS) Research Program is an expansion of the Zebra Mussel Research Program. Funded under the Operations and Maintenance appropriation, this expanded program addresses all invasive aquatic animal species. Invasive species in general cost the public over \$137 billion annually. Zebra mussels alone cost the public over \$1 billion annually and they have now been

discovered in lakes and rivers west of the 100<sup>th</sup> meridian. It is estimated that over 100 nuisance species are introduced into U.S. waters annually. Many of these species have the potential to impact facility operations - as well as threaten valued native species diversity. The Corps is responsible for the O&M of water resource projects on navigable waters and the associated resources. More effective, inexpensive methods of prevention and control of aquatic nuisance species must be developed to reduce impacts to public facilities and protect valuable natural resources.

Prevention methodology focusing on dispersal barrier technology will be investigated. Control strategies are being developed for navigation structures; hydropower and other utilities; vessels and dredges; and water treatment, irrigation, and other water control structures. Methods to reduce invasive species impacts to Threatened and Endangered species and restore natural habitat will be investigated. Numerous dredged material disposal areas in the Atlantic, Gulf coast, and Great Lakes region have mosquito abatement programs. Due to the introduction of the West Nile Virus, local communities want greater assurances that mosquito populations at Corps disposal sites are controlled to the maximum extent practicable. Following the introduction of the northern snakehead fish, a number of Corps reservoir projects have had to take interdiction measures to prevent introduction of the fish.

#### Accomplishments in FY 2007 include:

- Evaluated potential control measures for Asian carp in the Upper Mississippi River.
- Evaluated potential new chemical compounds to control harmful algal blooms.
- Investigated life stage sensitivity analysis to chemical control measures for ANS.
- Developed ANS assessment technologies for early detection, threat level, monitoring strategies, management protocols, and exclusion protocols.
- Developed Internet/computer-based information system containing ANS species profiles for quick access by Corps project managers.

### **Coastal Inlets Research Program**

The Coastal Inlets Research Program (CIRP) is a R&D program funded under the Operations and

Maintenance appropriation. Records demonstrate that the Corps will expend an estimated \$15 to \$20 billion over the next 25 years at the more than 150 coastal inlets with existing major federal navigation projects to maintain, modify, and create navigation channels and structures, and to mitigate damages to adjacent beaches. In addition, the national “2020” plan for deeper and wider channels to accommodate the next class of vessels brings great uncertainty in prediction of maintenance requirements. Political, engineering, and demographic factors may increase these costs. The public perception, right or wrong, that federal activities at inlets cause adverse response at adjacent beaches may require additional, expensive mitigation. Public sensitivity to the common maintenance practice where dredged material is placed in offshore disposal areas may result in requirements for more nearshore placement of maintenance materials to benefit adjacent beaches. Inlets are the primary conduits for the transport of environmental constituents between bays and the open ocean, and the Corps may be constrained from performing present activities unless the Corps can make accurate predictions of inlet response, and thus environmental response, to such activities. As inlet behavior becomes better understood through the R&D, reliable tools for management of inlets for navigation projects, such as models and empirical relationships, are becoming available for inlet O&M. These new tools will lead to more efficient, cost-effective designs and reduce O&M requirements and, consequently, costs.

Accomplishments in FY 2007 include the following:

- Developed new jetty designs and criteria for reducing dredging maintenance cost.
- Produced advanced Boussinesq numerical model for calculation of waves at around and through structures. Presented two workshops to Districts.
- Produced integrated Coastal Modeling System for calculating sediment transport, channel infilling, and morphology change under all typical hydrodynamic forcing at inlets. Presented workshop to Districts.
- Developed new barrier island breaching modeling for analyzing breaches that are tending to occur near older jetties.
- Published and implemented state-of-the-art sediment transport formulas that provide integrated calculation through all hydrodynamic regimes at inlets (rivers, tide, waves, waves plus current).

- Prepared guidance documents on strategies to reduce navigation channel infilling.
- Conducted morphologic assessment and provided engineering guidance for stability of multiple inlets connecting to the same bay, treating the bay system as a hydrodynamic and sediment-sharing system.
- Developed a numerical tool box for estimating infra-gravity or very long waves that can cause dangerous oscillations to vessels moored at harbors.
- Published guidance on sand waves that may appear in navigation channels.
- Applied modeling technology to develop justifications for mining of inlet ebb shoals as a source of bypassing material to the down-drift beaches.

### **Dredging Operations and Environmental Research Program**

This R&D program is funded under the Operations and Maintenance appropriation. The Dredging Operations and Environmental Research (DOER) Program is an integral and highly beneficial component of the Corps’ navigation dredging and environmental protection missions. Dredging and disposal must be accomplished within a climate of increased dredging workload, fewer placement sites, environmental constraints, and decreasing fiscal and manpower resources. A major challenge is balancing environmental protection with critical economic needs while accomplishing dredging activities. The program has validated innovative technologies for high-profile contaminants and developed risk-based assessment methods that will significantly reduce testing costs at virtually all harbors. Methods for reclamation and beneficial use of dredged material will contribute to sustainable management of disposal sites, providing both economic and environmental benefits.

Major focus areas of DOER include dredged material management, environmental resource protection, operations technologies, and risk science. Accomplishments in FY 2007 are listed below by research focus area.

#### **Dredged Material Management:**

- Surface-water Modeling System Version 10 was upgraded to include dredging toolbox, which includes methods for data transfer,

model setup, model execution, and analysis of results.

- Developed the Particle Tracking Model (PTM), Version 2.0. PTM is a Lagrangian particle tracking model that monitors the far field fate of dredged material. Features added in Version 2.0 include more accurate methods for determining pathways, advanced cohesive sediment capabilities, and additional verification and test case validation.
- Developed the LTFATE Version 2.0, a new LTFATE sediment transport model for dredged material mound dispersion. Version 2.0 includes user-specified wave fields, three-dimensional hydrodynamics and sediment transport, three-dimensional stratified sediment bed, multiple grain sizes, bed and suspended load transport, and cohesive sediment processes.
- Developed the Particle Imaging Camera System, an in situ system to provide rapid imaging of particles in dredge plumes. A prototype system was developed and adapted for field deployments.
- Completed development of process-based models for loss rates during these dredging methods (cutterhead, hopper, and auger dredges). Collected additional field data for model verification for hopper dredge with overflow.

**Environmental Resource Protection:**

- Completed formulation of a risk-informed decision framework as a basis for setting environmental windows for dredging projects, allowing consideration of socio-political factors and stakeholder values in addition to technical input. Submitted a paper describing the framework to a peer-reviewed scientific journal.
- Completed design and construction of a large capacity Brett-type swim tunnel for expansion of research into factors that govern risk of entrainment of endangered species by hydraulic dredges.
- Completed preliminary configuration of a GIS-based tool using eCoastal as a platform for assessing potential impacts of navigation projects on foraging habitat of protected gulf sturgeon. The tool will assist planners in avoiding conflicts and proactively investing in studies to minimize impacts.

- Developed a research plan to address critical Threatened and Endangered bird habitat management issues that arise in conjunction with beach nourishment projects.
- Prepared guidance on a strategy for sustainable management of confined disposal facilities (CDFs). The final document describes options for beneficial re-use of sediments placed in CDFs with a goal of reclamation and restoration of placement capacity.
- Completed analyses of historical data on risk factors associated with incidental take of sea turtles to support expansion of existing environmental windows.
- Completed field evaluations of hopper dredge overflow anti-turbidity valve effectiveness in reducing dimensions of suspended sediment plumes. Study results have major implications for determining means to minimize risk of exposure and detrimental effects on a variety of protected species.

**Operations Technologies:**

- Completed hydrocyclone optimization analysis to separate and isolate contaminated sediment fractions from dredged material, thereby reducing disposal costs.
- Demonstrated a Silent Inspector automated cutterhead dredge monitoring system on contractor dredge.
- Completed laboratory and field evaluations of fluid mud and dredging residuals survey systems for investigation into feasibility of implementation of a Corps-wide navigable depth policy and to improve capability to characterize dredging projects with unconsolidated contaminated sediment bottoms.
- Completed eGIS application requirements and preliminary design for developing and reporting calculations of key performance measures related to navigation channel reliability.
- Completed final draft of Engineer Manual 1110-2-5025 (Dredging and Dredged Material Management) by updating and merging the three primary Corps dredging engineer manuals (Dredging and Dredged Material Disposal (1983), Beneficial Uses of Dredged Material (1986), and Confined Disposal of Dredged Material (1987)), along

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS FOR FY 2007

with the addition of an entirely new open water dredged material placement chapter.

for many projects. The Corps also contributes through this program to the Nation's Integrated Ocean Observing System (IOOS).

### **Risk:**

- Completed a detailed review and engineering analysis of promising contaminated sediment treatment technologies to evaluate the costs and benefits relevant to the navigation program.
- Enhanced DREDGE model source term and users guidance to provide more reliable estimates of sediment resuspension rates and exposure estimates for risk assessment.
- Upgraded RECOVERY and CAP models to provide more accurate predictions of contaminant flux from sediment to the overlying water. Such models are essential design tools for evaluating confined aquatic disposal options for contaminated dredged material.
- Developed experimental methods for quantifying the contribution of biological disturbance of the sediment column (i.e., bioturbation) to contaminant flux through sediment caps. Bioturbation is a major source of uncertainty in cap design.
- Completed experiments to evaluate use of solid-phase microextraction as a much less costly and time-consuming experimental method for predicting porewater concentration and the bioavailability of polychlorinated biphenyls in sediments.

### **Other Programs**

Within the Investigations, Operations and Maintenance, and Construction appropriations, the ERDC conducts technical support efforts that consist of activities such as demonstrations, mapping, data collection and management, studies, and technology transfer and support. Significant activities in this area of effort are described below.

#### **Coastal Field Data Collection**

The Coastal Field Data Collection Program is a nationwide program designed to measure, analyze, and assemble information required to accomplish the Corps' mission in coastal navigation and storm damage reduction. It is designed to collect non-project-specific data, such as regional data necessary

Significant accomplishments in FY 2007 include:

- Completed modeling of 24 years of historic Pacific Ocean waves and made them available on the Internet. The modeled wave data provide high-quality detailed coastal wave information for project planning and coastal management. New wave and wind information products and enhanced download features were added to the Web site. In collaboration with the National Oceanic and Atmospheric Administration (NOAA), wave hindcasting procedures for the Pacific were updated to the latest version of NOAA's Wavewatch III numerical wave model, and model output now includes spectral parameter products.
- Led the development of a National Operational Wave Observation Plan for the IOOS. The plan comprehensively addresses all aspects of a measurement program including spatial and temporal coverage and the accuracy requirements to serve the broadest range of wave information users. This is a significant document that builds on the limited wave observation network that exists today.
- Added three new directional wave measurement stations as part of the Coastal Data Information Program (CDIP): Tampa/St. Petersburg FL; the San Francisco Bay, CA; and Kaunapala, Lanai, HI. All sites were added in collaboration with multiple federal agencies and local sponsors. CDIP is a collaborative effort with the State of California and the Scripps Institution of Oceanography.
- Mapped 120 miles of coastal Southern California twice in FY 2007 using airborne LIDAR (Light Detection and Ranging), continuing a unique effort that began in 2002. The mapping provided a new understanding of a previously undocumented alongshore variation that is not predicted with existing coastal sediment/evolution models. Based on the LIDAR mapping data and estimates of sediment transport based on wave observations, these studies advanced regional sediment management concepts through a new nearshore sediment budget formulation.

## U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

- In collaboration with the MORPHOS beach modeling activity under the System-Wide Water Resources Program, added real-time wave forecasting for North Carolina to ERDC's Field Research Facility's (FRF) website. This is a first step to evaluating the performance of a number of coastal models. The FRF Web site was revamped and new wave analysis products added. These changes provide data users with better access and more comprehensive analysis tools.
- Under the Pacific Island Land-Ocean Typhoon experiment that is studying storm surges on islands caused by typhoons: (1) added LauLau, Saipan, to the cross-reef measurement locations; (2) continued 100% data record (began in 2004) on the Guam reef; (3) captured wave, water level, and meteorological data during passage of typhoon Man-yi; and (4) continued 100% data record at Mokuleia on Oahu, HI. The University of Hawaii is lead collaborator at the Guam and Hawaii sites.
- Developed the TWAVE (Tropical storm and WAVE ) modeling suite to estimate winds, waves, and surge on reefs for use by emergency managers as well as others interested in coastal hazard forecast and response.
- Deployed a new interferometric survey system for the Corps that provides high-resolution side-scan sonar images in shallow water. The 100% bottom coverage leads to three-dimensional maps that greatly enhance the analysis of shallow coastal changes.

### **Remote Sensing/Geographic Information System (GIS) Center**

The Remote Sensing/GIS Center is the Corps' Center of Expertise for Civil Works remote sensing and GIS technologies, providing mission-essential support to the Corps. Through centralized management of this function, the Center provides cost-effective support through technology transfer and applications development for Corps mission responsibilities in all business practice areas: navigation, flood and coastal storm damage reduction, hydropower, regulatory, environment, emergency management, recreation, water supply, and work for others. An enterprise GIS approach is an essential component of this support. Continuing interaction with other researchers and practitioners throughout the Corps, government, the private sector,

and academia ensures that state-of-the-art and state-of-the-practice knowledge of evolving trends that are important are available for the Corps and that duplication of effort is avoided.

The Remote Sensing/GIS Center develops approaches for the integration of data from the disparate sources necessary for system-wide land and water resources management including: regional sediment management, regional water management, ecosystem processes and assessment; basin studies; water control; support to emergency management; and compliance with the attendant environmental regulations and related policies. The Center maintains cognizance of state-of-the-art sensors, data collection, analysis, and storage systems; commercial software; and bridging software that integrates these and operational technologies into Corps Division, District, and other agencies activities.

Technology is transferred through telephone and short, no-cost assistance to the field. The existence of the Center ensures that the necessary support can be rapidly directed toward solving operational problems that require specialized expertise. The PROSPECT training program in remote sensing and GIS, managed by Center staff, provides another avenue for the transfer of knowledge to those who are, or soon will be, using these technologies. Training is also conducted in the field through workshops, conferences, and distance learning. White papers, pilot projects, publications (including Engineer Technical Letters, Circulars, and Manuals), and the Internet are also used to transfer procedures and lessons learned to end users.

#### Accomplishments in FY 2007 include:

- As the Center of Expertise, served as key resource and technology point of contact for the Corps of Engineers for Civil Works remote sensing and GIS.
- Provided guidance and technical support to the Corps' Geospatial Community of Practice (CoP) and provided leadership to the remote sensing, hydrology and hydraulics, and emergency sub-CoPs.
- Continued technology transfer through training courses, briefings, development of distance learning, technical papers, technical demonstrations, pilot programs, and conferences.
- Supported one-stop service requests from Corps Districts and Divisions.

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS FOR FY 2007

- Assisted with geospatial emergency management support during disasters and supported Interagency Performance Evaluation Taskforce (Hurricane Katrina) efforts.
- Provided leadership and technical support to strategic and enterprise USACE geospatial initiatives: National Levee Database deployment; Corps Project Notebook; Corps Map; DISDI Portal; Corps Water Management System; Geospatial Operations and Maintenance Business Interlink developer; Emergency Management, Remote Sensing, GIS, and Modeling Group; and Hydrology and Hydraulics modeling software development and support team member.
- Sponsored and participated in program development of national and international remote sensing and GIS conferences.
- Updated the PROSPECT Introductory and Intermediate GIS courses.
- Participated in the technical execution of the Missouri River Recovery Program.
- Provided technical support to Corps District offices for the development of implementation plans for geospatial data management including development of enterprise geospatial data approaches.
- Provided ad hoc mapping functions for HQUSACE.
- Conducted worldwide mapping and charting missions in support of the Joint Center partners, including the U.S. Great Lakes and New England regions, Hawaii, Guam, Saipan, and the Philippines.
- Acquired a third post-Katrina topographic LIDAR and hyperspectral imagery data set in the New Orleans vicinity for development of change analysis routines fusing LIDAR and spectral imagery.
- Developed new shoreline classification tool that produces data and formats compatible with NOAA's and the Corps' classification schemes. This expands the the Joint Center's shoreline vector product to include shoreline classification.
- Produced numerous technical papers, such as "CHARTS-enabled data fusion for coastal zone characterization," which was presented at the Coastal Sediments 2007 Conference.
- Delivered FY 2006 National Coastal Mapping Program data to the Lakes & River's Division for Lake Erie, Lake Huron, and the Detroit River.
- As of Dec 2007, over 2,893 individual downloads of the Corps' National Coastal Mapping Program LIDAR data have been made, totaling 190 gigabytes. This is accomplished through the NOAA Coastal Services Center's LIDAR dissemination system.
- Completed coastal mapping operations in New England for the North Atlantic Division with topographic and bathymetric LIDAR and RGB imagery.
- Completed Eighth Annual Coastal Mapping & Charting Technical Workshop in Seattle, WA, to coordinate with federal, state, industry, academia and international experts in related technologies. The workshop included 22 technical presentations over 2 days.
- Completed the second year of a 3-year National Ocean Partnership Program initiative to develop data fusion tools to bring topographic and hydrographic LIDAR and hyperspectral imagery together to improve our ability to classify and characterize land use, nearshore bottom types, and environmental resources.
- Completed the Coastal Zone Mapping and Imaging LIDAR (CZMIL) conceptual design for an integrated airborne, data processing, and product generation system.

### **Joint Airborne LIDAR Bathymetry Technical Center of Expertise**

The Joint Airborne LIDAR Bathymetry Technical Center of Expertise is a Joint Center with the Corps of Engineers, the Naval Meteorology and Oceanography Command's Naval Oceanographic Office, and NOAA's National Ocean Service. The Joint Center's mission is to conduct airborne coastal mapping and charting in support of the partners and perform research and development to evolve capabilities and supporting technologies. Through the Joint Center, the Corps implements its National Coastal Mapping Program. The program provides regional coastal data to measure and monitor engineering, environmental, and economic conditions along the U.S. coast, supporting both regional sediment management and individual project operations and maintenance.

Accomplishments in FY 2007 include:

CZMIL is the third-generation system being developed through the Joint Center partnership.

- Competed and awarded a new 5-year Joint Center Technical Support contract, which includes worldwide operation of the CHARTS system.

### **Automated Information Systems Support - Computer Aided Design and Building Information Modeling (CAD/BIM) Technology Center**

This effort provides technical support to engineers and scientists utilizing CAD, BIM, GIS, and facility management technologies in the planning, design, construction, and operation and maintenance of Corps projects. The Center includes participation by the Army, Navy, and Air Force to reduce duplication of effort between the three services in the management of CAD/BIM technology for facilities and environmental engineering. The Center is tasked to set standards; coordinate the use of CAD/BIM systems; promote system integration; support centralized acquisition; and provide assistance for the installation, training, operation, and maintenance of CAD/BIM systems within the DoD facilities and environmental communities, including the Corps Districts. All Corps Districts that use CAD, GIS, and BIM in mapping, planning, real estate, design, construction, operations, maintenance, and homeland defense and readiness benefit from the Center's efforts.

Accomplishments in FY 2007 include:

- Developed BIM Road Map document for HQUSACE to define vision and milestones for successful BIM implementation.
- Published Real Estate Guidebook defining scanning techniques for CAD data storage.
- Established collaborative engineering oversight group (ProjectWise Steering Committee) to coordinate rollout of CAD/BIM applications across the Corps.
- Developed ProjectWise PCM Version 2.0 to standardize ProjectWise data structure across Corps.
- Developed and conducted BIM Managers Training for the newly designated BIM Managers within the Corps' District offices.
- Completed Release 3.0 of the A/E/C CAD Standard used across the design industry to provide the Corps with consistent CAD submittals.

### **Dredging Operations Technical Support Program**

Within the Operations and Maintenance appropriation, the Dredging Operations Technical Support (DOTS) Program fosters a "one-door-to-the-Corps" concept by providing comprehensive and interdisciplinary technology transfer, technology demonstrations, and training essential to all stakeholders involved in navigation projects. The DOTS Program is managed as a centralized program to maximize cost effectiveness while facilitating consistent implementation of National policies and laws pertaining to navigation. The program emphasizes rapid applications of state-of-the-art technology and research results to problems identified by field offices. Maintenance of the Nation's navigation infrastructure requires compliance with numerous environmental statutes and Presidential Executive Orders. These requirements and new emerging environmental concerns necessitate ready access to advances in scientific knowledge to avoid uncertainties in administration of the Corps' navigational dredging program. The DOTS Program's Web-based and topical expert networking capabilities provide access to extensive, up-to-date, technically defensible databases, predictive models, and tools that enable rapid, proactive responses to emerging technical issues. This access fosters networking and solutions to common problems confronting the navigation and dredging communities. Short-term, quick-turnaround technical efforts that address problematic issues encountered during maintenance and operation of navigable waterways and infrastructure are the foundation of the DOTS Program. Demonstration of new, innovative techniques with potentially high returns on investment for management of Corps navigation projects is another important DOTS function. By disseminating knowledge of new R&D products to field offices constrained by staff reductions, the DOTS Program will continue to perform a critical technology transfer role in support of all O&M navigation projects.

Accomplishments in FY 2007 include:

- Provided numerous technical responses to requests for assistance from field offices, including the Chicago, Detroit, Buffalo, New England, New York, Baltimore, Jacksonville, Mobile, New Orleans, Memphis, San Francisco, and Portland Districts. Responses covered diverse issues, including oil spill response, concerns for microbial pathogens in dredged material, mosquito controls in CDFs, beneficial use of

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS FOR FY 2007

dredged material for bird habitat construction conflicts with airport safety assessments, volatilization of contaminants, open-water placement of dredged material, fish spawning habitat protection, and equipment selection for turbidity controls.

- Performed mandated reporting and coordination with the Environmental Protection Agency (EPA) and the International Maritime Organization in compliance with the 1972 London Convention.
- Conducted several small dredged material management training seminars for regional stakeholder groups. Updated plans for a major training seminar/workshop to be held in the new fiscal year. New topics addressing changing technology needs and solutions have been incorporated into the next training seminar agenda. Renewed training efforts will expand upon the cumulative 5,000 personnel trained by DOTS since 1991.
- Continued expansion of Web-based tools used by field offices to reconcile and manage incidental takes of Threatened and Endangered species across individual District and Division boundaries.
- Refined the DOTS-sponsored Web-based O&M Project Endangered Species Act cost compliance reporting system. This tool has become the Corps' standard for generating required annual reports and facilitated coordination with the Fish and Wildlife Service.
- Continued support of collaborative efforts with the American Bird Conservancy to resolve potential conflicts between O&M projects and bird habitat conservation. Significant progress was made in high-priority areas, including interior least tern and coastal piping plover protection initiatives.
- Fostered improved methodologies for remediation of contaminated sediments via the Center for Contaminated Sediments. Treatment and handling of residuals following cleanup dredging continues to be a priority topic as well as applications of Multi-Criteria Decision Analysis methodologies.
- Continued to update content of Web-based databases and tools that represent critical aids for successful implementation of

guidance contained in Corps/EPA dredged material testing manuals.

### **Inland Waterway Navigation Charts**

This effort provides the Corps' Electronic Navigational Chart data for all inland waterways and other federal navigation channels maintained by the Corps. On inland waterways, the Corps collects accurate survey and mapping data in support of waterway maintenance and construction activities, which is also used to produce Inland Electronic Navigation Charts (IENC) that are available to users of the waterways. When combined with the commercial chart systems, the IENCs greatly improve the safety and efficiency of navigation. Such capability allows safe navigation through bridge openings during fog and other bad weather conditions as well as during heavy traffic situations, and provides an accurate display for other systems such as radar and Automatic Identification Systems. The IENCs use the S-57 international data format, which is readily compatible with commercial systems and enables proper use onboard marine vessels. The IENCs are also consistent with electronic chart products produced by NOAA, which enables seamless transit between shallow and deep water channels. The Corps also coordinates with the Coast Guard for aids to navigation information and collaboration rules for chart carriage by waterway users.

In coastal and Great Lakes areas, the Corps will produce standardized channel conditions chart products that will provide consistent and reliable information to NOAA for chart updates, in accordance with the Water Resources Development Act of 2000, Section 558. Similar channel chart products will be provided to navigation users, and these coastal and Great Lakes channel condition chart products will also follow the S-57 format. The IENC development and publication activities are in accordance with National Transportation Safety Board recommendations to the Corps, and subsequent commitments made by the Chief of Engineers.

Significant accomplishments in FY 2007 include:

- Charts for 5,700 miles of inland waterways were published and maintained, including coverage of the Mississippi and Ohio Rivers and various tributaries.
- Development of charts for 1,800 miles of additional waterways began or was continued.

## U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

- IENCs were used on several hundred towboats navigating inland waterways.
- Precise data delineating over 400 coastal deep-draft channels was compiled and used in various chart products.
- Coordination with European Union countries and Russia continued to develop a common international data standard.

### Monitoring of Completed Navigation Projects

The purpose of this monitoring program is to identify the best navigation project practices and use them to improve the performance of all navigation projects. Optimizing project performance requires that projects be monitored and evaluated against preconstruction projections and present needs, and that the lessons learned be translated into proactive management guidance for Corps Districts. Information gained from monitoring navigation projects, including changes in sediment transport, water levels, currents, waves, flushing, river flows and other hydraulic phenomena with associated environmental impacts, will be used to verify design expectations, determine benefits, and identify O&M efficiencies. Information collected from monitored navigation projects can improve project performance and optimize opportunities for environmental enhancement. Information collected and analyzed on a national basis documents successful designs, disseminates lessons learned on projects with problems, and provides upgraded field guidance that will help reduce life-cycle costs on a national scale.

Selective and intensive monitoring of Civil Works navigation projects is executed to acquire information to improve project-purpose attainment, design procedures, construction methods, and O&M techniques. Both shallow- and deep-draft navigation projects located in rivers, reservoirs, lakes, estuaries, and the coastal zone are included in this program. Projects that will potentially provide maximum life-cycle cost savings are identified and those that best address high-priority cost savings are selected for monitoring and evaluation. Monitoring plans are developed jointly by Corps Districts and ERDC. Plans consist of either a comprehensive detailed survey to verify post-construction conditions on a one-time basis or a repetitive collection of field data. The intensive data are analyzed and the results compared with the pre-construction predictions to verify or upgrade existing design guidance for minimizing O&M cost and ensuring project benefits. The analyses include structural, topographic,

bathymetric, and hydrodynamic responses and intercomparisons of projects when applicable.

Coordination between the Corps and other federal, state, and local agencies is essential for proper accomplishment of this program. In addition to satisfying Corps' requirements, the data are made available through publications and will be of value to local, state, and other federal agencies tasked with the development and implementation of regional coastal and inland navigation management policies. Results are communicated to member agencies of the Marine Transportation System committees.

Accomplishments in FY 2007 include:

- **Kaumalapau Harbor, HI:** The largest Corps-developed CORE-Loc™ concrete armor units were utilized for breakwater stability. Monitoring construction techniques during rehabilitation placement completed. Baseline monitoring with Ground Based Tripod-LIDAR completed. Developed high-resolution geo-referenced Digital Elevation Model linked to existing benchmark. Conducted multi-beam survey of breakwater sub-aerial surface. Analysis of settlement and movement of armor units was initiated, and numerical model of wave transformation from ocean gage to inner harbor was developed. Toe stability and armor unit concrete strength analysis was initiated. Used remotely operated vehicle with underwater camera to inspect placed core and under-layer stone during construction. Deployed three pressure-sensitive wave gages.
- **John T. Myers Locks and Dam, KY:** Tow damage to wall armor is a major maintenance problem especially at the 1,200-ft locks along Ohio and Upper Mississippi Rivers. Innovative repair techniques were developed and installed at vertical joints near the bullnose. Present design does not provide for wall armor protection at vertical joints. Documented that successful repairs can be made with minimal disruption to river traffic. Developed imaging technique to quantify volumes of wall material lost to spalling and impacts to forecast optimum time for horizontal and vertical wall repairs.
- **John Day Lock and Dam, OR:** Flow deflectors installed to improve fish passage

resulted in hazardous navigation under certain flows. High-velocity surface currents interacted with power house discharge to create cross-currents at downstream entrance to lock. Specialized Acoustic doppler current profiler flow monitoring equipment was installed at several locations around the dam site for current acquisition during spill season (April through October). Data were transmitted to ERDC by satellite dish on gate tower. Analysis of acoustic data was initiated to develop recommendations regarding flow discharge releases to minimize hazards to upstream traffic tows.

- **Great Lakes Armor Stone:** Rapid armor stone deterioration results in high O&M costs and is a significant problem around the Great Lakes under freeze/thaw and wet/dry cycles. Index test stones previously placed on Keweenaw, MI, breakwater were monitored three times for temporal weathering. Conducted quarry investigations, selected, and placed index stones on Cleveland, OH, breakwater. Performed quarry investigations for index stones for Burns Harbor, IN. Initiated laboratory testing of scale effects by using a range of samples, and a range of prototype index stones cut to uniform dimensions, to better estimate stone quality and durability. Conducted lab tests for three different criteria (Corps, American Society for Testing and Materials, and Modified Procedure) to develop enhanced acceptance criteria and specifications.
- **Montgomery Point Lock and Dam (L&D), AR:** The purpose of this L&D is to ensure that the McClennan-Kerr Arkansas River Navigation System remains a viable asset by providing navigation depths in the White River entrance channel at confluence with the Mississippi River. Declining Mississippi River stages have resulted in reduced drafts, lengths, and widths; daylight navigation only; and escort service. A monitoring plan was developed to study aspects of the problem at this unique dam design planned to be used subsequently on the Upper Mississippi River. Study elements include sedimentation, dredging frequency, spillway gate rating, and forces on the crest gates.

- **Periodic Inspections (PI):** Completed inspections at Cleveland, OH, and Burns Harbor, IN, rubble mound and artificial structure units, and prepared technical reports. Reconstructed Coastal Structure and Inlet Database (CSID). Developed coupled Google Earth interface, and transferred technology to field. Continued digitizing historic PI data and loading newly digitized data into CSID. Created CSID Web page, and prepared Coastal and Hydraulic Engineering Technical Note for CSID.

### Regional Sediment Management Program

Regional Sediment Management (RSM), coastal and watershed management of the sediment, applies to all Civil Works programs through planning, design, construction, operation, maintenance, restoration, rehabilitation, and regulatory activities. This encourages opportunities for enhancing the O&M of existing projects, the long-term effectiveness of existing projects, and the management of ecosystem resources. In addition, RSM facilitates the regional integration of the Civil Works business programs into the identification and development of new Corps initiatives.

The RSM Program's goals are to link the management of authorized Corps projects with one another, particularly across District/Division boundaries, and to leverage data collection and shoreline management activities with other federal agencies and state and local governments within the limits of a regional watershed system (including uplands, rivers, estuaries and bays, and the coast). The purpose of the Program is to demonstrate short- and long-term cost-savings and increased economic and environmental benefits of maintaining sediments within their regional system, and of using sediments to sustain a balanced environment.

Accomplishments in FY 2007 include:

- The New England District produced a reconnaissance level report evaluating the feasibility of placing O&M dredged material from the Cape Cod Canal onto nine nearby beaches. Results of the report support placement of material on adjacent beaches using existing CAP authorities.
- Initiated development of a framework for the restoration of urban watersheds using the

Darby-Cobbs Watershed in southeastern Pennsylvania as a pilot. This framework will be applicable nationwide to urban watersheds affected by excessive development, habitat degradation, and recurrent flooding.

- The New York District developed a strategy for integrating and balancing National Economic Development and National Ecosystem Restoration (NER) account benefits for storm damage reduction projects. The project finalized two analytical tools and applied to the Fire Island to Montauk Point Reformulation Project to quantify NER benefits.
- Completed initial implementation phase to establish eCoastal GIS platform at the New Orleans District and populate with USACE and Louisiana Department of Natural Resources data. The goal of the project is to develop an operational regional sediment budget for the Louisiana coast and the Lower Mississippi River.
- Worked with Coastal Carolina University, the U.S. Geological Survey, and the South Carolina Office of Ocean and Coastal Resource Management to develop Web-based beach profile management and analysis tools. The Web-based system of tools supports central storage and maintenance of an extensive historical data set and provides for easy access and consistent analytical methodologies.
- Continued to support the development and implementation of a Regional Sediment Management Plan as part of the California Coastal Sediment Management Master Plan.
- Initiated first phase of a basin-wide sediment yield analysis for the Niobrara River Basin, NE. This 3-year study is conducted in collaboration with the United States Department of Agriculture, the Natural Resource Conservation Service and the local Natural Resource Districts. Information developed by the study will be used to determine the feasibility of managing sediment from the Niobrara River Basin to reduce impacts to Lewis and Clark Lake and will serve as a model for regional sediment management planning elsewhere in the Missouri River Basin.
- The Howard Hanson Dam (HHD) Sediment Management Project is a component of the general restoration program at HHD and the Green River. In 2007, the Seattle District

calibrated sediment transport models for the HHD reservoir and the lower reaches of the Green and Duwamish Rivers. A series of experimental drawdowns will be conducted in the winter of 2008 to investigate sediment erosion and transport in the reservoir and downstream effects.

- **Southeast Coast of Oahu, Hawaii:** Performed a sediment trend analysis offshore of Wailea Point to determine net sediment transport, dynamic behavior of sediments, and potential suitability of offshore deposits as source material. Launched an Internet mapping service that provides access to study data and information for the public and other science and resource interests.
- **Littoral Drift Restoration Program, Benson Beach, WA:** The intent of the program is to return sediment to the littoral drift of southwest Washington in order to provide material to eroding shorelines within the mouth of the Columbia River littoral cell.
- **Coastal Zone Mapping and Imaging LIDAR, University of Southern Mississippi:** Coastal zone mapping and imaging LIDAR will improve the ability to accurately measure coastal and seafloor elevations, water quality parameters, and environmental features under a wide range of conditions. The program initiated development of an integrated LIDAR and imaging electro-optic sensor and developed new data fusion algorithms.

### Water Operations Technical Support

The Water Operations Technical Support (WOTS) Program is funded out of the Operation & Maintenance appropriation. The WOTS Program provides for the effective transfer of environmental and engineering technology to address water resources environmental problems at USACE reservoir and waterway projects, and in river systems affected by project operations nationwide. WOTS is managed as a comprehensive centralized program that will maximize cost effectiveness and ensure broad dissemination and implementation of technology and information. Maintaining the environmental and water management conditions at 562 reservoirs (5,500,000 surface acres), 237 navigation locks, 926 harbors, 75 hydropower projects, and 25,000 miles of inland and coastal waterways impacted by the operation of Corps

projects requires compliance with numerous statutes and state standards. The WOTS Program's direct technical assistance function provides rapid direct technical assistance to USACE project offices in applying technology to solve water quality and other environmental problems. The technology transfer function is designed to ensure the effective use of technologies through the appropriate transfer of information and techniques using a variety of media. Short-term field demonstration efforts for the verification of tools developed through R&D and the application of management strategies, techniques, and approaches are important WOTS functions. By disseminating knowledge of new capabilities to field offices, the WOTS Program will continue to perform a critical technology transfer role in support of all USACE water resources.

Accomplishments in FY 2007 include:

- Provided technical assistance in response to requests by field offices confronted with water quality and other environmental problems. Responses covered diverse issues, including water quality management, watershed management, fisheries, shoreline erosion control, invasive species, sedimentation, and stream stabilization.
- The program conducts numerous training workshops on water quality and environmental management techniques. In 2007, these workshops were attended by approximately 1,000 personnel from Corps Districts, other federal agencies, state agencies, local agencies, private industry, and universities.
- A continual endeavor of the WOTS Program is coordination with water quality and environmental elements of other federal agencies such as the Environmental Protection Agency, Tennessee Valley Authority, Bureau of Reclamation, Fish and Wildlife Service, U.S. Geological Survey, and the Bonneville Power Administration. These efforts have involved watershed management activities, problems related to the introduction and spread of aquatic invasive species, environmental impacts of hydropower facilities, and impacts of water releases in tailwater areas on fisheries.

### **Scientific and Technical Information Centers**

Five information analysis centers located at the ERDC provide the major interface between the Corps and the public and private sectors to gather and disseminate information as required by Public Law 99-802, Federal Technology Transfer Act of 1986. The function of each center is to acquire, examine, evaluate, summarize, and disseminate newly published scientific and technical information generated within the Corps' and other activities in the United States and abroad.

The Coastal Engineering Information Analysis Center focuses on wave data and predictions, shore processes, inlet dynamics, navigation channels and structures, harbors, and coastal construction. The Cold Regions Engineering Information Analysis Center focuses on ice engineering, meteorology, climatology, geophysics, geology, remote sensing, global and climate change, and environmental engineering. The Concrete Technology Information Analysis Center focuses on cements, concrete, aggregates, concrete construction, concrete repair, and rehabilitation technology. The Hydraulic Engineering Information Analysis Center focuses on hydraulic, hydrologic, water resources, and sedimentation of streams, rivers, waterways, reservoirs, and natural impoundments; estuaries, and inland and coastal groundwater; fishery systems; and hydraulic structures of all types. The Soil Mechanics Information Analysis Center focuses on embankment and foundation engineering, earthquake engineering, engineering geology, and rock mechanics.

The information centers critically evaluate and summarize the technical validity and merits of published and unpublished research and technical publications on design, construction, or other technology utilization. User communities have been well established and distribution lists for technology transfer are continuously updated. Electronic media including the Web are used where appropriate. The effectiveness of activities and services is evaluated on a continuing basis, and technology transfer products and methodology are revised when appropriate.

### **CUSTOMER SUPPORT**

Increasingly, ERDC expertise and products developed in R&D programs are being requested to solve challenges in critical areas of concern. Following are a few examples of the many projects

the ERDC conducts for its many customers, listed by ERDC laboratory.

### **Reimbursable highlights from Coastal and Hydraulics Laboratory**

**Turbine Passage Survival Program (TSP).** Under present conditions, direct fish survival through a Columbia and Snake River turbine ranges from approximately 89 to 94 percent. ERDC engineers are conducting research to gather information that will allow an accurate evaluation of fish passage benefits associated with turbine operational changes and changes resulting from the incorporation of improved fish passage turbine design concepts. The TSP defines the need to understand the hydraulic conditions within the turbine environment in order to develop reasonable solutions to the problem of fish passing through turbines. However, trying to understand what is happening within a turbine on the Snake and Columbia River is extremely complicated. The conditions are very harsh, with velocities as high as 50 ft/s, rapid pressure changes, rapid flow decelerations, high levels of shear, and constantly changing relationships between water flow and rotating parts. Other complications include the large size of the turbine passage area, the difficult access due to the depth of the intake, and the limited visibility due to high turbidity. Cameras can only capture a few feet of the water column that may be 20 ft wide, over 45 ft high, and 100 ft long.

ERDC's use of hydraulic scale models offers solutions to many of the difficulties associated with turbine study. Two types of hydraulic models are being used in this study: performance models (typically used by turbine manufactures to determine expected turbine performance) and fish passage models (used to examine flow characteristics through the turbine passage).

The ERDC turbine physical models include a model turbine, the downstream draft tube, and the exit to tailrace, which allows detailed examination of the complete passage route of water through the turbine environment. The models are made of clear plexiglass allowing high visibility and easy data collection. A non-intrusive laser Doppler velocimeter, neutrally buoyant beads, dye, videotape, and photography are utilized to collect data and visualize flow patterns and fish passage routes. Due to the smaller scale, the improved access, and better visibility, options can be built and tested faster in a model than in the prototype, at a much lower cost.

Studies are not linked to the fish window, allowing year-round testing. These models can also be used to develop prototype tests and provide information for input into numerical models (important for study of the turbine area). Hydraulic models enhance the ability to understand what is physically happening within the turbine environment. Information on how these conditions actually affect fish passage is also collected. The models are verified that they accurately represent prototype conditions. The model test program is closely tied to a prototype test program (including both physical and biological testing) to verify conditions identified in the models.

**Combined Wave and Surge Overtopping of Levees.** ERDC scientists are contributing to an expanding research program investigating the hydrodynamics of levee overtopping. In coordination with the New Orleans District, ERDC conducted controlled scale model experiments to examine the hydrodynamics of flow on the landward-side slopes of levees caused by a combination of storm surge overflow and irregular wave overtopping. Combined wave and surge overtopping was responsible for significant failures of earthen levees during Hurricane Katrina. Engineers now realize that they need to provide robust erosion protection to landward-side levee slopes if the levees cannot be raised to a level that prevents overtopping, but there are no design procedures for estimating either the velocity, flow thickness, or overtopping discharge for the most problematic case of combined wave and surge overtopping. Furthermore, no armoring products have ever been tested for stability under these unsteady flow conditions.

A 1-to-25-scale physical model with necessary instrumentation to document many of the characteristics of the unsteady flow due to combined waves and surge overtopping was designed. A total of 27 unique combinations of overtopping surge level and irregular wave conditions were simulated in the overtopping flume. A relationship was developed for estimating the average overtopping discharge due to combined wave and surge overtopping in terms of the incident significant wave height and the height of the storm surge above the levee crest. Two previous equations for estimating average overtopping discharge for this case were not based on any measurements or observations, and they both overestimated the actual discharge.

The time-varying instantaneous overtopping discharge was measured and a cumulative probability distribution of discharge successfully developed. The distribution will be useful for describing the probable

variation in discharge likely to occur at overtopped levees. A key aspect of the research was to characterize the unsteady, supercritical flow down the landward-side slope. While this had never before been attempted, this type of information is vital for evaluating potential armoring alternatives. Based on the laboratory model measurements, ERDC developed empirical equations for the average flow thickness, average flow velocity, root-mean-squared flow thickness, and velocity of the wave front. These new equations are the first to predict the unsteady flow parameters due to combined wave and surge overtopping, and they will serve as the basis for design guidance needed to specify adequate protection for landward-side levee slopes.

**Multi-Purpose Sustainability of Tybee Island and Savannah Harbor Deep-Draft Navigation.** ERDC scientists provided Savannah District technical assistance with a cutting-edge integration of numerical modeling and morphological analysis of historical shoreline and shelf bathymetry change dating back to the mid-1800's. The work included the generation of pre- and post-project sediment budgets. The change in morphology, sediment budget and modeling of circulation, waves, and sediment transport processes were evaluated through a collaboration between ERDC and the Savannah District. The result was an improved capability to document and measure the impacts that dredging and navigation structures had on the deflation of the shelf and formation of erosion hotspots on the adjacent beach in a complex multi-inlet coastal environment. The multi-purpose nature of this research provides for continued operation of a critical deep-draft national port while sustaining unique and significant national shoreline habitat.

**Reimbursable highlights from Cold Regions Research and Engineering Laboratory**

**USACE National Federal Emergency Management Agency (FEMA) Project Delivery Team (PDT).** The USACE Remote Sensing/GIS Center of Expertise, located at CRREL, manages the USACE National FEMA PDT. The FEMA PDT began in October 2004 with two primary goals: to provide nationwide support to FEMA for its Map Modernization (MapMod) and other hydraulics and hydrology studies, and to provide capacity building to the Hydrology, Hydraulics, and Coastal CoP. The PDT also facilitates effective virtual teaming, especially important since FEMA regional boundaries cross USACE Division and District

boundaries. The PDT is currently handling approximately \$7M in MapMod studies, with the participation of 21 Districts in six Divisions, plus the Remote Sensing/GIS Center of Expertise and the Coastal and Hydraulics Laboratory. The primary benefit of this collaborative effort is that flexible teaming between Districts helps USACE meet FEMA's tight time deadlines for MapMod Projects in a manner that allows USACE to build and maintain core competencies in hydrology, hydraulics, and coastal engineering within a geospatial framework. FEMA benefits through the involvement of local USACE Districts with intimate knowledge of past, present, and future projects impacting flood damage reduction.

**Dam Decommissioning, Sandusky River.** CRREL is assisting Buffalo District regulatory, planning, and engineering and construction functions through an analysis of the Ballville Dam on the Sandusky River, in Fremont, OH. The Great Lakes Fisheries and Ecosystem Restoration Program prompted efforts to investigate the environmental benefits of removing the Ballville Dam to allow migratory fish, particularly walleye, to gain access to upstream reaches of the Sandusky River and increase their spawning ground. Fremont has a long history of flooding events, some catastrophic, and many have been made worse by the presence of ice jams. This analysis focused on the ability of the dam to retain ice during the most significant ice jam events, and showed that the Ballville Dam has had an impact on reducing damaging ice jams in Fremont. Further investigations will focus on the risk of flooding and ice damage to bridges and floodwalls caused by the additional ice from upstream of the current dam to downtown Fremont. Two major alternatives for controlling ice in the absence of the Ballville Dam are ice piers and active river ice management. The results of the study are significant because dam decommissioning in northern rivers is an increasingly popular method of ecosystem restoration, but care must be taken to balance the flood damage reduction and emergency management impacts associated with dam removals.

**Modeling Ice Impacts on Armor Stone Revetments at Barrow, AK.** As the Arctic ice cover continues to recede, the Alaska District is met with increasing demands for cost-effective coastal erosion designs. While the wave climate is not severe at Barrow, AK, increased open water area and ice-free conditions extending into the early fall have resulted in increased shoreline erosion and adverse impacts on the community's infrastructure. Of particular concern are wind-driven ice events, known to

Alaskan Natives as “ivus”, where large sheets and bergs are driven into the shoreline. A series of refrigerated scale model tests were completed at ERDC facilities to simulate the impact of ice shoves on a proposed coastal protection structure to be constructed at Barrow. The tests showed that ice forces are much higher than wave-induced forces for this part of the Arctic coast. Test results were used by the Alaska District to modify the design of the erosion protection structure.

**Design Support to Antarctic Program for Overland Fuel Transport to South Pole.** The National Science Foundation (NSF) research program at the Amundsen-Scott South Pole Station is supported logistically by ski-equipped LC-130 aircraft from McMurdo Station on the coast of Antarctica. In terms of tonnage of material transported to the South Pole, approximately 50% is fuel. This includes the fuel used by the LC-130's to transport fuel. CRREL engineers, working closely with NSF and its logistics contractor Raytheon Polar Services, developed an innovative sled system pulled by commercially available rubber-tracked tractors to transport fuel to the South Pole overland. The 1,000-mile over-snow route requires very little trail preparation and traverses the Ross Ice Shelf and Leverett Glacier as it climbs 10,000 ft to the Polar Plateau. Convoys consisting of eight to ten tractors, conducting three trips per season, can supply essentially all the annual fuel needs at the South Pole Station. Overland re-supply to the South Pole Station reduces fuel consumption by a factor of four and air emissions by more than 100-fold compared with re-supply by aircraft. It will potentially save millions of dollars annually and free valuable LC-130 flight time for science missions around the continent.

**ERDC Leads Arctic Sea Ice Experiment: Dynamic Nature of the Arctic.** The Sea Ice Experiment: Dynamic Nature of the Arctic (SEDNA) team completed a 3-week field program in the Alaskan Beaufort Sea in March 2007, marking the successful completion of one of the initial activities of the International Polar Year. The primary objective of the SEDNA project is to advance the understanding of the complex interaction between the atmosphere, sea ice cover, and ocean. Results are being used to improve models of the sea ice cover, leading to better predictions of future changes and assessments of the impacts of these changes on regional and global communities. CRREL staff made critical contributions as members of the international team of scientists. The SEDNA program had strong diversity and educational outreach components with the participation of women in key leadership roles

and a Vermont high school teacher. Fifteen students and early career researchers participated on the field team.

#### **Reimbursable highlight from Construction Engineering Research Laboratory**

**Update of the Environmental Assessment and Management (TEAM) Guide for USACE Civil Works.** The TEAM Guide, State Supplements to the TEAM Guide, and the Environmental Review Guide for Operations (ERGO) Supplement have been designed to aid both internal and external assessors in evaluating environmental compliance and management practices at Corps facilities. The guide and its supplements address applicable Corps and Army regulations and Corps environmental assessment policies. The Corps of Engineers (Civil Works) has limited personnel and budgetary resources to meet baseline compliance auditing requirements and limited tools to document and track findings and deficiencies through abatement. CERL assists in implementing the environmental compliance requirement through auditing services and automated safety and environmental regulatory resources and auditing tools, resulting in access to real-time compliance data for use in developing future program initiatives and determining implementation direction. The TEAM Guide and its supplements were developed in 1994 by the Corps, in partnership with Air Force Center for Environmental Excellence, National Guard Bureau – Environmental Programs Directorate, Army Environmental Center, Air National Guard, U.S. Army Reserve Command, and Defense Logistics Agency for use by all DoD components. This partnership has been expanded to include non-DoD agencies, specifically the U.S. Postal Service, National Aeronautics and Space Administration, U.S. Forest Service, Department of Energy, and Department of Homeland Security, thereby reducing the product development cost to the Corps.

#### **Reimbursable highlights from Environmental Laboratory**

**Endangered Sturgeon Studies in the Mississippi River.** The pallid sturgeon is an endangered fish species impacting Corps navigation and flood control projects. Potential anthropogenic impacts to pallid sturgeon include habitat alteration by dredging, dikes, revetments, water diversions; blockage of migratory routes by locks and dams; and commercial sand and gravel mining. A jeopardy

opinion has been issued by the Fish and Wildlife Service for Corps activities on the Missouri and Middle Mississippi Rivers, and there has been concern that similar impacts may be occurring in the Lower Mississippi River. A 5-year research study funded by Mississippi Valley Division demonstrated that populations appear stable or even expanding, dispelling the notion that this species will become extinct unless the Corps spends substantial funds on habitat improvement projects. ERDC's population models confirmed that commercial fishing of shovelnose sturgeon in the Middle Mississippi River between the mouths of the Ohio and Missouri Rivers may be threatening the sympatric, endangered pallid sturgeon due to incidental harvesting (i.e., the two species are difficult to distinguish). As a direct result of these studies, the Corps has recommended that commercial harvesting cease before implementing expensive habitat restoration projects.

**Mississippi Coastal Improvement Project.** The Mississippi Coastal Improvement Project is supported by a multi-disciplinary ERDC team consisting of 21 biologists, ecologists, hydraulic engineers, civil engineers, and mathematicians. The group was assembled to support the Mobile District's fast-tracked emergency response study in reaction to the devastation caused on the Mississippi Gulf Coast by Hurricanes Katrina and Rita. Other collaborators included the Fish and Wildlife Service, the State of Mississippi, and other federal and local agencies. The ERDC team advised the Mobile District in ecosystem functional analysis, hurricane storm surge modeling and frequency analysis, a preliminary assessment of the water quality and ecological impacts of proposed freshwater diversions, and risk-informed multi-criteria decision analysis needs. They also helped the District decide on appropriate methodologies and models to generate the information needed, participated in multi-disciplinary problem solving, responded to comments from internal and external review, and gave presentations at public input events. The combined results form the basis for future planning, engineering and design work, and operational plans of potential freshwater diversions, thus guiding the potential expenditure of hundreds of millions of dollars.

**Fish Passage Design, Environmental Benefits Analyses, and Incremental Cost Analysis on the Truckee River.** ERDC is assisting the Sacramento District to scope a full range of alternatives for a basin-wide fish passage program on the Truckee River, extending from Lake Tahoe in California to the system's terminus at Pyramid Lake in Nevada. Fish passage concerns are one element in a larger

ecosystem restoration and flood management project in planning for the Truckee that enjoys significant support from Congress. ERDC is developing and implementing an alternatives analysis for upstream and downstream passage, including the cost effectiveness and incremental cost analyses. To support these analyses, an assessment of the environmental benefits and costs of alternative restoration strategies and techniques is being pursued. This is the only basin-wide fish passage project under way on a major river in the United States at this time. In addition to quantifying passage benefits at individual structures, the cumulative effects of passage are being examined in order to develop system-wide plans of alternative implementation.

**Risk Assessment and Engineering Support for Inner Harbor Navigational Canal Lock Replacement.** ERDC scientists and engineers provided technical support to the New Orleans District for the environmental assessment and engineering management assessment of sediments from the Inner Harbor Navigational Canal as part of the construction of the new lock. The effort included the completion of a comprehensive contaminant assessment in support of an Environmental Impact Statement following Hurricane Katrina. The studies included contaminant presence, toxicology, bioaccumulation, fate in aquatic and terrestrial systems, material characterization, and modeling. The results of the effort will enable the project to move forward and allow project managers to complete the project while complying with all environmental laws and regulations. Ultimately this effort will allow the construction of the Inner Harbor Navigational Canal Lock that will expand port facilities in New Orleans including the Mississippi River, Lake Pontchartrain, and the Gulf Intracoastal Waterway.

**Evaluation of Herbicides to Selectively Control Invasive Submersed Plants.** ERDC scientists provided the Minnesota Department of Natural Resources (MDNR) assistance for developing species-selective chemical techniques to manage public water bodies infested with the invasive aquatic plants Eurasian watermilfoil and curlyleaf pondweed. Results from small-scale studies carried out in ERDC facilities are being used to plan and conduct operational treatments in numerous lakes in Minnesota to reduce the abundance of the invasive weeds, while protecting and enhancing native plant communities that provide critical fish and wildlife habitat and improve water quality. The studies included herbicide dose-response characterization against target and non-target plants, fate of herbicide

residues in aquatic systems, and development of temporal strategies for optimizing species-selective control. Project sponsors and partners included the MDNR, local agencies (county and city), Mississippi State University, and the Aquatic Ecosystem Restoration Foundation.

**Reimbursable highlights from Geotechnical and Structures Laboratory**

**Blast Mitigation Research.** ERDC is currently conducting research and demonstrations in application of current research in mitigation of critical assets that include cable-stayed bridges, zoned embankments, and underwater tunnels. This effort was initiated in FY 2007 and is planned to continue through FY 2009.

**Levee Assessment and Strengthening Research.** This program seeks to develop technologies that will rapidly identify problem levees, develop affordable strengthening options for new and existing levees, and allow them to be repaired rapidly when and if a failure occurs. This effort was initiated in FY 2007 and is planned to continue through FY 2010.

**Reimbursable highlight from Topographic Engineering Center**

**Comprehensive Evaluation of Project Datums.** ERDC expertise in survey engineering was enlisted for the Comprehensive Evaluation of Project Datums (CEPD), a nationwide program to conduct a vertical datum review of all Corps federally authorized and constructed hurricane protection, shore protection, flood control, and navigation projects. ERDC coordinated the effort to implement lessons learned from the recent findings of the Interagency Performance Evaluation Task Force (IPET) on Hurricane Katrina. These findings highlighted the need to ensure that the Corps' flood control and navigation projects across the country are referenced to the proper vertical datums to correctly compensate for subsidence/sea level rise. The IPET findings also highlighted the need to ensure that all projects are adequately referenced to nationwide spatial reference systems used by other federal and local agencies responsible for flood forecasting, hurricane surge and inundation modeling, navigation, flood insurance rate maps, hurricane evacuation route planning, coastal boundary delineation, bathymetric mapping, and topographic mapping. This review is to inventory the

vertical datums used on all flood control, hurricane protection, and navigation projects; identify deficiencies in those datums that require corrections; develop a plan to transition to the correct datums; and implement appropriate project changes if needed. Accomplishments included the development of guidance documentation for the evaluation and reporting of project vertical datums (Engineer Circular 1110-2-6065), the development of a training class in coordination with NOAA, conducting a training and certification class for District Datum Coordinators from each Corps District, and development of a database and tool to track the evaluation process.

# INSTITUTE FOR WATER RESOURCES

## BACKGROUND

The U.S. Army Engineer Institute for Water Resources (IWR) is a field operating activity under the staff supervision of the Director for Civil Works, Headquarters, U.S. Army Corps of Engineers (HQUSACE). The Institute is the USACE center of expertise for integrated water resources management (IWRM), focusing on planning analysis and hydrologic engineering and on the collection, management and dissemination of Civil Works and navigation information, including the Nation's waterborne commerce data.

IWR was established by the USACE Chief of Engineers in 1969 with the approval of the House and Senate Appropriations Committees and the Subcommittees on Public Works in order "to enhance the capability of the Corps of Engineers to develop and manage the Nation's water resources, within the scope of the Corps' responsibilities, by developing essential improvements in planning to be responsive to the changing concerns of our society."

The Institute's mission is to facilitate the adaptation of the Civil Works Program to future needs by providing the USACE with the capability for developing forward-looking analysis and state-of-the-art methodologies. IWR fulfills this mission by supporting the HQUSACE Civil Works Directorate and USACE Major Subordinate Commands (MSCs) and District offices by providing: (a) analysis of emerging water resources trends and issues; (b) state-of-the-art planning and hydrologic engineering methods, models and training, and (c) national data management and results-oriented program and project information.

## IWR CENTERS

IWR has offices at three locations, each of which is a USACE designated center of expertise (DX): the National Capital Region (NCR) and Navigation Data Center (NDC) offices in the Casey Building at the Humphreys Engineer Center, Alexandria, Virginia; the Hydrologic Engineering Center (HEC) in Davis, California and the Waterborne Commerce Statistics Center (WCSC) in New Orleans, Louisiana. WCSC is part of the Navigation Data Center (NDC).

**National Capital Region Office:** The IWR National Capital Region (NCR) office is the Corps designated center of expertise for the development of methods, models, and analytical tools used for water resources and water systems planning, investment decision-support, environmental (natural resources) conflict resolution, and international water resources. IWR fulfills this mission through a synergy of water resources planning and socio-economic expertise that blends practice with research, policy development and information. IWR planners, economists, social scientists, civil engineers and specialists in the physical sciences lead Civil Works strategic planning and technology transfer initiatives; conduct national and focused policy development studies; develop a broad range of partnering and investment decision-support techniques, methods and models for integrated water resources management (IWRM) and navigation system applications; interact with national and international members of the water resources community at-large and partner with the HQUSACE, Corps field offices and laboratories in solving complex technical water resources planning and evaluation problems. In particular, the Institute provides a critical mass of socio-economic expertise within the Corps and serves as the residence for the USACE Chief Economist position, which is responsible for the leadership of the Corps Economics Community of Practice (CoP). IWR also provides a cadre of international water specialists who lead the USACE's engagement in water resources partnerships around the globe. Additional information about IWR is available on its web site at [www.iwr.usace.army.mil](http://www.iwr.usace.army.mil).

**Hydrologic Engineering Center (HEC):** The primary goal of HEC from its inception in 1965 has been to support the Nation in its water resources management responsibilities by increasing the Corps technical capability in hydrologic engineering and water resources planning and management. An additional goal is to provide leadership for improving the state of the art in hydrologic engineering and analytical methods for water resources planning. Program efforts in research, training, planning analysis and technical assistance raise awareness of the problems and needs of the Corps and the Nation. HEC is committed to keeping abreast of the latest developments throughout the water resources engineering profession and to make use of this information in a manner best suited to the needs of the USACE nationally and internationally. HEC increases

the effectiveness of the Corps and the profession by bridging the gap between the academic community, practicing hydrologic engineers and planning professionals. HEC ground-tests and incorporates state-of-the-art procedures and techniques into manuals and comprehensive computer programs. The procedures are made available to the USACE, United States government and international professionals through an effective technology transfer system of technical assistance, publications, DVD's and training. Technical specialty areas addressed by HEC include: precipitation runoff processes, reservoir regulation, reservoir systems analysis, hydrologic statistics and risk analysis, river hydraulics and sediment transport, groundwater hydrology, water quality and analytical aspects of water resources planning. Application areas include: flood risk management, real-time water control, water control management, hydroelectric power, navigation, erosion control, water supply, watershed studies and ecosystem restoration. Additional information about HEC and its software is available on its web site at [www.hec.usace.army.mil](http://www.hec.usace.army.mil).

**Navigation Data Center (NDC):** NDC is the Corps designated center of expertise for the management of infrastructure utilization and performance information for U.S. waterways and port and harbor channels. Because of the integrated nature of water resources, NDC also directly supports a range of related Civil Works business areas, including hydropower, recreation, environmental compliance, environmental stewardship, water supply, regulatory and homeland security, as well as other Federal, state and local agencies and the private sector. The primary operational arm of NDC is the Waterborne Commerce Statistics Center (WCSC), which provides one-stop capability for national navigation information systems. NDC also provides integrated business information in support of Corps decision making including financial output, performance measurements and performance-based budgeting processes. Additional information about NDC is available on its web site at [www.ndc.iwr.usace.army.mil](http://www.ndc.iwr.usace.army.mil).

## FY 2007 SUMMARY

**Post-Hurricane Context:** The Institute's FY07 program served as an affirmation of IWR's status as an essential intellectual asset to the Corps Civil Works program, the overarching USACE missions, and the Nation's water resources. Many of the technical and policy development challenges faced in FY07 represented an extension of the ambitious program that emerged in the aftermath of Hurricanes Katrina, Rita and Wilma in 2006 and the devastation wrought along

the U.S. Gulf Coast. The resulting mix of planning, policy and research initiatives that IWR initiated in 2006 and continued through 2007 provides the overarching context for what has proved to be the most challenging, productive and rewarding period in the Institute's 38-year history. After years of preparatory planning, organizational enhancement, and strategic refinement of IWR's capabilities and focus, FY07 represented a pinnacle of the Institute's substantive technical contributions during what turned out to be an especially crucial timeframe for the USACE and the Nation given the urgent need to (1) restore hurricane risk reduction facilities for communities in the Gulf States, (2) determine why the hurricane system didn't perform as intended, while (3) concurrently planning for the future rebuilding of the Gulf Coast based on the principles of IWRM.

These natural disasters precipitated a wide range of ex-post inquiries, investigations and analyses that not only focused on determining the circumstances and cause of these disasters, but also addressed broader issues of policy interest, such as: revisiting the Nation's approach to and commitment for protecting citizens against flooding and coastal storms; reinforcing the need for comprehensive, systems-wide approaches to water resources management, including the full integration of the social, economic and environmental goals of society; and questioning the confidence in and effectiveness of public engineering and USACE flood and coastal storm damage reduction programs.

The U.S. and its principal agencies and science academies (in partnership with other government agencies, non-government organizations, professional societies, universities, and international organizations) undertook a number of comprehensive post-flood audits aimed at identifying lessons-learned to inform future decisions on how to harden the hurricane protection system and strengthen flood preparedness and response processes. Aspects of the review encompassed the design and safety standards used for infrastructure, governance and institutional considerations, along with examining the analytical principles and policies used for determining project scope, formulation and justification. The Institute actively participated in this unprecedented array of ex-post initiatives, which involved technical experts drawn from across IWR and the entire USACE.

**Key Post-Katrina Activities:** In particular, IWR played a central role on aspects of seven key initiatives:

- the completion of the interior flood control and the socio-economic consequences portions of the

Interagency Performance Evaluation Task Force (IPET) investigation into the engineering physics of the system failures within New Orleans and vicinity during Hurricane Katrina;

- leadership of the Hurricane Protection Decision Chronology (HPDC) assembly of the 50-year chronological record of planning, economic, policy, legislative, institutional and financial decisions that shaped the hurricane protection system for greater New Orleans;
- partnership with the Netherlands Rijkswaterstaat (Department of Public Works, part of the Ministry of Transport and Water Management) which facilitated the completion of a study by the “Netherlands Water Partnership” consortium to identify options for the long-term reduction of flood risks and landscape stabilization within the scope of the Louisiana Coastal Protection and Restoration project (LACPR). The resulting report, which identifies potential measures and strategies, is entitled: “*A Dutch Perspective on Coastal Louisiana Flood Risk Reduction and Landscape Stabilization*”;
- a series of technical workshops was conducted in The Hague and New Orleans to facilitate the intergovernmental exchange of views on a broad range of topics, including risk-informed decision making, advanced dredging technologies, soft soil improvement, non-structural floodplain management and design-build contracting;
- provision of direct planning support to the New Orleans District on the Congressionally authorized Louisiana Coastal Protection and Restoration (LACPR) study, which is developing the comprehensive risk reduction plan;
- formal activation of the National Flood Risk Management Program (which pre-dated the occurrence of Hurricane Katrina) and its acceleration on a national basis subsequent to the Gulf Coast disaster, which was instrumental in institutionalizing the Intergovernmental Flood Risk Management Committee (IFRMC) and initiating the National Levee Inventory and Assessment Program; and
- serving on the program development team for what became the major Corps organizational response to, and primary vehicle for technological and institutional reform based on the lessons learned from Hurricane Katrina—the **Actions for Change** (AFC) initiative. The USACE Chief Economist was appointed to lead the Risk Analysis AFC team, while specialists from the Institute actively participated in the Risk Communication and Comprehensive Systems (including Climate Change) teams.

**Integrated Water Resources Management:** While the Institute’s Future Directions Program and Civil Works Strategic Planning activities continued to foster a corporate recognition of the need for systems approaches to solving water resources problems, IWR specialists played central roles in advancing the practice of integrated water resources management (IWRM) through the successful completion of the Lake Ontario and St. Lawrence River Study for the International Joint Commission (IJC), and initiation of a follow-on IJC study on the International Upper Great Lakes (IUGLS) which is investigating the extent to which Lake Superior outflow water management affects the on-going changes in lake levels for Superior and Lakes Michigan Huron and Erie and their connecting channels, particularly the St. Clair River. The demonstrated value of practicing IWRM was also furthered by the involvement of IWR specialists in the Corps Western States Watershed Study, the co-leadership in collaboration with ERDC of the Gulf of Mexico Regional Sediment Management (RSM) demonstration program and other Corps RSM activities, and participation in pilot project partnerships with The Nature Conservancy on their Sustainable Rivers Program.

At the same time, IWR researchers worked to continue advancing IWRM planning, economic and hydrologic and hydraulic engineering tools, resulting in the 2007 issue of the new IWR-Planning Suite software, and the release of new editions of the full range of HEC’s flagship NexGen software products, along with the rollout and immediate field application of state-of-the-art systems models for maritime transportation economics as part of the Institute’s Navigation Economic Technologies (NETS) Research Program. Another significant technology milestone was the completion of the deployment and training phases for the OMBIL Regulatory Program Module (ORM 2.0), a web-based, enterprise GIS data management system now used by all USACE field offices, which provides the anchor technology for watershed-based analytics and decision-support for the Corps regulatory program, and is expected to play a foundational role for the entire Civil Works program.

Also during 2007, a key IWRM-related activity was the establishment of the Institute’s new “International Center for Integrated Water Resources Management (ICIWaRM)”. This USACE IWR center was subsequently nominated (in February 2008) by the U.S. Government (USG) as a global water center in conjunction with the UNESCO International Hydrological Programme (IHP). ICIWaRM would be the first U.S.-based UNESCO water center in the U.S.

**Collaborative Planning and Partnerships:** Through the Institute's role in supporting the USACE-wide implementation of the Civil Works Strategic Plan (2004-2009) and the ongoing development of the next Strategic Plan (2010-2014) in accordance with GPRA, IWR continued to promote, support and engage in intergovernmental collaborations and partnering throughout USACE, and with a wide range of national and international institutions and organizations as a means of accomplishing common goals. IWR continues to serve as the USACE lead for multiple national partnerships and is committed to developing new technologies, processes and policies to further collaborative planning and partnering.

IWR's partnering focus on national water resources issues in 2007 included representing both USACE and the Office of the Secretary of Defense (OSD) on the Executive Office of the President's National Science and Technology Council Interagency Subcommittee on Water Availability and Quality (SWAQ). IWR actively participated in the development of the SWAQ Strategic Plan for Federal water resources agencies to ensure adequate water availability and quality, culminating in the publication of the report "*A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States*", September 2007. IWR is likewise supporting USACE participation in the implementation of the President's Ocean Action Plan through integrated networks and partnerships of Federal, state, local, territorial and tribal authorities, the private sector, international partners and ocean communities.

In the advancement of collaborative planning models and guidance, IWR's National Cooperative Modeling and Collaborative Planning and Management Demonstration programs worked in synergy to test and demonstrate a variety of collaborative modeling tools and concepts. Given the Institute's long history of applying collaborative modeling tools through its signature Shared Vision Planning (SVP) process, IWR was positioned to advance and apply contemporary conceptual and methodological approaches, as well as documenting, vetting and publicizing the advances and experiences of other institutions.

This led to IWR establishing a new Conflict Resolution expertise center in 2007, while concurrently welcoming a significant new MOU partner - the U.S. Institute for Environmental Conflict Resolution, located within the Udall Center at the University of Arizona. These advances culminated in 2007 with the convening of a major workshop on Computer Aided Dispute Resolution (CADRe) that brought nine federal agencies, nonprofit organizations,

states, irrigation interests and the private sector together to share experiences on the use of collaborative computer modeling in solving water resources disputes.

In FY07, IWR also published a collaborative planning handbook for use by USACE field practitioners. The report entitled, "*Project Planning in Collaboration with Government Entities – Practical Approaches*" (IWR publication [07-R-02](#)) provides an introduction to the concept of collaboration as it applies to problem solving with Federal, state, and local governmental agencies.

The Institute executed a wide range of technical assistance projects, such as HEC's support of system-wide reservoir operations for the Lower Colorado River Authority (LCRA). IWR continued building international water partnerships with the appointment of IWR senior staff to the Governing Board of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Water Education (IHE-Delft), and the Advisory Board of the International Center for Water Hazard and Risk Management (UNESCO-ICHARM).

Memorandums of Understanding (MOUs) were executed in FY07 with a number of universities and professional organizations, with these partnerships facilitating cooperation in technology, science and research in aspects of integrated water resource management and capacity building in developing nations and countries in transition. Each of the universities with which IWR has entered into MOUs has unique program features that compliment the strengths and talent of the Institute. These include new partnerships with The University of Arizona's Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHARA); the University of New Hampshire's Institute for the Study of Earth, Oceans, and Space, Water Systems Analysis Group; and the Oregon State University's Institute for Water and Watersheds. In addition, IWR executed its third international MOU partnership with a UNESCO-IHP water center - the Center for Humid Tropics of Latin America and the Caribbean (CATHALAC) in Panama.

**Risk Analysis:** IWR continued to provide technical assistance to the New Orleans District and Mississippi River Division on the congressionally authorized LACPR study. IWR senior staff specified a scenario-based, risk-informed planning approach to be integrated within the Corps traditional six-step planning process, and led workshops with LACPR staff to enhance understanding and advance the implementation of the planning framework for coastal

## INSTITUTE FOR WATER RESOURCES

Louisiana. This served a complementary purpose of developing a nationally consistent risk-informed planning framework to support implementation of the risk-based concepts in planning, design, construction, operations, and major maintenance action of Actions for Change. IWR involvement was concentrated on implementation, using the LACPR study as a test-bed demonstration.

**Adaptation to Climate Change:** FY07 represented a milestone in the Corps involvement in and application of global climate change science, culminating in the policy affirmation for an adaptation strategy for the Civil Works Program reflected in the Congressional testimony of the Honorable John Paul Woodley, Jr., Assistant Secretary of the Army (for Civil Works), before the House Committee on Transportation and Infrastructure in May, 2007. IWR climate change specialists provided technical support to USACE and the OASA(CW) in the preparation of the testimony, and IWR subsequently accelerated its Climate Change policy development program, including the initiation of an interagency component aimed at developing consistent water management adaptation policies and approaches to address global warming throughout USACE CW's and in partnership with U.S. Geological Survey (USGS), the U.S. Bureau of Reclamation (BuRec), and the National Oceanic and Atmospheric Administration's (NOAA) Climate Program Office.

**Nobel Prize Recognition:** 2007 also represented a milestone for the recognition of the contributions of climate change scientists around the world, with the Norwegian Nobel Committee awarding the Peace Prize to former Vice-President Al Gore and the Intergovernmental Panel on Climate Change (IPCC). IWR's Dr. Eugene Z. Stakhiv, who has been an active contributor to the IPCC from its inception, co-chairing the first IPCC Water Resources Group, serving as lead author in the second and third IPCC reports, and participating as a reviewer of the fourth IPCC report, was honored by the IPCC and shared in the recognition for the Nobel Peace Prize.

**Other Key FY07 Activities:** Overall, IWR executed a FY07 program of approximately \$50 million with 150 in-house employees, primarily in professional disciplines with most possessing advanced degrees. IWR's in-house staff was supplemented by other experts detailed from USACE field offices and laboratories and Intergovernmental Personnel Act (IPA) visiting scholars from universities, state and local governments, policy think tanks and the private sector.

A major FY07 initiative for the Institute was accomplished through IWR's role as the Secretariat of the U.S. Section PIANC (the International Navigation Association), which convened the "Smart Rivers 2007 Conference", held in Louisville, KY. This was the first time the U.S. Section PIANC had organized a major industry conference and the outcome was a resounding success with more than 200 navigation professionals in attendance. The theme of the conference was "Positioning Inland Navigation as a Powerful Link in the Global Supply Chain", with the USACE Director of Civil Works, MG Don T. Riley and Sean T. Connaughton, U.S. Maritime Administrator, serving as the keynote speakers.

In 2007 IWR institutionalized two additional international programs: the Civil-Military Emergency Preparedness Program (CEMP), and Emergency Management International (EMI) Program. In particular, CEMP activities in 2007 focused transferring to other nations a fundamental understanding of how disaster response is managed by U.S. federal agencies; an introduction to emergency response in the private and public sectors in democracies; national GIS seminars and workshops; evaluations of disaster response capability; regional GIS seminars; how to develop national response plans; how to build national emergency operations centers; national and regional response to all (or any specific hazard); and special topics as determined by the host nation. Specific events/activities in 2007 were held with the Black Sea Initiative; support of the South Eastern Europe (SEE) Council; and meetings within the Balkans region, including GIS workshops; and with the U.S.-Russian Joint Emergency Management Committee.

In FY07 HEC engineers provided training in water resources engineering in Nairobi, Kenya and Addis Ababa, Ethiopia as part of the Combined Joint Task Force – Horn of Africa (CJTF/HOA) host nation agreement. HEC specialists also performed a critical levee evaluation and engineering performance analysis for a levee along the Anseung River protecting Camp Humphreys in Korea.

FY07 marked the conclusion of Dr. Gerald Galloway's tenure as IWR's Arthur Maass - Gilbert White Visiting Scholar. Dr. Yacov Haimes, University of Virginia was appointed his successor as Maass - White Scholar for 2007 - 2008. Dr. Leonard Shabman remained with IWR throughout FY07 working on several efforts. These included completing his work with Dr. Douglas Woolley (retired Professor of Economics from Radford University) on the HPDC investigation.

IWR's specific accomplishments during FY07 are described in the following sections, organized in accord with the Institute's major focus areas.

### FUTURE DIRECTIONS

The Institute's Future Directions activities include the identification of emerging water challenges and opportunities and the tactical engagement of USACE senior leaders on these issues to stimulate "strategic thinking." Such critical thinking is seen as an essential prerequisite to strategy development and planning. IWR employs a variety of approaches to encourage strategic thinking, including the development of water resource outlook papers and the conduct of topic specific provocation sessions with senior leaders. Outlook papers that were presented at provocation sessions during FY07 included: "*U.S. Water Demand, Supply and Allocation: Trends and Outlook*" (IWR Publication [07-R-03](#)) and "*Maritime Transportation System: Trends and Outlook*" (IWR Publication [07-R-05](#)). External and internal subject matter experts and stakeholders joined IWR staff at these sessions.

In FY07, IWR continued to use two innovative instruments to engage senior leaders strategically: the "Castle Forum" and the "Lunch Roundtable." The Castle Forum, an off-site event for senior leaders and external thought leaders where they can engage in out-of-the-box thinking regarding subjects not usually addressed by them specifically, is intended to provide a venue for leaders to recognize (previously undetectable) signals of weakness and anticipate potential implications. Castle Forum subjects explored during FY07 included "Chaos and Complexity Theory," "The Competitive Approach to Modernizing the Business of Government," and "Government and Other Factors in 2050". The Lunch Roundtables brought in water experts from outside the Corps to provide perspectives on issues familiar to senior leaders. Topics discussed during FY07 included, "Taking a Systems Approach to Water Resources Management," "Engineering Ethics and Organizational Structure," and "Partnering with States to Support Integrated Water Resources Management."

**Strategic Planning:** FY07 strategic activities continued to address implementation of the current Civil Works Strategic Plan and informed the intellectual development of the next strategic plan through research, identification of new challenges and strategies based in part on scenarios developed in FY06, and outreach. IWR supported a session designed to elicit stakeholder responses to the aforementioned scenarios. It should be noted that the

release of the inaugural Civil Works Strategic Plan in 2004 represented the culmination of a multi-year effort aimed at establishing a new direction for the Civil Works Program based on the contemporary IWRM "watershed" planning approach. The plan's five strategic goals were firmly grounded in the "systems" perspective of IWRM and are fully aligned with the principle of environmental sustainability.

The Institute's technical experts and OMBIL national data management systems continued to support the formulation of the yearly budget guidance, the five-year development plan and the evaluation of USACE Civil Works program business areas in conjunction with the Office of Management and Budget (OMB) Program Assessment Rating Tool.

**Post-Katrina Studies:** In FY07, work continued on the Interagency Performance Evaluation Task Force (IPET) Risk and Reliability modeling effort to develop flood risk maps for the New Orleans metropolitan area as Task Force Hope completed construction on the Lake Pontchartrain and Vicinity Hurricane Protection System. IWR and HEC staff provided updated consequence data and interior modeling to support the map updates. IWR also provided planning support to the Louisiana Coastal Protection and Restoration (LACPR) study. This congressionally authorized 24-month study will produce a report in FY08 documenting the development and analysis of a comprehensive hurricane protection system. As part of that support, IWR has been assisting the LACPR team to develop a risk-informed planning and decision making framework that is intended to also have national application. Complementary risk assessment tools will be developed through the Actions for Change program.

**Interagency Performance Evaluation Task Force (IPET):** The results of the analysis and technical documentation for the IPET Interior Drainage and Consequences tasks are included in IPET report "*Volume VI: The Performance — Interior Drainage and Pumping*" and "*Volume VII: The Consequences.*"

The *Consequences* report developed information on the full range of consequences from Hurricane Katrina. The analysis and report were completed by a team of over 50 economists, sociologists and environmental scientists from IWR, HEC, the Engineer Research and Development Center (ERDC), Corps districts, academia and consultants. Direct flood damages to private property were estimated using an innovative GIS census block based assessment for the 5-parish greater New

Orleans area. The approach allowed the estimation of potential flood damages at flood stages both below and beyond those experienced during Katrina. The impact of the Katrina flooding on the New Orleans community infrastructure was documented. This neighborhood infrastructure supported the local society and culture and enhanced the quality of life in the greater New Orleans region. Scientists from ERDC provided the analysis of the environmental impacts of Katrina flooding and the subsequent dewatering of the flooded parishes. The available information on the human health and safety impacts of Hurricane Katrina was also documented, including loss of life and a wide range of other physical and mental health outcomes. *Volume VII: Consequences* was one of the first volumes released as final by IPET.

The IWR Consequences team also developed stage-damage and stage-fatality functions that provide estimates of direct property loss and life loss as a function of inundation elevations for different parts of the greater New Orleans area. In FY07, these functions were used by the IPET Risk and Reliability team to develop estimates of the probability distributions of life loss and direct physical damage relating to the expected performance of the Hurricane Protection System in Greater New Orleans as of June 2007 associated with a wide range of possible hurricane events with different severities, directions, and points of landfall.

**Hurricane Protection Decision Chronology:** In FY05, IWR developed the study plan, formed the study team and initiated the Hurricane Protection Decision Chronology (HPDC) investigation. The HPDC team is composed of external experts on water resources policy and planning and non-Federal flood and storm water protection. The team interviewed individuals and reviewed 50 years of documentation to assemble a chronological record of planning, economic, policy, legislative, institutional and financial decisions that influenced the design, scale, configuration and condition of the Greater New Orleans hurricane protection system. The HPDC was established at the direction of HQUSACE and is complementary to IPET.

During FY06, the team produced a draft report that underwent internal independent technical reviews (ITRs) and an external review by a panel of experts convened by the National Association of Stormwater and Flood Management Agencies (NAFSMA). The team gave briefings to Corps leadership and the Assistant Secretary of the Army (Civil Works). A draft final report and database of source documents

were publicly released via the IWR website in the third quarter of FY07 after undergoing a third round of internal technical review. The final report will be published in FY08, which will include a compact disc containing the more than 350 project-related documents reviewed for the report.

**Intergovernmental Panel on Climate Change:** The Institute has been involved in climate change impacts analysis and research since 1978. In 1988, the World Meteorological Organization and the United Nations Environment Programme, recognizing the need for an objective, balanced, and internationally coordinated scientific assessment of the understanding of the effects of increasing concentrations of greenhouse gases on the earth's climate and on ways in which these changes may impact socio-economic patterns, established the International Panel on Climate Change (IPCC).

Dr. Eugene Stakhiv has co-chaired the IPCC's committee on water resources and participated in the preparation of the four Assessment Reports of the Panel (1990, 1995, 2001 and 2007).

In 2007, the Norwegian Nobel Committee awarded the Peace Prize to the Intergovernmental Panel on Climate Change. For his many contributions to the IPCC, Dr. Stakhiv was honored by the Nobel Committee and shared in the Nobel Peace Prize.

**Actions for Change:** Actions for Change were developed to address the lessons learned from the Hurricane Katrina and Rita disasters. The goals of the Actions are to improve public safety and the Nation's water resources infrastructure by providing expert and professional services to the Nation. The Actions for Change are divided into four themes: (1) Comprehensive Systems Approach, (2) Risk Informed Decision Making, (3) Communication of Risk to the Public, and (4) Professional and Technical Expertise. IWR is actively participating on the core teams for the first three themes.

Theme 1 (Comprehensive Systems Approach) is emphasizing integrated, comprehensive and systems-based approaches that incorporate anticipatory management so infrastructure systems will be adaptable and sustainable over time. IWR is leading the Temporal and Spatial System Changes project delivery team (PDT). The objective is to review the dynamic processes that potentially impact USACE projects and to develop guidelines and recommend policy and program changes to address the changes and their impacts. The PDT will leverage their activities with IWR's project on "Corps Adaptations to

Climate Change.” Many IWR activities support Theme 1 and the comprehensive systems approach. These activities include developing a framework for environmental sustainability and guidelines for multi-objective planning that include other social effects such as public safety.

Theme 3 (Communication of Risk to the Public) emphasize the communication of flood risks to the public and public involvement in flood risk management decision making. Initiatives will focus on concepts of residual risk and the involvement of disadvantaged populations that are most likely to be impacted by floods. IWR is leading the Public Involvement subteam, and is presently partnering with the National Flood Risk Management team to develop a framework for public involvement in flood risk management decision making. Future activities will include public involvement training, further development of the framework and associated policy changes, as well as pilot studies.

To implement the Actions for Change initiative, a program development team that was familiar with IPET and HPDC results and implications was established, composed of senior technical experts from HQUSACE, IWR, ERDC and Corps field offices. IWR actively participated in the development of the Actions for Change and led development of a key risk-informed planning and decision making framework component, leveraged through IWR’s work in support of the LACPR study.

**Adaptations to Climate Change:** IWR has initiated a project to address USACE adaptations to climate change. The objectives of the project are to develop consistent approaches to climate change science throughout USACE and in partnership with other Federal agencies. The project will also provide recommendations for policy and guidance to prepare for, and respond to, climate change and variability. IWR organized a meeting at USACE headquarters on climate change and water resources in May 2007. Representatives from USACE, the U.S. Geological Survey (USGS), the U.S. Bureau of Reclamation (BuRec), and the National Oceanic and Atmospheric Administration’s (NOAA) Climate Program Office and Hydrology Program attended. An interagency group was formed to consider what actions Federal water agencies should take to incorporate climate change considerations into water resources activities.

IWR also supported the Western States Watershed Study as technical lead for a pilot study evaluating the impacts of warming temperatures on reservoir rule curves in California. USACE guidance on sea level rise in project planning is also being revised.

**Louisiana Coastal Protection and Restoration (LACPR):** During FY07 IWR continued to provide technical assistance to the Corps’ New Orleans District and Mississippi River Division on the congressionally authorized LACPR study. In partnership with ERDC, a small team of risk analysis experts developed a decision framework that weaves together quantitative risk assessment, scenario planning and risk-informed decision making with active and transparent stakeholder involvement. IWR senior staff outlined a process to integrate risk-informed planning within the traditional six-step planning process, then led workshops for LACPR staff to enhance understanding and advance the implementation of the planning framework for coastal Louisiana. IWR also advised the LACPR study team on best planning practices, and an IWR senior social scientist lead the formulation and evaluation of non-structural components to the comprehensive risk reduction strategies. This combined effort served a complementary purpose of developing a nationally consistent risk-informed planning framework to support implementation of the risk-based concepts in planning, design, construction, operations, and major maintenance action of Actions for Change. IWR involvement was concentrated on implementation, using the LACPR study as a test-bed demonstration.

**USACE Chief Economist:** Dr. David Moser of IWR is the USACE Chief Economist and leader of the Economics Community of Practice (CoP). During FY07, the Chief Economist continued to provide support to the IPET Risk and Reliability team.

The Chief Economist’s leadership engaged to build and advance the economic analysis capability across the USACE, holding two national meetings and regular teleconferences with senior economists.

A subject matter expert (SME) database of all Corps economists was reviewed and updated by senior economists to maintain a directory identifying economists by experience and expertise for each economic activity conducted by the USACE. This SME database is used by MSC economists, planning centers of expertise and others to identify resources for feasibility studies, ITRs and special purpose teams. In FY06, the senior economist group started the expansion of the SME database to include more detailed knowledge, skills and abilities (KSAs).

As a complementary activity to building capacity, the Chief Economist focused on enhancing technical guidelines and economic manuals available to field practitioners. In FY07 work proceeded on the update of water resources planning National Economic Development (NED) Manuals. The Chief Economist

participated in selection boards for senior economists throughout the Corps and was involved in issues relating to NED evaluation of transportation externalities, agricultural water supply and value of time saved.

In FY07, the Chief Economist was appointed as the National Lead for Risk Informed Decision Making, one of the four themes in the restructured Actions for Change initiative. As part of that effort, the Chief Economist led development of approaches and frameworks to articulate the value of risk analysis, with emphasis on risk management, to Civil Works decision making.

**National Shoreline Management:** The National Shoreline Management program, authorized in 2000, remains a collaborative, inter-agency effort that is adapting to the recent surge in coastal and ocean initiatives. The study is intended to describe the extent and causes of erosion and accretion along the shores of the U.S., the economic and environmental effects caused by erosion and accretion, and the systematic movement of sand along the shores. It will describe the resources committed by Federal, state and local governments to restore and nourish shores, recommend appropriate levels of Federal and non-Federal participation in shore protection and use a systems approach to sand management.

Initiatives and events have influenced the future course of national shoreline management program. These include the President's formation of a Committee on Ocean Policy and an associated new ocean governance structure; U.S. Geological Survey publication of the results of shoreline change studies; the initiation of a National Coastal Data Bank; joint coastal mapping initiatives; emerging joint Federal coastal science and technology collaborations; and the formation of regional coastal collaborations to address ocean and coastal management in an ecosystems context.

By the end of FY07, the study management team had engaged partner agencies in discussions of how the study could best serve and integrate ongoing initiatives to improve agency program integration and effectiveness with emphasis on systems approaches to Federal and non-Federal roles in shoreline management. The study team has begun preparing an interim report that will summarize study products as well as results of other initiatives in terms of answering the study directives and making recommendations for proceeding towards next steps, including developing information for a final report.

**Policy Development:** A new initiative on "The Nature of Policy Studies" resulted in the publication of

a report entitled "Policy Studies Supporting Civil Works Missions: Problems and Issues" and a supporting primer entitled "The Nature of Policy Studies Supporting Civil Works Missions: A Primer." Additional policy activity took place in specific program areas such as flood risk management, where issue papers led to proposals for a national levee assessment and closer coordination with the Federal Emergency Management Agency (FEMA).

## COLLABORATION AND PARTNERING

The USACE recognizes that Civil Works missions must be carried out in collaboration with multiple partners and stakeholders with differing authorities, capabilities and perspectives. Thus a major IWR focus has been as the unofficial USACE center of expertise for collaboration, partnering and public participation. In FY07 the Corps took steps toward official recognition of that role with funding for a Center for Collaboration, Environmental Conflict Resolution and Participation. In addition, IWR serves as the USACE lead for multiple national partnerships and is committed to developing new technologies, processes and policies to further collaborative planning and partnering.

In FY07 IWR shepherded a review of current practices in environmental conflict resolution and continued the National Cooperative Modeling and Collaborative Planning Demonstration programs with multiple Federal, state, university and non-governmental partners. Of particular note, IWR led the development of an interagency federal initiative on the intersection of computer tools and multi-stakeholder collaborative water resources management processes. As part of this initiative, IWR led an interagency workshop on Computer Aided Dispute Resolution.

IWR represented both USACE and the Office of the Secretary of Defense (OSD) on the Executive Office of the President's National Science and Technology Council Interagency Subcommittee on Water Availability and Quality (SWAQ). IWR actively participated in the development of the SWAQ Strategic Plan for Federal water resources agencies to ensure adequate water availability and quality, culminating in the publication of the report "*A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States*", September 2007."

IWR also developed guidance on collaborative planning in support of HQUSACE, led execution of Corps-wide Memoranda of Agreement (MOAs) and

Memorandum of Understanding (MOUs) and engaged the academic community through the Maass-White Visiting Scholars program, the Universities Council on Water Resources (UCOWR) Fellowship Visiting Scholars program, the National Research Council (NRC) Research Associates program, the American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellows program, and the Leo R. Beard Visiting Scholars program (resident at HEC).

**National Partnerships:** Forming strategic alliances, both through formal agreements and informal working relationships, is becoming a way of doing business in the USACE, government agencies and non-governmental organizations (NGOs). Driving this movement are the complexity and far-reaching impacts of today's water resource problems, juxtaposed with the limited financial and intellectual resources of any single organization. The USACE is increasingly committed to partnerships as a means of accomplishing common goals. In FY07 IWR initiated several new MOAs and MOUs and furthered work on existing agreements.

*Natural Resources Conservation Service Partnership:* A partnership agreement was signed between the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and the Corps on July 7, 2005. The purpose of the agreement is to promote a long-term working relationship and collaborative effort to improve the management of water and related natural resources under the missions and authorities of the NRCS and USACE. Initially, collaboration focused on three areas: (1) watershed planning and implementation; (2) wetland creation, restoration and enhancement and (3) natural disaster recovery. The agencies agreed to coordinate other programs and activities, including the Wetland Conservation Compliance (Swampbuster) and the Regulatory Program (Section 404 of the Clean Water Act). Accomplishments in FY07 include the development of a partnership brochure, a website, and a draft action plan. Interagency teams have been formed and are working on several of the action items.

*U.S. Geological Survey Partnership:* Significant activities for the U.S. Geological Survey MOA included senior level meetings addressing streamgaging issues, climate change and water resource issues, coastal and environmental research and collaboration on international activities.

*U.S. Bureau of Reclamation Partnership:* In June 2006, a meeting was held in Folsom, California between HQUSACE, IWR and Bureau of Reclamation

management to discuss the existing USACE - Bureau of Reclamation (U.S. Department of the Interior) MOA, provide additional definition to the agreement and discuss details of current collaboration projects, the most visible being Folsom Dam. A similar meeting is planned for FY07.

*Oak Ridge National Laboratories Partnership:* During FY07 IWR continued to implement a 2005 MOU with the U.S. Department of Energy's Oak Ridge National Laboratories and ERDC that centers on energy, security and environmental sustainability. Thrusts of the agreement include joint work on regional energy and water management, transportation modeling, emergency response, homeland security and environmental sustainability.

*Other Partnerships:* IWR is working closely with Sandia National Laboratories through the National Cooperative Modeling Demonstration Program and is developing an MOU which is expected to be signed in 2008.

IWR represented both the USACE and the Office of the Secretary of Defense (OSD) through participation in the National Science and Technology Council's interagency Subcommittee on Water Availability and Quality (SWAQ) and its Subcommittee on Disaster Reduction. IWR actively participated in the development of the SWAQ Strategic Plan for Federal Research and Development to ensure adequate water availability and quality, (publication title "*A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States*", September 2007), and is leading development of the resultant interagency Federal Initiative on Collaborative Tools and Processes for U.S. Water Solutions.

## **Academic and Professional Practice Partnerships**

### *Universities*

In FY07, IWR entered into Memoranda for Understanding (MOU) with a number of universities and professional organizations, and made continued progress on other MOUs with additional universities and professional organizations that will be signed in FY08. Key agreements were executed with the University of Arizona, the University of New Hampshire, and the Oregon State University.

These partnerships will facilitate cooperation in research in the areas of integrated water resource management, scientific research, and capacity building in developing countries and countries in

## INSTITUTE FOR WATER RESOURCES

transition. Each of the universities with which IWR has entered into MOUs has unique program features that compliment the strengths and talent of the Institute.

The University of Arizona is home to the National Science Foundation's Science and Technology Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHARA), thus allowing the Institute and the University to focus on sustainable development and sound water management policies, particularly in arid and semi-arid climates.

IWR's partnering with the University of New Hampshire's Institute for the Study of Earth, Oceans, and Space, Water Systems Analysis Group which focuses on the understanding of water resources issues on a global scale and the application of technological improvements in water resource management, allows cooperation in the field of global water science, integrated water resources management, and interdisciplinary scientific research and capacity building, particularly in developing and emerging countries and post-disaster nations and regions.

IWR's partnering with the Oregon State University's Institute for Water and Watersheds, which focuses on integrated water resource management, sustainable development, ecological design, ecosystem restoration and environmental conflict resolution, allows for cooperation in numerous areas including, infrastructure development, adaptive management and adaptation to global warming, flood risk management, hydrologic analysis, risk analysis and systems modeling, environmental restoration, ecological design, consensus building, conflict resolution, alternative dispute resolution, and shared vision planning.

### *Professional Practice Organizations*

In FY07 the Institute entered into an MOU with the Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers. The MOU will further both organizations' goals of enhancing the use of effective water resources development and management policies, and will establish a long term cooperative effort in the field of integrated water resources development and management, engineering and scientific excellence, and capacity building both in the United States and internationally.

Memoranda of Understanding under development in FY07 and scheduled to be signed in FY08 include

partnerships with the Colorado State University, International School for Water Resources, Department of Civil and Environmental Engineering; the American Water Resources Association, and the Global Water Partnership, an international network of organizations involved in water resources management, established in 1996 by the World Bank, the United Nations Development Program, and the Swedish International Development Agency, and headquartered in Stockholm, Sweden.

**FEMA Silver Jackets:** Through the Silver Jackets program, managed by IWR, the USACE cooperates with FEMA and other Federal agencies to create Federal interagency teams which engage at the state level to develop and implement solutions to the state's natural hazard priorities. The primary goals of the Silver Jackets program are to leverage information and resources, improve public risk communication through a united effort and to create a mechanism to collaboratively solve issues and implement initiatives. To date, Silver Jackets has initiated pilot programs in Ohio and Indiana. These teams have succeeded not only in improving communication, but also in leveraging resources and programs between Federal agencies. For example, coordination through the Ohio team has enabled the small community of Marietta to acquire detailed mapping of its community at nominal cost by tapping into an ongoing regional watershed study. Through the same Silver Jackets team, an opportunity was discovered to integrate two different programs by utilizing the USACE Planning Assistance to States (PAS) program to provide resources and FEMA's Flood Mitigation Assistance (FMA) program to outline the requirements—resulting in the town gaining eligibility for FEMA flood mitigation funds. Silver Jackets remains engaged in the pilot stage. The program will continue team development on a state by state basis, ultimately establishing an interagency team in every state.

**Ocean Action Plan:** The USACE is participating in implementation of the President's Ocean Action Plan through integrated networks and partnerships of Federal, state, local, territorial and tribal authorities, the private sector, international partners and ocean communities. In 2007, IWR coordinated USACE participation in regional ocean governance initiatives, co-leading USACE support to the Gulf of Mexico Alliance with ERDC. The Corps is one of thirteen Federal agencies supporting the Governors' Action Plan for Healthy and Resilient Coasts. IWR staff participated in the development and review of material for the West Coast Governors' Ocean Health Agreement, and led USACE participation in the Subcommittee on Management of Ocean Resources

(SIMOR), engaging other USACE staff depending upon the issues raised to the Subcommittee. Through participation on the Joint Subcommittee on Ocean Science and Technology, IWR staff contributed to development of the Ocean Research Priorities Plan and its implementation strategy, and to projecting the need for new ocean research facilities.

**National Ocean Service Partnership:** The USACE and the National Oceanic and Atmospheric Administration's National Ocean Service (NOS) formed a collaborative partnership as an outgrowth of Ocean Action Plan initiatives, calendar year 2005 post-storm experiences, and recognition of mutually beneficial advances and synergies that could be affected through collaboration. The partnership is leveraging each agency's programs and talents through joint centers for coastal mapping, instrument testing, evaluation and training; improving data sharing capabilities; coordinating vertical datum systems and improving tidal measurement and information; and improving natural hazard risk communication that incorporates consideration of community resilience. In 2007, the partnership initiated leveraging the NOS coastal resiliency initiatives with the Corps Flood Risk Management Program.

**Interagency Committee on the Marine Transportation System:** The Corps continues coordinating with the Maritime Administration (MARAD), National Oceanic and Atmospheric Administration (NOAA), the Coast Guard and other Federal departments and agencies to support the Committee on the Marine Transportation System (CMTS), which was initiated in July 2005. The Corps' Director of Civil Works was selected as the initial chair of the Coordinating Board for the CMTS and the Assistant Secretary of the Army (Civil Works) was designated as the Department of Defense principal to the CMTS. The Coordinating Board chair rotated to the Administrator of NOAA in 2007 and will rotate to the Maritime Administrator in 2008. IWR provides logistics support and participates on Integrated Action Teams, including leading the team to develop an assessment of the Marine Transportation System. A contract was awarded to DOT's Volpe Center in 2007 to assist with the assessment.

**Regional Sediment Management:** The USACE has adopted the Regional Sediment Management (RSM) approach in carrying out many of its programs. Sediment management spans the USACE Navigation, Flood and Coastal Storm Damage Reduction, and Ecosystem Restoration missions and responsibilities. The RSM approach implements the watershed perspective and the principles of integrated water

resources management. The USACE applies this perspective and approach as a major stakeholder in many of the Nation's inland and coastal watersheds. In 2007, IWR staff initiated development of guidance on implementing the RSM approach, and facilitated initial support to a Regional Sediment Management Master plan to support the Gulf of Mexico Alliance.

**Coastal Engineering Research Board:** The CERB provides broad policy guidance and review of plans and requirements for the conduct of research and development in support of coastal engineering and the objectives of the Chief of Engineers. In 2007 IWR supported the Director of Civil Works in organizing the CERB visit to the Rijkswaterstaat in the Netherlands and to meet with other European Union countries regarding flood risk management and coastal protection, and reporting to the Chief of Engineers on their findings.

**Environmental Advisory Board:** IWR has led the USACE technical team supporting the Chief of Engineer's Environmental Advisory Board (EAB) since FY04. In FY07, the EAB completed a focus on an overarching theme of ecosystem restoration through water resources management. Out of those themes, but particularly the adaptive management theme, the EAB recommended to the Chief that the Corps form and lead a National Center for Ecosystem Restoration that involved collaboration with leading ecosystem restoration experts among universities and Federal and other agencies. In FY07 the EAB also concentrated on the continued need for Regulatory Program improvements and USACE regulatory jurisdiction issues associated with court cases, including the Rapanos and Carabell U.S. Supreme Court decisions. Two public meetings were held in FY2007: December 2006 in New Orleans and July 2007 in Washington, D.C.

**Inland Waterways Users Board:** IWR continued its technical and administrative support of the Inland Waterways Users Board (IWUB) in FY07, including the analysis of and reporting on the financial status and capability of the Inland Waterway Trust Fund, assistance with drafting of the IWUB Annual Report to Congress, evaluation of candidates nominated for Board membership and the administration of three IWUB meetings including No. 53 on November 17, 2006 in Pittsburgh, PA, No. 54 on March 14, 2007 in New Orleans, LA, and No. 55 on July 31, 2007 in Louisville, KY.

**Collaborative Planning:** The National Cooperative Modeling and Collaborative Planning and Management Demonstration programs work together

to develop, test and demonstrate collaborative modeling tools and concepts. Although IWR has a long history of applying collaborative modeling tools through its signature Shared Vision Planning (SVP) process, IWR is developing new conceptual and methodological foundations as well as documenting, vetting and publicizing advances and experiences.

FY07 activities included collaborative development of an integrated system model to facilitate a common understanding of linkages between reservoir operations, water quality, ecology and economics on Oregon's Willamette River; initiatives to support the USACE Section 404 regulatory role and state water planning processes on the James River in Virginia and on the front range of Colorado; initiation of work with the Nature Conservancy and the Sustainable Rivers Project on the Connecticut River, and development of an MOA with the California Department of Water Resources to provide assistance in using the Shared Vision Planning approach to engage stakeholders in advance of its 2009 water plan update.

A major event during FY07 was the convening of a September 2007 workshop on Computer Aided Dispute Resolution that brought nine federal agencies, nonprofit organizations, states, irrigation interests and the private sector together to share experiences on the use of collaborative computer modeling in solving water resources disputes. The proceedings of the workshop entitled "*Computer Aided Dispute Resolution: Proceedings from the CADRe Workshop, Albuquerque, New Mexico, September 13-14, 2007*" were published as [IWR Report 07-R-6](#).

**The Nature Conservancy Sustainable Rivers Project:** Begun in July 2002, the Sustainable Rivers Project (SRP) is a nationwide partnership between the USACE and The Nature Conservancy (TNC) to improve the integrity and life of rivers by changing the operations of USACE dams while maintaining or enhancing project benefits. The SRP is working towards this goal through a combination of partnered activities, including demonstration projects, training, software development and a staff exchange that assigned an engineer from HEC to the SRP through an Intergovernmental Personnel Act (IPA) agreement. February 2006 concluded the two-year exchange that was instrumental in promoting the partnership, providing direct support to project sites and initiating a joint software development project and joint training program. As of 2006, joint HEC/TNC training has been provided to 219 students, including representatives from seven different agencies, nearly 90% of USACE districts and all eight USACE divisions. Training agendas in 2006 included a series

of increasingly difficult topics and workshops in which course participants gained experience using six different software tools, including the new HEC Regime Prescription Tool (HEC-RPT). A product of the first software collaboration between the USACE and TNC, HEC-RPT is designed to help groups of scientists, engineers and water managers access hydrologic data and draft flow recommendations while they formulate different ways to manage rivers. HEC plans to explore other emerging partnership opportunities such as removal of small dams and river-floodplain reconnections.

**National Flood Risk Management Program:** In May of 2006 in an IWR-led effort, the USACE established the National Flood Risk Management Program for the purpose of integrating and synchronizing USACE flood risk management programs and activities both internally and with counterpart activities of FEMA and other Federal, state, regional and local agencies. Its vision is to lead collaborative, comprehensive and sustainable national flood risk management to protect the public and reduce flood damages to our country.

Since its inception, the National Flood Risk Management Program continues to build on coordination work that has already taken place between USACE and FEMA to ensure consistent communication to the public on FEMA's Flood Mapping Modernization (MapMod) Program and related flood risk issues and to leverage resources when working on similar activities or within the same geographic area. Some of the specific accomplishments that have taken place under the umbrella of the National Flood Risk Management Program include:

- Conducting an inventory of 13,000 miles of levees nationwide that are part of a USACE project or are inspected as part of a USACE program and developing a methodology for risk assessments of levee systems.
- Cooperating with FEMA to notify owners of levees that pose a threat to public safety based on past inspection results.
- Working with communities to identify options to remediate deficient levees or otherwise address the resulting public safety hazards.
- Providing ongoing support of both FEMA regions and levee owners at the USACE district level by providing data for the flood mapping studies and information to communities affected by efforts to update

flood maps under FEMA's MapMod program.

- Collaborating with FEMA to develop levee certification guidance for USACE District offices and FEMA regions.
- Developing a consistent inspection methodology and procedures to strengthen the USACE Inspection of Completed Works program under which USACE constructed levees are inspected.
- Continuing to coordinate quarterly meetings of USACE and FEMA leadership as part of the Interagency Flood Risk Management Committee to ensure that the two agencies maintain complementary policies and practices as the FEMA MapMod Program and USACE Flood Risk Management Program progress.
- Cooperating with FEMA and other Federal agencies through the Silver Jackets program to create interagency teams at the state level to develop and implement solutions to state natural hazard priorities.
- Supporting and participating in policy research and discussion forums to develop policy proposals for improving national flood risk management.
- Working with FEMA to jointly develop a risk communications plan to convey the purpose and specifics of ongoing activities to improve levee safety, including MapMod, a strengthened Inspection of Completed Works program and the levee inventory and risk assessment.

**IWR Visiting Scholar Programs:** Each Visiting Scholar program seeks to bring the foremost water resources experts from academia, private industry and other agencies and laboratories to residence at IWR or HEC for periods of six months to one year. Visiting scholars are expected to infuse new energy, perspectives and ideas to the IWR program, while the practical work environment at IWR and HEC provides a stimulating context for mutual exploration of potential advances in hydrologic engineering and planning analysis.

FY07 marked the sixth year for the Institute's Maass - White Visiting Scholar program, established in 2001 in recognition of the contributions of, and the Institute's intellectual alignment with, two of the founders of modern water resources analytical theory—Professors Arthur Maass of Harvard University, and Gilbert White of the University of Colorado. FY07 was the fourth year for two other designated visiting scholar positions, both established in 2004: the first a

partnership with the Universities Council on Water Resources (UCOWR) and the second, HEC's Leo R. Beard Visiting Scholar program, named after the founding director of HEC. FY06 marked the initiation of two new post-doctoral Fellows programs: the National Research Council (NRC) Research Associateship and the American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellows program. IWR and HEC underwent a rigorous certification process by independent reviewers in order to qualify for these two prestigious programs.

In FY07, Dr. Yacov Haimes, the Lawrence R. Quarles Professor of Engineering at the School of Engineering and Applied Science, University of Virginia was named as the Maass-White Fellow for 2007-2008. He will be engaged in risk analysis and risk informed decision making as part of the Actions for Change initiative.

Dr. Paul Kirshen of the Department of Civil and Environmental Engineering, Tufts University was named as the 2007 – 2009 Universities Council on Water Resources Fellowship Visiting Scholar. Dr. Kirshen's research will be in the field of Shared Vision Planning.

Dr. David W. Watkins, Jr. of the Department of Civil and Environmental Engineering at the Michigan Technological University was named as the Leo R. Beard Visiting Scholar at HEC. Dr. Watkins' research will focus on risk analysis and decision making under uncertainty.

Previous IWR visiting scholars have included:

- Maass-White Visiting Scholars: Dr. Daniel (Pete) Locks, Cornell University (2001-2002), Dr. Peter Rogers, Harvard University (2003-2004), Dr. Leonard Shabman, Resources for the Future, (2004-2006), and Dr. Gerald Galloway, University of Maryland (2006-2007).
- UCOWR Fellow: Dr. Bruce Hooper, Southern Illinois University (2004-2005).
- Leo R. Beard Visiting Scholar: Mr. Tony Thomas, founder and president of Mobile Boundary Hydraulics (2004), followed by Professor Jerry Steiner, Cornell University (2005).
- IWR NRC Research Associate: The first IWR NRC Fellow was Dr. Peter Rogers, Colorado State University (2006), while HEC selected Dr. Jason Giovanettone, Duke University (2006).

- AAAS Fellow: Dr. Alexey Voinov, University of Vermont, was the 2006 AAAS Fellow.

As part of Dr. Leonard Shabman's work at IWR, he along with Dr. Kurt Stephenson of the Virginia Polytechnic Institute, co-authored a paper entitled "*Environmental Valuation and Decision Making for Water Project Investment and Operations: Lessons from the FERC Experience*", published in March 2007 as IWR Report [2007-SVP-01](#).

## WATER RESOURCES METHODS AND MODELS

Two major IWR focus areas are (1) the evaluation of engineering, economic, social, institutional and environmental needs and, to address those needs, (2) the development, transfer and application of improved water resources analytical techniques, models and information systems. The goal is to produce state-of-the-art multi-purpose planning and hydrologic engineering methods and models to support investment decisions. This is accomplished by means of programs in research, training, planning analysis and technical assistance.

**Planning Models Improvement Program:** HQUSACE guidance EC 1105-2-407, "Planning Models Improvement Program: Model Certification", published in 2005 prescribed a corporate business process and policy for the development, certification, training and on-going support for planning models, with the certification process based on internal and external peer support and review and with the responsibility for establishing priorities and managing the certification process residing with the planning centers of expertise in coordination with the findings of the Strategic Engineering and Technology Initiative. In FY05 and FY06 IWR, with input from other Corps laboratories and the planning centers of expertise, developed protocols for model certification that include the processes and criteria to be used for certifying planning models. In FY 07, IWR initiated the certification process for two legacy models widely used by Corps planners, HEC-FDA and IWR Planning Suite. HEC-FDA, developed by the Hydrologic Engineering Center, is a frequency-based model for the estimation of inundation damages. IWR Planning Suite, developed by IWR NCR, is a model designed to assist Corps planners in the formulation and evaluation of ecosystem restoration projects using cost effectiveness and incremental cost techniques.

**Navigation Economic Technologies Research:** For more than a century the USACE has played a key role in maintaining a robust national economy by ensuring that farmers, manufacturers and businesses can easily transport goods up and down our Nation's rivers and out to sea via coastal ports. The Navigation Economic Technologies (NETS) Research Program supports the navigation mission by developing state-of-the-art, credible, independently verified economic models, tools and techniques to be used by USACE field planners in informing investment decision making at all levels of the agency. The knowledge and tools developed by the NETS research program are based on reviews of economic transportation and market theory, current best practices both within and outside of the USACE; data needs and availability; and peer recommendations.

In FY07, the centerpiece of NETS research was a suite of simulation models that included:

- The Global Grain forecasting model, modified in response to independent peer review comments.
- A repeat of the Mid-America Grain study, expanded to include non-grain waterway freight. Findings have been incorporated into a new annual "Survey Model" designed to respond to the criticisms made by the National Academy of Sciences to the structure and inputs of previous models. It has been evaluated and certificated by the Planning Center of Expertise for Inland Navigation.
- Model certification has begun on the HarborSym channel widening model. Prototypes for suite modules have been developed for the Navigation System Simulation (NaSS).
- Work has begun to incorporate NETS research findings into legacy models. In conjunction with the Oak Ridge National Laboratory, NETS is working with the Planning Center of Expertise for Inland Navigation to incorporate "shipper response" into the Ohio River Navigation Investment Model (ORNIM). In a related effort, NETS is working with the Planning Center of Expertise for Inland Navigation to conduct surveys to estimate the shape of the shipper response curves on the Ohio River, needed inputs for the modified version of ORNIM.

Looking forward to 2008, NETS is transitioning from research to practice. Several NETS tools will be certified by the USACE planning centers of expertise for use in current navigation studies. The HarborSym

channel widening model is being used in field study and the NETS team is extending its functionality to include channel deepening analysis. The NETS team continues to focus on outreach and communications via the NETS web site [www.nets.iwr.usace.army.mil](http://www.nets.iwr.usace.army.mil), the NETS Newsletter and participation at conferences around the world.

**Environmental Sustainability:** The Environmental Sustainability Project, managed by Dr. Richard Cole, includes activities that pertain to the implementation of the Environmental Operating Principles (EOP). Development of a framework for achieving environmental sustainability has been completed in draft and is in internal review for IWR publication. An assessment of the condition of freshwater biodiversity at Federal water resources projects has been reviewed and awaits final approval for publication. A new metric for measuring the benefits from ecosystem restoration projects has been developed and two technical reports are in final review for publication through ERDC. A third technical report, nearing completion, compares the new metric with other metrics now used for ecosystem restoration benefits estimation. In addition, a technical note and journal article on the metric are in progress. A study addressing the need for a more clearly stated ecosystem restoration objective for the Civil Works program is also underway.

**IWR Planning Suite:** In January 2007, the Institute deployed IWR Planning Suite, Version 1.05, a water resources investment decision-support tool that performs cost-effectiveness and incremental cost analyses associated with the formulation and evaluation of planning alternatives that produce non-monetary or a combination of monetary and non-monetary outputs. Originally designed to assist with the development and comparison of alternative plans for ecosystem restoration and watershed planning studies, the program can also be applied to a wide variety of integrated water resources planning and management problems by identifying which plans are the best financial investments, then displaying and comparing the effects of each plan on a range of decision variables. An IWR Planning Suite User's Guide was published to accompany the software. Training in the software was delivered to HQUSACE, OASA (CW) and Galveston District. Two new modules were developed and beta-tested that can be "plugged in" to IWR Planning Suite: the "Multi-Criteria Decision Analysis" module, and the "Annualizer" module (the latter annualizes cost and outputs based on user-provided implementation costs, discount rate, periodic operation and maintenance

costs, period of analysis, benefits streams, ecological response rates, etc). These modules will be deployed in 2008. Certification of IWR Planning Suite in compliance with the requirements of the Planning Model Improvement Program (PMIP) guidance is currently in progress.

**Transportation Systems:** The Transportation Systems Program supports HQUSACE and USACE district offices in accomplishing waterborne navigation project planning and evaluation responsibilities through the provision of (1) uniform and consistent maritime transportation data concerning costs of operation and replacement of foreign-flag and domestic commercial vessels and (2) comprehensive statistics on the composition and physical parameters of the world deep draft fleet and the domestic shallow-draft inland fleet. Macro-level world trade and cargo flow forecasts are also provided. Future work includes updating of vessel operating costs for both the deep and shallow-draft fleets with an increase in statistical samples and the number of ship types covered compared to previous years; world trade and commodity flow forecasts; distribution of updated materials and statistics from various maritime industry data subscriptions; update of general reporting statistics for the inland navigation system and updated subscriptions for barge, rail and truck alternative transportation modal models. Supporting efforts will include a first edition of the vessel operating cost primer, enhancements to the estimation of vessel bunkering costs, and an investigation of long-term normalized rates of return on hull assets as an improvement on vessel operating cost evaluation.

**Flood Damage Data:** The Flood Damage Data Collection program is intended to produce generic relationships for computing expected annual flood losses and tools for the collection and management of floodplain inventory data. In FY07, IWR completed the development of a geospatial floodplain inventory tool for residential, business and public property. IWR-GeoFIT had its first development in New Orleans District. IWR also completed a post-Katrina data collection effort for the New Orleans Metropolitan area. Work was initiated on cooperation with FEMA on benefit-cost analysis procedures. Damage functions were computed for vehicles and temporary relocation.

**System-Wide Water Resources Research:** The System-Wide Water Resources Research Program (SWWRP), a joint effort between IWR (led by HEC) and ERDC laboratories, is focused on expanding research activities to the "System Wide" perspective, reflecting a concerted effort by USACE to follow

concepts of sustainable development in a watershed context. Funding from SWWRP supports the development of multiple software packages that are widely used throughout the USACE and the professional engineering community, including HEC-HMS (Hydrologic Modeling System), HEC-RAS (River Analysis System), HEC-WAT (Watershed Analysis System), HEC-PRM (Prescriptive Reservoir Model), and HEC-EFM (Ecosystem Functions Model).

**Flood and Coastal Storm Damage Reduction Research (FCSDR):** Work funded through the FCSDR research and development program continued in FY07. The FCSDR program is a collaborative effort between IWR, ERDC and other entities. IWR is responsible for three programs within the FCSDR, H&H and Risk and Uncertainty both led by IWR - HEC in Davis, California, and Alternatives Analysis and Decision Making led by IWR - NCR, Alexandria, VA. FCSDR looks at methods to improve the analysis of flood damage and flood damage reduction techniques. It concentrates on the development of tools relating to modeling of flood damage and flood damage reduction techniques.

*IWR-HEC H&H and Risk and Uncertainty:* Funds from FCSDR support the development of HEC-WAT, HEC-ResSIM, HEC-DSSVue, HEC-SSP, HEC-FDA, HEC-FIA, HEC-GeoRAS, and HEC-GeoHMS. Additional funds are provided for research topics including, flood frequency analyses, extreme flood events, groundwater and surface water interaction and real-time forecasting. Several research related activities were initiated in FY07 including the investigation into the development of the next generation of HEC-FDA. This proposal stemmed from a February workshop for considering the future of flood risk management and development of a new version of a flood damage analysis tool. This new tool could include event sampling, the ability to do scenarios analysis, structure-by-structure analysis, cost analysis and agricultural damage analysis all in a systems context. This new tool will accommodate those recommendations that the Corps concurred with from the National Research Council 2000 report on the Corps implementation of risk analysis for flood damage reduction and it would also aid in implementing the Chief of Engineers Actions for Change initiative.

HEC also initiated modification of two Engineer Manuals, EM 1110-2-1413, "Engineering and Design – Hydrologic Analysis of Interior Areas" and EM 1110-2-1619, "Engineering and Design – Risk Based

Analysis for Flood Damage Reduction Studies" via the Guidance Update Management Program (GUMP) to include materials generated from research actions.

Additionally, HEC led the PDT for creating the new Engineer Circular (EC) addressing levee certification for the National Flood Insurance Program (NFIP). This EC will supplement and clarify existing policy, procedural and technical guidance; provide an overview of documentation requirements; outline an Independent Technical Review (ITR) process; and summarize authority and funding mechanisms.

Related to the EC, HEC has provided input to the FEMA AR Zone evaluations for the Natomas area near Sacramento, CA and for parishes in and around New Orleans. An AR Zone establishes a flood zone for flood control restoration areas on NFIP maps. It establishes minimum floodplain management restrictions and requires protection from the 3% flood event.

*IWR-NCR Alternatives Analysis and Decision Making (AA&DM):* The AA&DM in the old structure of ERDC, was a stand-alone program aimed at addressing decision making criteria, such as social impacts and economics. It evolved into a methods approach to address a growing number of concerns, including how to formulate and evaluate projects that do not have an economic basis or justification for being. Ecosystem restoration projects, the newest mission of the Corps of Engineers, falls into this category. In the AA&DM program there are several work units aimed at this objective.

The "Catalog of Management Measures" is an illustrated set of management measures which was created to better enable planners to consider a wider range of alternatives, including non-structural for ecosystem restoration projects. The catalog has been digitized and posted on the IWR website to promote greater access. The catalog is available at <http://www.iwr.usace.army.mil/inside/products/pub/MMDL/FLD/>.

The IWR Planning Suite was initially a tool for conducting cost effectiveness and incremental cost analysis on restoration projects. It guided planners and decision makers to the alternative plans that provided the greatest amount of output for the least cost. It has grown to include plan formulation assistance as well as accommodating a tradeoff analysis tool known as Multi-Criteria Decision Making or "MCDM." The next effort will attempt to link environmental values to the output discussions.

A new program was initiated in FY07, entitled Estimating Flood Damage to Roads caused by severe and prolonged flooding events. A model will be developed to link the expected damages to roads based on the severity of a given flood.

The Collaborative Planning work unit looked at a number of case studies across the Corps of Engineers, attempting to identify characteristics of successful collaboration among Corps offices and their local and regional partners. The second phase attempted to identify barriers to successful collaborative planning.

The project, titled “Theoretical Underpinnings of Other Social Effects,” was aimed at identify other social effects and how they can or should influence the decision making process. The funding for this effort was leveraged with ongoing IWR work and with ERDC R&D funding.

**Planning Methodologies:**

*National Economic Development Manuals:* IWR is in the process of updating the National Economic Development (NED) Manuals series, originally published between 1987 and 1991. The manuals are important basic references for economists and others involved in planning and analysis of Federal water resource projects. The manuals discuss the principles and concepts associated with NED benefits and provide detailed procedures to measure and calculate benefits. The updated manuals will be exclusively web-based to increase accessibility for field personnel; facilitate the maintenance and update of the manuals; improve the efficiency and effectiveness of providing up-to-date information to the field; and be responsive to a diverse audience. The web-based interactive manuals will provide links to relevant and timely guidance, data sources and case examples from USACE and non-USACE sources. The framework for the web-based manuals was completed in FY06. The Flood Damage Reduction manual is complete and available for use. Coastal Storm Damage and Deep Draft Navigation manuals are under development and are scheduled to be completed in FY08.

*Collaborative Handbook:* In FY07, IWR published IWR Report [07-R-2](#), “*Project Planning in Collaboration with Government Entities, Practical Approaches.*” This handbook is an introduction to the concept of collaboration as it applies to problem solving with Federal, state, and local governmental agencies. The handbook addresses the concept of the “National Interest Plan” which embraces a broader approach to problem solving by incorporating elements that address traditional Corps missions and

also elements that have national importance as expressed in the missions of other collaborating governmental agencies. This handbook explores ways that the Corps District planner can identify opportunities to collaborate throughout all phases of the planning process by incorporating into the formulation of plans all four evaluation accounts, including regional economic development and other social effects, as described in the Principles and Guidelines, 1983. The concept of net beneficial effects is discussed along with how trade-off analysis can be useful in identifying a National Interest Plan.

*Other Social Effects (OSE) Handbook:* EC 1105-2-409, “Planning in a Collaborative Environment” reemphasizes the importance of fully considering the Other Social Effects (OSE) and Regional Economic Development (RED) accounts in project development, evaluation and decision making. The OSE handbook provides field analysts with the framework and tools they need to perform an OSE analysis. The handbook includes a framework and principles for OSE analysis; tools for performing analyses and examples by business line. The importance of considering OSE throughout the planning process is emphasized by organizing the handbook along the six planning steps. The OSE handbook is the third item produced addressing the OSE account. Previous reports on this subject include an IWR white paper entitled “*Review of Guidance and Procedures for Regional Economic Development and Other Social Effects*”, dated August, 2006 and a research report entitled “*Theoretical Underpinnings of the OSE Account*” March 2007 [http://www.usace.army.mil/cw/cecw-cp/psa/f\\_and\\_e/theo\\_under\\_aug07.pdf](http://www.usace.army.mil/cw/cecw-cp/psa/f_and_e/theo_under_aug07.pdf)

*Regional Economic Development Handbook:* IWR is in the process of finalizing a handbook on Regional Economic Development (RED). The need to perform RED has grown in recent years given the renewed emphasis in EC 1105-2-409, “Planning in a Collaborative Environment” on the consideration of all four accounts (National Economic Development (NED), Environmental Quality (EQ), RED, and Other Social Effects (OSE)). There is limited experience and expertise in RED analysis throughout the Corps. This handbook will provide valuable tools and education in the use of RED analysis. It includes discussion of RED for each of the Corps' business lines. Consideration of RED impacts in the planning process will result in more comprehensive accounting of project contributions and effects.

*Multi-Objective Planning Manual:* In response to ER1105-2-100 (“Planning Guidance Notebook”),

EC1105-2-404 (“Planning Civil Works Projects Under the Environmental Operating Principles”) and EC1105-2-409 (“Planning in a Collaborative Environment”), the Corps has been increasingly encouraged to formulate projects having multiple purposes. Since few Districts have performed true multi-purpose planning, IWR prepared this manual to educate planners how to perform this more complex type of decision making. A draft version of this manual is currently under review.

*Four Accounts White Paper:* A draft white paper entitled “Issues and Applications in Formulation and Evaluation Considering the Four Principles and Guidelines Accounts” was written and circulated for review within IWR and the USACE Planning Community of Practice. The paper highlights the challenges and potential approaches for considering the four accounts in project planning while also discussing the advantages and disadvantages of various formulation strategies. Additional discussion points such as measurement tools and portfolio management in the four account context are also included in the white paper.

*Quality of Life White Paper:* The Corps uses four accounts, National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED) and Other Social Effects (OSE) to evaluate potential projects. In the last 20 years, the NED account has been the only required account. EC 1105-2-409, “Planning in a Collaborative Environment” emphasizes the need to consider all four accounts and the values which they represent. Quality of Life is a possible construct to display and evaluate multi-dimensional values in the evaluation process. A white paper has been completed which explores Quality of Life indices and their “fitness for purpose” as an additional metric for Corps’ project evaluations.

**NexGen Software:** HEC continued to enhance many software products and introduce new products. Released in FY07 were:

- HEC-HMS, Hydrologic Modeling Systems, version 3.1 includes several new features and improvements to version 3.0. The companion GIS utility package (HEC-GeoHMS) continues to be updated and is compatible with ArcGIS 9.x versions.
- HEC-RAS, River Analysis System, beta version 4.0. Additional features include water quality temperature modeling, sediment transport, gate rules and modeling of the Katrina event. The companion GIS utility

package (HEC-GeoRAS) continues to be updated and is compatible with ArcGIS 9.x versions.

- HEC-ResSim, Reservoir Simulation Model, version 3.0. New features with this version include new and improved outlet capabilities, operation options, and data management and analysis features.
- HEC-RPT, Regime Prescription Tool, Version 1.1. Enhancements and bug fixes were made to version 1.0 of the RPT. The RPT assists decision makers as they define competing flow recommendations. The tool allows visualization of large amounts of flow data and helps define consolidated flow recommendations. The ultimate goal is to combine it with the HEC-ResSim software to enhance planning and real-time operational decision making.

More information about these software packages and other HEC software can be found on HEC’s website, <http://www.hec.usace.army.mil>.

FY07 also saw improvements to HEC-FDA, the major flood damage and risk analysis software package and HEC-FIA, Flood Impact Analysis. FY08 will see release of HEC-EFM (Ecosystem Function Model), and a beta version of the new HEC-WAT, Watershed Analysis Tool (which will include HMS, RAS, SSP, ResSim and FIA software) and HEC-SSP, the new Statistical Software Package that will replace the multiple DOS based statistical applications.

In FY07, HEC initiated the generation of Economy Act based MOA’s with Sonoma County (CA) Water Agency and South Florida Water Management District.

Both of these agreements will be for specific additions to HEC software that provides capabilities for these agencies. ERDC - Coastal and Hydraulics Laboratory and HEC have drafted a proposal to integrate HEC-ResSim and CEQUAL-W2 for modeling of water-quality constraints on the operations of one or more reservoirs. HEC and the USGS, in association with IHE-Delft, are working together to integrate HEC-RAS and the USGS MODFLOW software. This association will continue in 2008.

#### INTEGRATED CIVIL WORKS SYSTEMS

Performance based budgeting, performance measurement and program assessment are increasingly important. In response, IWR created a corporate data

warehouse of financial and inventory data, lock characteristics, navigation project profiles, OMBIL outputs, waterborne commerce, lock performance, hydropower, recreation, water supply, National Recreation Reservation System and environmental stewardship data. Data from these sources is linked, integrated and combined to generate performance measures, which are then used in the budget process.

**OMBIL:** The Operations and Maintenance Business Information Link (OMBIL) Plus, a centralized performance management information system, encompasses the Civil Works business lines of navigation, hydropower, recreation, environmental compliance, environmental stewardship, water supply and regulatory. The OMBIL decision support system distributes data to support a variety of Corps management initiatives, performance-based budgeting and Federal and public data requirements.

In support of the Civil Works business performance measurements, the Navigation Data Center (NDC) extracts expenditure data from the USACE financial management system (CEFMS) and combines it with business output data to generate efficiency and effectiveness measurements, including submissions to the Office of Management and Budget. NDC data supports and is a source of information and data used in the Corps "*Value to the Nation*" publications and the Federal government's recreation access site: <http://www.recreation.gov>. Navigation data is also integrated with CorpsMap, providing an intranet web-based GIS interface. All of NDC's publicly available navigation and water transportation data is available at [www.ndc.iwr.usace.army.mil](http://www.ndc.iwr.usace.army.mil) or on its annual CD-ROM.

**ORM 2.0:** IWR has completed development and deployment of OMBIL Regulatory Module Version 2 (ORM 2.0). ORM 2.0 is a web-based geospatial database application for tracking and managing all aspects of the Corps regulatory process. ORM 2.0 was developed using a unique combination of Corps in-house expertise and contract support. ORM 2.0 supports a consistent national business process for the regulatory program resulting in consistent tracking and reporting of program performance. ORM 2.0 integrates with USACE district enterprise geographic information systems and other federal and state agencies. ORM 2.0 provides the foundation for watershed based decision making in the Corps regulatory program.

**CWMS:** The Corps Water Management System (CWMS) is a comprehensive data acquisition and hydrologic modeling system for short-term decision

support of water control operations in real time. CWMS supports field-level decision making within the Corps water management mission. It embodies data acquisition, validation, transformation and management; forecasting, simulation and decision support analysis; and information dissemination. The first version of CWMS was released in 2002. CWMS has been updated at roughly annual intervals at the thirty plus Corps offices with water control management responsibilities. Improvements to the system continue via a field-prioritized betterments program. Version 1.5 was released in FY07. Version 2.0, which is scheduled to be released in the summer of 2008, will include major revisions to the basic database structures, allowing water control users more direct access to their data and enabling them to make more effective use of the features inherent in the commercial Oracle database at the center of CWMS. A public release of the modeling component of CWMS, HEC-RTS (Real Time Simulation) is scheduled for release at the end of calendar year 2008. Information about CWMS and other HEC software is available on the HEC web site [www.hec.usace.army.mil/cwms/](http://www.hec.usace.army.mil/cwms/).

## WATER RESOURCES TRAINING AND EDUCATION

The Institute for Water Resources, including HEC, has always been a leader in innovation within the Corps of Engineers family. IWR has been responsible for developing techniques and approaches for economic analysis, risk analysis, planning methodologies, public involvement, conflict dispute resolution, water conservation and other topic areas. HEC, through the development of hydraulic, hydrologic and planning analysis methods and models, has built a reputation recognized throughout the world in the fields of hydraulics and hydrology. Over the course of their existence, both IWR and HEC have made considerable effort to build appropriate training vehicles for the instruction in the use of the various tools they have developed. As a result, each office routinely offers eight to twelve courses per year through the Proponent-Sponsored Engineer Corps Training (PROSPECT) program and/or through other training venues, such as workshops and seminars.

**PROSPECT Program and Specialty Workshops:** IWR continued the USACE Proponent-Sponsored Engineer Corps Training (PROSPECT) program in 2007 by presenting 27 week-long courses (fifteen led by the IWR-NCR and twelve by HEC). The PROSPECT courses covered a wide range of Civil Works water resources topics: Public Involvement

## INSTITUTE FOR WATER RESOURCES

and Teaming in Planning; Public Involvement–Communications; Regulatory for New Regulators; Regulatory – Procedural Issues; Regulatory – Decision-Making; Regulatory Executive Seminar; Hydrologic and Hydraulic Engineering; Water Resources Planning; Ecosystem Restoration; Flood Risk Management; Collaborative Planning; and Plan Formulation. The specialty workshops often used pieces of the PROSPECT training courses but generally, the specialty workshops were built specifically for the requesting office and often included topics outside of the normal PROSPECT training. IWR is committed to technology transfer and the dissemination of its tools, processes and procedures. The organization and staff are committed to provide assistance in using our tools, through workshops, telephone consultation or whatever may be necessary.

IWR-NCR assumed responsibility for several of the Planners Core Curriculum (PCC) courses in FY07. IWR staff worked with field instructors to present three of the courses as they were originally created. These included Collaborative Planning, Environmental Considerations in Planning, and Plan Formulation. In addition IWR presented the following classes: Planning for Ecosystem Restoration, a course designed to teach the planning process in the approach to ecosystem restoration projects, with considerable focus on the planning process and decision making. Other IWR courses included Risk Analysis - Water Resources Planning; Conflict Management and Dispute Resolution taught primarily by contractors; Public Involvement - Communications, again taught by contractors; Regulatory I - New Regulators; Regulatory IIA - Procedural Issues; and Regulatory IIB - Decision Making, all of which were taught by Corps regulators from across the country. In addition to the IWR sponsored courses, IWR staff members are active members in a number of other PROSPECT courses, teaching special topics such as Cost Effectiveness and Incremental Cost Analysis (IWR-PLAN), Economics, Forecasting, Risk Analysis, Environmental Benefits, etc.

In addition to the aforementioned training, IWR is also responsible for managing the Corps Planning Associates (PA) program, which is designed to be comprehensive training to build future leaders in the planning community of practice. The program is a series of interrupted one, two and three week sessions interspersed with trips back to the home district to keep up with the workload. Students are committed to keeping their work at home moving while participating in the program.

During FY07 IWR-NCR held a one week workshop on Risk Analysis as part of Actions for Change risk education and training.

IWR is now embarking on a new venture, that of a Center for International Training in Water Resources Management. IWR has been nominated by the U. S. Government, through the Department of the Army, to become a UNESCO Water Related Center. Should this nomination be approved, IWR will become the UNESCO Center for Integrated Water Resources Planning and Management. IWR-NCR and HEC will be heavily involved in promoting and staffing this program. In anticipation of this coming to pass, IWR-NCR has constructed a new classroom in the Casey Building to accommodate future classes of national and international students.

HEC conducted ecosystem oriented training courses such as “Water and the Watershed” and “Hydrologic Analysis for Ecosystem Restoration” as well as a full menu of hydrologic engineering and planning analysis topics, including courses on HEC-ResSim, Hydrologic Engineering Applications for GIS, Statistical Methods in Hydrology, H&H for Dam Safety Studies, CWMS Modeling for Real-time Water Management, Sediment Transport Analysis with HEC-RAS, Risk Analysis for Flood Damage Reduction Projects, and advanced courses in unsteady flow with HES-RAS and HEC-HMS.

A one week specialized training course was provided to Exponent Inc., an American company partnering with two Italian firms on executing water resources projects for the Iraq Foundation NGO and the Iraqi Ministry of Water Resources. The training was tailored to present advanced features of HEC-HMS, HEC-ResSim, and HEC-RAS computer programs.

HEC also hosted an international workshop organized by U.S. Bureau of Reclamation on the status of models for simulation of dam breach mechanics.

As part of the Combined Joint Task Force-Horn of Africa host nation agreement, HEC presented specialized training in water resource engineering. The training emphasized stream hydraulics and groundwater hydrology and took place in Kenya (4 days) and Ethiopia (6 days).

HEC also presented a basic HEC-RAS workshop to the state of Missouri Department of Transportation. HEC presented a workshop on Hydrology and Hydraulics for Dam Safety Studies to Honolulu District, state employees and consultants. A one-day

short course on HEC-EFM was conducted for planning and engineering staff of Fort Worth District.

The first of three HEC specialized workshops was conducted in Jordan as part of a capacity development program for the Iraqi Ministry of Water Resources engineering staff. The capacity development program is focusing on the use of HEC-DSSVue and HEC-ResSim computer programs in a water resources planning study that the Ministry is undertaking.

The training course "Unsteady Flow Analysis Using HEC-RAS" was presented to Maricopa County in Phoenix, AZ and to the National Weather Service in Davis, CA. This course was intended to provide participants with the knowledge to effectively utilize the HEC-RAS software to analyze hydraulic conditions that require one-dimensional unsteady flow modeling.

At the USGS Idaho Water Science Center in Boise, HEC trained six engineers from the Iraqi Ministry of Water Resources in the use of HEC-DSS for data management, and provided consulting regarding their telemetry system and database designs.

HEC provided training in Kabul, Afghanistan that consisted of Hydrology (Introduction to HMS), Hydraulics (Introduction to RAS), and Reservoir operations (Introduction to ResSim) and included an explanation of the model HEC developed for the Helmand River in Afghanistan.

HEC assisted with a one-day training seminar at the 10th International River Symposium held in Brisbane, Australia. As part of this seminar, HEC-RPT was presented and used in a workshop by 44 students from 12 different countries.

**Planning Excellence Program:** Throughout FY07, IWR provided managerial and technical support to the Civil Works Planning Community of Practice (CoP) in the execution of the Planning Excellence Program.

This included the management of the Planning Associates (PA) program and conduct of the three-week "Washington DC Experience" module for the FY07 class. The goal of the PA program is to develop planning leaders who can manage complex planning studies that lead to quality decision documents and who will provide water resources technical and professional leadership in the future.

IWR, in coordination with HQUSACE, is responsible for the implementation of the program, including

setting up the criteria for selection of candidates, development and delivery of training sessions and financial management and logistical support.

IWR also provided support to the local delivery of selected Planning Core Curriculum courses by the Corps MSCs. These seven courses provide the basic, full-performance training needed by entry level planners across the USACE as the means to accelerate their progress to the journeyman stage of their career development. These courses include: Civil Works Orientation, Planning Principles and Procedures, Environmental Considerations, Economic Analysis, H&H Considerations, Plan Formulation and Public Involvement and Team Planning.

### **Advanced Degree Program in Integrated Water Resources Management**

The USACE strives to provide optimum training and development opportunities in order to assure maximum efficiency of members of its workforce in the performance of their official duties. The Advanced Degree Program in Integrated Water Resources Planning and Management has been developed to ensure that the USACE maintains its standing as a leader in water resources planning and management. The program was designed to promote interdepartmental degrees at the graduate level that were specifically geared towards water resources practitioners.

IWR has worked closely with the Universities Council on Water Resources (UCOWR) to develop a program which addresses the many challenges that the water resources planning and management community faces.

Courses are offered at five universities: The University of Arizona; The University of Florida; Harvard University; Johns Hopkins University; and Southern Illinois University.

Since the program's initiation in 2002, 36 employees have enrolled in the program. To date, 14 students have graduated from the program, two in 2005, five in 2006, and 7 in 2007.

More than 50% of the students, either currently enrolled in the program or who have completed the program, have taken their entire program via distance learning. In particular, the University of Florida has been at the forefront of developing distance learning opportunities for participants in the program.

### **REIMBURSABLE TECHNICAL ASSISTANCE**

Reimbursable project work was undertaken for USACE field offices as well as: HQUSACE Civil Works Planning, Engineering, Operations-Regulatory and Office of Homeland Security; the HQUSACE Office of Interagency and International Activities; the Corps Engineering Research and Development Center (ERDC) - Coastal and Hydraulics and Environmental Labs; the Federal Emergency Management Agency; the International Joint Commission (IJC); the U.S. Agency for International Development (USAID); the National Weather Service; the U.S. Geological Survey; the Natural Resources Conservation Service; other Federal agencies; and approved Thomas Amendment Agreement technical support to the Lower Colorado River Authority, Texas and the Tampa Bay Water Authority, Florida. Other projects for IWR's USACE clients included navigation systems economic evaluation, technical advice and guidance on plan formulation, incremental cost and cost effectiveness analysis, risk analysis, watershed and reservoir system modeling, water quality, river hydraulics, wetlands hydrology, water control management, regional statistical analysis, flood damage analysis, flood warning response systems, GIS applications in hydrology and hydraulics, groundwater modeling and water supply in support of interagency investigations.

IWR worked on a variety of projects including: post-Katrina IPET support, hydraulic modeling, and risk analysis; Ft. Worth Flood Warning modeling; development of an integrated forecasting model for the National Weather Service for joint operations on Feather and Yuba Rivers, CA; Tooele and Ft. Huachuca groundwater modeling; development of HEC-RPT software for use on the Savannah River as part of the Sustainable Rivers Project; providing additional features in RAS software for the Tampa Bay Water Authority; helping the Lower Colorado River Authority implement CWMS for their water management needs; contributing to the revision of Bulletin 17B; writing levee certification guidance; working with the Corps Screening Portfolio Risk Assessment teams evaluating the safety of our Nation's dams; and numerous miscellaneous consultations.

IWR staff provided reimbursable technical assistance to the Louisiana Coastal Protection and Restoration (LACPR) study team that is investigating long-term risk reduction strategies for southern Louisiana. An IWR senior economist and senior social scientist are integrated into the team and have assisted the development and execution of the risk-informed planning strategy. IWR has the lead for planning non-

structural measures, including the formulation and evaluation of alternatives as well as development of the implementation strategy for these measures within the comprehensive plans.

Internationally, IWR conducted work in Iraq and Afghanistan. USAID funded both of the Middle East efforts. In Iraq, IWR/HEC worked with the Iraq Ministry of Water Resources on the Strategy for Water and Land Resources in Iraq project. This effort extended the Iraq water management tool for the Tigris-Euphrates River basins, which included the reconstruction of historical data and completion of the HEC-ResSim model. HEC also collaborated with the U.S. Geological Survey to begin the renovation of Iraq's stream gage network. In Afghanistan, HEC developed an operations manual and performing a water budget analysis for the Kajakai Reservoir in the Helmand Valley of Afghanistan. Both the Iraq and Afghanistan work included training of our international partners.

### **CIVIL WORKS PROGRAM AND PROJECT INFORMATION**

IWR maintains, develops and provides a full range of international, national and USACE project and program data and information for decision support for the Corps, other federal government agencies, the private sector, and the public on key Civil Works activities. National water resources database concept development, design, implementation, operation and maintenance activities are provided through a combination of in-house and private sector systems analysts, statisticians, engineers and scientists who work in close coordination with USACE users. Also IWR acquires external data from other federal agencies and private sector sources, to be used by the Corps for integrated analysis and benchmarking. These data are used within the Corps for program management, budget development and justification, OMB Program Assessment Rating Tool, numerical models and real time management at the project. Major initiatives within the past year have been the development and creation of performance measurer for the Corps business lines to reflect the efficiency and effectiveness of the programs and analysis.

**Navigation Data Center:** The Navigation Data Center (NDC), located at the National Capital Region headquarters of IWR at Ft. Belvoir, VA., is the central manager of navigation, hydropower, recreation, environmental stewardship, water supply and regulatory program data for the Nation. Information provided by NDC directly supports the USACE annual

Civil Works performance-based budgeting program. NDC is responsible for national level executive oversight and management responsibilities, including the development of Federal and USACE Engineer Regulations (ER's), the Code of Federal Regulations, and their enforcement. OMB, acting on legislative mandates, recognizes USACE, acting through NDC, as the Federal collection agent for waterborne commerce, vessel activities and waterway infrastructure data and statistics.

NDC accomplishes its objectives of supplying timely and accurate data through the following activities: assessing user requirements; developing, designing, operating and maintaining systems to collect, process and store data and information; developing and disseminating data, information and statistical products; training providers and users of project and program information and data; and maintaining knowledge of the latest developments in the area of technical and content interoperability.

As a national statistical center, NDC coordinates extensively with other Federal statistical agencies and data users, representing the U.S. government before other nations in the development of data and information standards and protocols and in the negotiation of data exchanges. NDC actively participates in corporate information integration and coordination within the USACE and plays a lead role in developing, coordinating and disseminating water resources information for performance measurement and management purposes. It leads the development of strategic communication with both internal communities of practice and external water resources interests, stakeholders and communities. Key information and data provided in FY07 include:

**Waterborne Commerce and Vessel Statistics:** Under the authority of the River & Harbors Act of 1922, as amended and codified in 33 U.S.C. 555, the USACE is to collect, process, distribute and archive waterborne commercial vessel trip and cargo data. These data and statistics are used to analyze the feasibility of new water transportation projects and activities; to set priorities for new investment and rehabilitation; and for management of the operation and maintenance of existing projects.

Under Federal law, vessel-operating companies must report domestic waterborne commercial vessel movements directly to the USACE. The types of vessels include: dry cargo ships and tankers, barges (loaded and empty), towboats (with or without barges in tow), tugboats, crew boats and supply boats to offshore locations and newly constructed vessels from

shipyards to the point of delivery. Vessels remaining idle during the monthly reporting period are also reported. U.S. foreign waterborne import, export and in-transit cargo and vessel movement data is provided to the Corps by the U.S. Customs and Border Protection, the U.S. Bureau of the Census and the Port Import Export Reporting Service.

Movement data acquired by the NDC Waterborne Commerce Statistics Center is primarily for the use of the USACE and other governmental agencies. Since 2004, data have been incorporated into the USACE budget preparation process, providing the navigation project outputs and performance measures used to rank and justify operation and maintenance funding requests. Summary statistics, which do not disclose movements of individual companies, are also released to private companies and to the general public.

### **International Trade Data System (ITDS)**

During FY07, the Institute's Navigation Data Center continued its involvement in the development of the International Trade Data System (ITDS). ITDS is a multi-agency technology initiative administrated by the e-Customs Partnership (eCP), a public-private partnership led by Customs and Border Protection (CBP). Both the public and private sectors have steering committees and numerous sub-committees.

The objective of this initiative is to provide a secure, single source interface for the collection, input, analysis, and proper dissemination of international trade and transportation statistics. The Corps is one of over 20 government agencies working with the trade and transportation community to implement this initiative.

In FY07, the USACE signed a Memorandum of Agreement (MOA) to receive trade data from the Customs and Border Protection and the Census Bureau; completed a Concept of Operations for interfacing with CBP systems through ITDS, and harmonized the Corps data elements with those of 40 other government agencies participating in ITDS and mapped data definitions to the World Customs Organization Standard Data Set.

### **Coastal and River Information Services (CRIS)**

CRIS is a public-private initiative lead by the USACE, the U.S. Coast Guard, NOAA, the IRS, and private sector representatives to establish a single method for electronic reporting and disseminating information on U.S. coastal and inland waterways. CRIS members serve on several Integrated Action

Teams on the Committee for the Marine Transportation System (CMTS).

The goal of this effort is to provide a framework by which domestic transportation and related information on U.S. coastal and inland waterways can be transmitted and received using one message, one set of codes, and at one time for Federal reporting purposes. The program will serve a wide range of safety, operational, security, environmental, and statistical needs.

In FY 07, the agencies involved with establishing the CRIS system created a permanent working group comprised of representatives from the USACE, the Coast Guard, the IRS, and private sector to focus on addressing the need for standardized coding schemes for vessels, commodities, and locations; migrated two legacy dock inventory systems into one modern system (Master Docks Plus); established a partnership with the University of Toledo to streamline the process for obtaining information on navigation points of interest; and completed a proof of concept for demonstrating the capture of data at lock in New Orleans using an automated information system.

**Navigation Infrastructure Inventory:** Navigation Infrastructure Inventory information supports the USACE Federal Central Collection Agency responsibility for documenting the Nation's commercial port infrastructure served by Federal channels. Data for over 9,280 individual docks is available in published reports and on the Internet in summary form and as data files. Data are updated and posted as each port area is re-surveyed and verified as current.

The initiative begun in FY06 to survey the ports of Southern Louisiana (west of New Orleans and east of Lake Charles, LA) is partially completed. This includes a portion of the Gulf Intracoastal Waterway, Vermillion River including Intracoastal City, Port Fouchon, Port Iberia, West St. Mary, the Barataria Waterway, Houma and Morgan City. Surveys were completed for approximately 450 ports, leaving about another 300 ports to be surveyed.

Navigation Infrastructure Inventory information is used to identify industries served by the Federal channels and is part of the budgetary process of prioritizing projects. The U.S. Coast Guard is another primary user of the information in the execution of its homeland security mission. Another new initiative begun in FY06 was the establishment of a central database of all USACE navigation projects

(Navigation Project Profile) with the critical attributes required for the budget prioritization process. The information uses OMBIL to more fully describe all aspects of a project.

**Lock Performance and Characteristics:** The lock performance database provides the USACE access to individual lock near-real-time information as well as summary and performance statistics. The data are entered into the database by the lock operator as the vessel is locking through the chamber. A national data warehouse provides all USACE users direct access to current and historical data and summaries. The data is used by the USACE and other agencies, such as the U.S. Coast Guard and the Tennessee Valley Authority (TVA), in the execution of their missions and in the formulation of the USACE budget. A successful pilot project at several New Orleans lock sites demonstrated the ease of using the Coast Guard required vessel Automated Information System (AIS) signal to increase lock operator situational awareness by visualizing on a map the location and identification information of all vessels in the vicinity of the lock. This enables the operator to better plan the locking procedure. The capture of the AIS signal also will allow selected timing events to be automatically entered into the database.

Lock characteristics data and the physical descriptions of all the USACE owned and operated locks are updated as information changes. Lock characteristics and performance data and information are available on the public web site, <http://www.ndc.iwr.usace.army.mil>. The lock databases are feeder systems to the OMBIL decision support system.

**Dredging Statistics:** This web-based ORACLE database is successful in supplying information on all USACE performed and contracted dredging to the USACE, industry and private users. Data entry and report generation is accomplished via the USACE intranet and enables all USACE members to access the central system information. Data is used to generate the Small Business Report for dredging contracts. Biweekly reports are posted on the public web site to inform the industry and public of Corps and contracted dredging activities. Standard reports and summaries plus custom queries and reports are quickly generated to meet Corps and user needs. Use of the information has resulted in improved bidding competition and more efficient utilization of dredging equipment. The dredging database is a feeder system to the OMBIL decision support system.

**Recreation:** Recreation data for the Corps' 4300 recreation areas are collected and maintained within the OMBIL database. Recreation inventory (recreation areas, visitor centers, facilities, and amenities), outputs (e.g. visitors, visitor hours) and activities (e.g. citations and interpretive contacts) are combined with revenues and expenditures to produce performance measures that assist the Corps in making management decisions for the Recreation program. These recreation data are furnished to public websites such as Value to the Nation, [www.vtn.iwr.usace.army.mil](http://www.vtn.iwr.usace.army.mil), CorpsLakes, [www.CorpsLakes.us](http://www.CorpsLakes.us), and the federal recreation website, [www.recreation.gov](http://www.recreation.gov). In FY07, OMBIL has focused on data quality control and generation of a complete inventory of recreation projects. OMBIL also supported the budget process by continuing to supply data to the RECreation Budget Evaluation SysTem (Rec-BEST) and the new RecStatus, project information and benchmarking report, both developed by ERDC.

IWR, in collaboration with ERDC, has provided additional technical support to Corps Recreation Business line activities. The activities that were accomplished in FY07 include: continuing to support the Performance Based Budget Development for Recreation Business line; Regional Economic Impact Analysis of Recreation; GIS Application and the implementation of Google Earth application for all Corps Recreation projects; and other miscellaneous technical support to Corps Natural Resources management activities.

IWR worked with Headquarters on a new engineering regulation concerning survey guidance. IWR redesigned and enhanced the guidance provided on the website for conducting recreation surveys of the public. IWR also provided technical support for individual survey submissions and updated the website with the revised compendium of OMB-approved surveys.

**Hydropower:** Hydropower data from the 75 Corps power plants is collected and maintained within the OMBIL database. For those power plants in the Northwestern Division that have automated control systems (Generic Data Acquisition and Control System or "GDACS"), electronic upload of generation data is in place. Data such as power generation statistics, unit availability and revenue generated, enable the Corps hydropower program to determine its performance, make budgeting decisions and furnish OMB with program performance information. In FY07, all five hydropower

performance measures for the FY09 budget process were supplied by OMBIL hydropower data.

**Water Supply:** IWR serves as the HQUSACE national program manager for the Water Supply business program. In this capacity, the yearly budget and the five-year development plan for that portion of the USACE Water Supply budget is developed in coordination with the MSCs and the strategic plan as presented in the Program Assessment Rating Tool. It is necessary to develop yearly budget guidance to the MSCs, collect their data, prioritize it in conjunction with the seven other business lines and eight program areas, present the data to the senior leaders of Civil Works, the Assistant Secretary of the Army (Civil Works) and a panel of water supply examiners from OMB. The yearly program must then be modified and adjusted as necessary based on OMB comments and directives.

IWR is responsible for the development and maintenance of the USACE database of Water Supply projects. This database was originally developed in 1996, updated in 2004 and again in 2005. In 2006 an effort was undertaken to develop a Water Supply module in OMBIL and this effort is still underway. This process, once loaded into the Water Supply module of OMBIL, will enable a continual update of the OMBIL data, similar to other business lines. There was no 2006 database due to the effort required to load OMBIL. For the 2007 database we are using a combination of the new OMBIL data, where loaded and the old 2005 data from those districts which have not completed the loading process. The 2007 database shows there are 134 Corps multipurpose projects which contain storage space for municipal and industrial water supply. These projects are located in 26 states, Puerto Rico and in 24 of the 38 Corps districts. In these projects the Corps has 316 repayment agreements representing some 9.38 million acre-feet of storage space and an investment cost of \$1.28 billion. The storage space is capable of providing some 5 billion gallons of water per day for use by municipalities and industries which have signed repayment agreements. All monies collected by the repayment agreements are deposited into the Treasury of the United States.

**Optimization Tools for Navigation (OTN):** The optimization tools for navigation program supports multiple initiatives concerning methods and analysis to minimize costs or enhance efficiencies for asset management of the Corps' waterborne navigation operation and maintenance (O&M) program. Related initiatives include support for development of CADET (in partnership with ERDC as technical scoping and

review lead and NAVSEA-Carderock as prime technical developer), development of a centralized system for benefit evaluation of the O&M program for deep-draft harbors (NNOMPEAS), research and investigation to better quantify critical inputs for navigation analysis conducted with assistance of the U.S. Naval Academy, and support to the USACE Marine Design Center (USACE-MDC).

## INTERNATIONAL WATER RESOURCES

The Institute formed the International Water Resources program in 2006 as a means to better coordinate the various international initiatives that are under its purview. These initiatives fall into three categories: global water resources strategies, international partnerships, and technical and advisory support. These initiatives and the major projects that fall under them are:

**Lake Ontario and St. Lawrence River Study:** The international Lake Ontario-St. Lawrence River Study was conducted and completed by IWR for the International Joint Commission (IJC). A [final report](#) was submitted to the Commission, recommending three alternative plans for their consideration. The purpose of the study was to assess and evaluate the Commission's *Order of Approval*, developed in the late 1950's and used to regulate outflows from Lake Ontario through the St. Lawrence River. During the course of the 50 years of operation, there were many changes in the operating plans, changes of flow regime, ecology and other new uses, such as recreational boating. This five-year, \$20 million study developed numerous options and recommended three candidate plans after evaluating the impacts of changing water levels on shoreline communities, domestic and industrial water users, commercial navigation, hydropower production, the environment and recreational boating and tourism, along with forecasted effects of climate change. The study was conducted in full partnership with Canada, utilizing a transparent planning process pioneered by IWR and known as Shared Vision Planning (SVP). The open citizen and public participation process was guided by a volunteer Public Interest Advisory Group appointed by the IJC, while the study team of approximately 150 scientists and engineers was composed of a broad assembly of multi-disciplinary technical experts on nine technical working groups and led by co-directors from Canada and the U.S. The U.S. co-director was Dr. Eugene Stakhiv and U.S. co-Manager was Dr. Anthony Eberhardt of IWR.

IWR staff provided input throughout 2007 on refining the candidate plans based on agency review and consultation. It is expected that the IJC will present its selected option at public hearings and information meetings around Lake Ontario during the spring of 2008.

**International Upper Great Lakes Study:** As the Lake Ontario - St. Lawrence River Study ended, in May 2006 USACE/IWR signed a MOA with the International Joint Commission for initiation of a new 5-year, \$15 million study focusing on the Lake Superior Regulation Plan and the potential erosion problems associated with the St. Clair River channel (thought to cause the long-term lowering of Lake Michigan/Lake Huron levels). Drs. Eugene Stakhiv and Anthony Eberhardt were appointed as U.S. co-Director and co-Manager and IWR was again selected to lead the U.S. contributions to the study, emphasizing the success of the Shared Vision Planning approach in the just concluded Lake Ontario - St. Lawrence River study.

IWR plans to initiate activities related to investigating whether the current Lake Superior outflow management procedures could be improved, considering evolving Upper Great Lakes interests and climate change, and investigating St. Clair River flow characteristics, determining how the natural regime of the river has been changed by human activities. Further on-going changes may affect the water level relationship between Lakes Michigan, Huron and Erie. Activities which have taken place since this study was officially initiated in March 2007 include:

- Bathymetric/topographic data collection at selected sites throughout the St. Clair River.
- Workshop of invited hydroclimatic experts to discuss the likelihood on the declining upper Great Lakes being due to short-term variability or the beginnings of long-term climate change.
- Establishment of two task teams: Lake Huron Outflow/St. Clair River Conveyance Task Team to investigate through hydrologic, hydraulic and sediment transport modeling the factors that may be responsible for declining levels and the Lake Superior Regulation Task Team to investigate improved outflow management plans. Dr. Eberhardt is U.S. co-lead of the Lake Superior Task Team.
- Wide-agency and academia support for assigning members and leads to the ten technical work groups investigating particular study aspects. Several members and leads are

from Corps offices, ERDC, HEC and CRREL.

- Cooperative investigations between IWR and USGS and NOAA, and universities around the Great Lakes.
- Development and implementation of a communications plan.
- Assistance by IWR staff with the IJC in the development of procedures to perform independent peer review throughout the Study.

**World Water Council:** The World Water Council (WWC) is an international association of over 400 private and public organizations involved in water-related activities. Formed in 1996, the WWC includes the principal United Nations water agencies and international banks as its founder organizations. The main activity of WWC is hosting the World Water Forum, which is held once every three years. As the main international event on water, it seeks to enable multi-stakeholder participation and dialogue to influence water policy making on a global scale, thus assuring better living standards for people all over the world and a more responsible social behavior towards water issues in line with the pursuit of sustainable development. The 4th World Water Forum (WWF) was held in Mexico City in March 2006 with the theme "Local Actions for a Global Challenge". The technical program included the previous Chief of Engineers, LTG Carl Strock, as a keynote speaker. Several USACE representatives participated in that event.

In 2006, Mr. Steven Stockton, Director for Civil Works, was elected as a WWC governor and an alternate on the Board of Governors. Dr. Jerome Delli Priscoli of IWR serves as the alternate and is a representative on the Executive Committee. Ongoing WWC activities involve close liaison with the U.S. Department of State on the dialogues and content of WWF, particularly the Bureau of Near Eastern Affairs and the Bureau of Oceans and International Environmental and Scientific Affairs, to assist U.S. interests. During this period, Dr. Delli Priscoli continued to serve as Editor-in-Chief for *Water Policy*, which is a peer-reviewed international journal that is published six times per year.

**Fifth World Water Forum:** IWR provides technical leadership for the Corps and the U.S. Government's participation in the Fifth World Water Forum (WWF5) scheduled for 15 - 22 March 2009 in Istanbul, Turkey. The forum is an international event sponsored by the World Water Council. An IWR

employee is stationed in Istanbul, Turkey, to represent the US Government in the various deliberations and activities leading to the Forum. The theme of the Forum is "Bridging Divides for Water" to include not only geographical barriers but conceptual barriers among water cultures, rich and poor and developed and developing regions. The objectives of the World Water Forum are to increase understanding and improved information exchange among water users, decision makers, experts and practitioners at all levels.

These activities and subsequent efforts by IWR will contribute to the success of WWF5, strengthen and expand interagency and international partnerships, and help to achieve U.S. government goals for international water resources.

**Sixth Inter-American Dialogue on Water Management:** In preparation for the Fifth World Water Forum, IWR participated in the Sixth Inter-American Dialogue on Water Management held in Guatemala City, Guatemala, August 12-17, 2007. The Dialogue was sponsored by the Government of Guatemala and the Inter-American Water Resources Network in collaboration with the Organization of American States, UNESCO, the Inter-American Development Bank, and other private and non-profit organizations. One of the main objectives of the Dialogue was to produce input for the World Water Forum on behalf of the Southern Hemisphere.

IWR Director, Mr. Robert Pietrowsky, represented USACE at the conference, and delivered a keynote presentation and spoke on several panels, while IWR specialists facilitated numerous sessions on integrated water resources management, water alliances, governance and empowerment, national water plans and collaboration in water management. Plans for collaborating on a variety of capacity building and technical assistance initiatives with Chile under the terms of the partnership agreement between IWR and the UNESCO Category II Water Center for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC) were also discussed, along with cooperation with Brazil, and UNESCO-IHP during the Dialogue.

**UNESCO Partnerships:** A large number of UNESCO-related activities are sanctioned by the U.S. Government; in particular those related to the U.S. National UNESCO Commission and the U.S. International Hydrological Programme (IHP) Committee. In 2006, the IWR Director was selected to

## INSTITUTE FOR WATER RESOURCES

be one of six permanent Federal agency members of the newly established U.S. National IHP Committee.

In support of these activities, USACE has five MOUs with IHP and its UNESCO water centers: an umbrella agreement with IHP; a second MOU with UNESCO-IHE (Institute for Water Education, Delft, the Netherlands); and newer IWR agreements with ICHARM (International Center for Hazard and Risk Management) in Tsukuba, Japan (signed July 3, 2006); CAZALAC (Centre for Arid and Semi-arid Zones of Latin America and the Caribbean) in Chile (signed July 3, 2006); and CATHALAC (Water Center for Humid Tropics of Latin America and the Caribbean) in Panama (signed August 22, 2007). IWR manages these agreements and is also engaged through an MOU with the Global Water Partnership (GWP) and its efforts to implement integrated water resources management in developing countries. GWP is an international NGO with the financial support of the European Union and the World Bank. IWR has been working with select members of the GWP Technical Working groups to develop protocols for IWRM.

During 2007, the key activity was the preparation of a proposal for establishing the “International Center for Integrated Water Resources Management (ICIWaRM)” to the US National UNESCO Commission. The proposal was submitted in December, and underwent a national-level competition. ICIWaRM was selected as the US nominee for consideration by UNESCO as a Category II Center.

Two IWR NRC Fellows were selected to work on UNESCO-CAZALAC joint projects, which included plans for a training workshop on applying “L-moments” for a ‘Drought Atlas for South America.

IWR Director, Mr. Robert Pietrowsky, was formally appointed to the UNESCO-IHE Board, and attended the 50<sup>th</sup> Anniversary of the UNESCO-IHE in Delft, the Netherlands as a sitting member of the Board in June, 2007.

Dr. Eugene Stakhiv was elected chairman of the ICHARM Advisory Board, and began working with ICHARM to prepare for the ‘International Flood Defense Conference’, to be held in Toronto in May, 2008.

FY07 saw the continued training of an additional 11 in-residence Master’s and Doctoral Degree water specialists from the Iraqi Ministries of Water Resources, Agriculture and Public Works at the

UNESCO-IHE, Delft, the Netherlands, funded by USACE, through IWR.

Additional activities in 2007 included the following: IWR led the development of the Draft Strategic Plan for the U.S. National IHP Committee, which was adopted at its spring semi-annual meeting in April, 2007, and confirmed by the full U.S. Commission for UNESCO at its annual meeting in May. Dr. Stakhiv was invited to a GWP Regional meeting in Ukraine in March, 2007, as part of the MOU, to participate in a workshop on IWRM. As part of the MOU establishing the ICIWaRM, Dr. Stakhiv participated as invited speaker to conferences at the University of Arizona in October, 2007 and the Stockholm Water Conference in August, 2007 on a Global Water Partnership panel. Mr. Pietrowsky and Dr. Stakhiv attended the fall U.S. IHP Committee meeting in November 2007 to help finalize the call for proposals and evaluation criteria for determining the U.S. nominee for a Category II Center. Dr. Stakhiv represented ICIWaRM as an invited expert on climate change and water resources at a World Water Council workshop in Delft in December, 2007. Preparatory activities for an “International Conference on Floodplain Ecohydrology” were initiated, and Dr. Stakhiv was named as Conference co-chair.

Activities in support of the UNESCO Hydrology, Environment, Life and Policy (HELP) program were initiated jointly with the National Science Foundation’s Science and Technology Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHARA) at the University of Arizona.

In 2008 the USACE and IWR will take a more active role in international water-related research and policy issues through the ICIWaRM Center. UNESCO, IHP and GWP serve to develop and implement innovative ideas, tools and policies related to improved water management. Active involvement in these forums enhances the stature of the USACE and works as a two-way technology transfer mechanism. IWR’s involvement in these forums has substantially elevated the USACE international profile. A key new activity is engagement in and support to the IHP World Water Assessment Program in preparation for the World Water Forum in Istanbul, Turkey in March, 2009. IWR/ICIWaRM expects to engage a number of visiting scholars and NRC Fellows to assist in the extensive effort, as well as the International Navigation Association (PIANC). The International Flood Defense Conference and the Floodplain Ecohydrology Conference will take place in May, 2008.

**Dutch Rijkswaterstaat:** The Corps signed an MOA with the Dutch Rijkswaterstaat (RWS) in May 2004 as a means to more effectively exchange information and resources. The RWS has a mission quite similar to that of the USACE and much collaboration has transpired regarding flood and coastal management and protection measures and policies in the aftermath of Hurricanes Katrina and Rita.

The second and third of a series of technical workshops was conducted respectively in The Hague and New Orleans. Representatives from ERDC, HQUSACE, USACE Districts, the State of Louisiana and IWR continued to exchange views on a broad range of topics, including risk-informed decision making, advanced dredging technologies, soft soil improvement, non-structural floodplain management and design-build contracting. A senior-level Dutch delegation re-visited Washington, DC to discuss the MOA with Corps Headquarters representatives and ASA-CW. The delegation then visited sites within the Sacramento District and participated in a round-table discussion on the regional levee system. The Netherlands Water Partnership conducted an independent assessment of coastal Louisiana under the auspices of the MOA. That study, which was performed by a large number of Dutch experts, will be included as an annex to the LACPR report. A historical study was also commissioned during this reporting period, which should be available for publication in early 2009.

Workshops between the two organizations on matters related to floodplain and coastal zone management will continue in FY08. Plans are underway to devise a more strategic approach to the agreement to allow for broader USACE engagement beyond the coastal Louisiana focus. Another high-level delegation plans to visit the US in spring 2008 to assess progress in Louisiana and be briefed on the Everglades Restoration work, and a USG delegation will visit the Netherlands in April 2008 to discuss a Corps/Florida State/Netherlands agreement, which will build on the activities of the MOA. The newly-formed Dutch institute Deltares is also in consultation with the OASA(CW) and USACE to possibly partner on a complementary portfolio of research. The Dutch have developed unique approaches to a broad range of relevant topic areas, such as levee and sea wall integrity, operations and maintenance, soft soil technology, dredging techniques and risk assessment methodologies. The joint activities flowing from the MOA continued to gain momentum during this reporting period.

**Japanese Ministry of Land, Infrastructure, Transport:** USACE participates in an ongoing technical exchange program with the River Bureau of the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLITT). The program is governed by an Implementing Arrangement (IA) under the "Agreement between the Government of the United States of America and the Government of Japan on Cooperation in Research and Development in Science and Technology," signed in Toronto on June 20, 1988, as amended and extended. The IA was signed by the USACE Chief of Engineers at the Third World Water Forum in Kyoto, Japan, in March 2003. It names the Chief of Hydrology and Hydraulics at the St. Louis District as the Technical Program Officer, responsible for the technical exchange on the USACE side and names the Director of Civil Works as the oversight authority for the exchange. The national project management oversight authority has been delegated to IWR and within the Institute to HEC. To date, the exchange has consisted of annual technical exchange meetings alternating between sites in the U.S. and Japan and some facilitation of requests for information between USACE and the River Bureau.

In February 2008, a U.S. delegation including two representatives from HEC traveled to Tokyo, Japan as part of a Water Resources Technical Exchange meeting between USACE and MLIT. A key part of the visit was the signing of a 5-year extension of the USACE-MLIT partnering agreement, which was scheduled to expire in March 2008.

The Office of the Secretary of Defense approved the extension to the agreement on 20 February 2008 and Mr. Lloyd Pike, Chief of the HQUSACE Pacific Ocean Division Regional Integration Team led the U.S. delegation on behalf of Mr. Woodley. IWR was represented in the delegation by HEC Director Christopher Dunn and HEC Water Management Systems Division Chief Tom Evans, who is the Corps team leader for the execution of the USACE-MLIT partnership. Corps MSC and district representatives included Jim Barton, Chief of the Columbia Basin Water Management Division, Northwestern Division; Stuart Townsley, Chief of the Water Management Section, Sacramento District; Mary Roth, USACE Representative to the Missouri River Recovery Implementation Committee, Northwestern Division; and Kyle Keer, Hydraulic Engineer in the Water Management Section, Sacramento District.

The Corps also recently hosted Makoto Kutsukake, a deputy director of the Water Administration Division in MLITT's River Bureau, on a 5-month residency technical exchange with HQUSACE and IWR. Mr.

Kutsukake was awarded a grant by the government of Japan to study abroad and elected to visit USACE, FEMA, and others to focus on "New measures to prevent flood disasters, based on the appropriate mutual relation among construction of levees and dams, flood insurance and land use restriction in flood-prone area - Taking Hurricane Katrina into consideration." While in the U.S., Mr. Kutsukake also visited HEC in California and gave a presentation on Japanese River Administration and Flood Management to the Intergovernmental Flood Risk Management Committee, comprised of the leadership from FEMA, USACE, the Association of State Floodplain Managers, and the National Association of Flood and Stormwater Management Agencies.

**International Technical Reimbursable Projects:** FY07 continued to yield major growth in technical assistance projects undertaken in cooperation with USACE, Federal and non-Federal organizations. This collaboration included work in Iraq and Afghanistan for USAID, its contractors and local government agencies.

In Iraq, the Hydrologic Engineering Center (HEC) entered into an MOA with the U.S. Embassy Baghdad to perform training to the Iraqi Ministry of Water Resources on the application of the Tigris-Euphrates Water Management Systems Model (WMSM). Under previous contracts with the U.S. Agency for International Development (USAID), HEC developed and delivered the WMSM and documentation to the U.S. Embassy and the Iraqi Ministry of Water Resources. The WMSM is a sophisticated model that needed further explanation and training if the Iraqi Ministry is going to use it for future planning purposes. Thus, HEC has entered into an MOA to provide additional training that is to take place in FY 2008 in Amman, Jordan.

Earlier efforts on the part of HEC included partnering with USAID and the Iraq Ministry of Water Resources to assist them with the development of a Water Resources Strategy Plan for Iraq. In Phase I of this effort, HEC compiled and reconstructed the water resources database and developed a water management model for the Ministry using the HEC-ResSim software. Partnering with the USGS, HEC also assisted with the renovation of the Iraq stream gage program.

The Institute worked in collaboration with the USACE Gulf Region District and the Iraqi Ministry of Water Resources to facilitate U.S. Government sponsorship of Iraqi professors attending the Master's Degree

program in residence at UNESCO-IHE in Delft, Netherlands.

HEC performed similar services for the Afghanistan Ministry of Energy and Water. A water budget was created for the Helmand Valley watershed using the HEC-ResSim software. With the assistance of the Portland District office of the Corps, HEC is developing a draft operations manual for the Kajakai Reservoir on the Helmand. To complete the operations manual, HEC worked with the USACE Cold Regions Research and Environmental Laboratory (CRREL) to complete the snowmelt modeling. HEC prepared and delivered a final report entitled "Water Balance and Regulation Alternative Analysis for Kajakai Reservoir using HEC-ResSim" to the AED. The report is now available at the HEC website as [PR-63](#). It is the culmination of two years worth of modeling.

In early FY07, engineers from HEC and the Wilmington District of the Corps went to Kabul, Afghanistan to provide three weeks of hydrologic, hydraulic and reservoir modeling training to engineers from the Afghan Ministry of Energy and Water, professors from Kabul University and Kabul Polytechnic. HEC-HMS, HEC-RAS and HEC-ResSim software was used during the training.

In FY07, as part of the Combined Joint Task Force-Horn of Africa host nation agreement, HEC engineers presented specialized training in water resource engineering in Nairobi, Kenya and Addis Ababa, Ethiopia. The course agenda consisted of hydrologic, hydraulic, and ground water modeling training and utilized HEC-HMS and HEC-RAS software. In Kenya, the training was held at the Regional Center for Mapping of Resources and Development. The majority of the students attending the training in Kenya were government officials, many of whom worked for the Ministry of Water and Irrigation. In Ethiopia, the training was conducted at the University of Addis Ababa. The majority of attendees of the training class were graduate students of the University. Other attendees included government officials from various government offices.

In August 2007, HEC performed a levee evaluation and performance analysis for a levee along the Anseung River protecting Camp Humphreys in Korea. In addition to river flooding, interior drainage issues were addressed. Nonstructural measures such as flood warning and flood preparedness were recommended as well.

HEC continues to participate in the Civil Military Emergency Response Preparedness Program. In this program, GIS and hydraulic engineers from the USACE work with former Eastern Block nations to perform exercises to develop plans to prepare for emergencies such as dam failures. An interesting aspect of the work is that the watersheds often cross international boundaries.

**Civil Military Emergency Preparedness (CMEP) and Emergency Management International (EMI) Programs:** CMEP supports capacity development and improved theater security cooperation by developing and encouraging civilian and military cooperation, as well as multi-national force compatibility to plan for humanitarian response to all forms of disaster (natural and technological) and improved capability to manage the consequences of Weapons of Mass Destruction (WMD). Approval for the concept plan associated with this program was obtained on 6 Jun 06. CMEP provides a capability that has been specifically requested by combatant commanders that supports national military and strategic objectives and which USACE has been directed to perform in the HQDA G-35 Strategy, Plans and Policy Army Action Plan for Stability Operations, Army Campaign Plan Decision Point 105 approved 2 August 2007.

CMEP supports Office of the Secretary of Defense (OSD) Policy (P) priorities to shape the security environment and to support Stability, Security, Transition, and Reconstruction Activities and Operations consistent with DOD Directive 3000.05 in Phases 0-2 and 4, 5 and 0 (peace, pre- and post-war), while also reducing long-term foreign reliance on U.S. Army assets to respond to emergencies. CMEP activities occur in the Warsaw Initiative (formerly part of the Soviet Union) countries while EMI activities can occur anywhere else.

Program objectives are accomplished through a range of seminars, workshops, and Table Top Exercises (TTXs). These can be performed in bilateral and multilateral formats depending upon the needs of the country and the region as determined by country officers, Combatant Commands (COCOMs), and OSD (P). Specific activities focus on the following areas: how disaster response is managed by federal agencies in the United States; an introduction to emergency response in the private and public sectors (at all levels) in democracies; national GIS seminars and workshops; evaluations of disaster response capability; regional GIS seminars; how to develop national response plans; how to build national emergency operations centers; national and regional

response to all (or any specific hazard); and special topics as determined by the host nation.

Specific activities in 2007 included: Black Sea Initiative TTX in Georgia (participating nations: Georgia, Romania, Bulgaria, Moldova, Turkey, and Ukraine); initial concept meeting for the next Black Sea Initiative TTX to be hosted by Moldova; support of the South Eastern Europe (SEE) CMEP Council Technical (June) and Annual meetings (hosted by Bosnia-Herzegovina); Balkans regional GIS workshop hosted by Macedonia; GIS workshop for Uzbek Ministry of Emergency Services; disaster response capability evaluation in Kazakhstan; U.S. federal disaster response for Uzbekistan and Kazakhstan; participation in the U.S. – Russian Joint Emergency Management Committee; Consultative Staff Talks for Uzbekistan with CENTCOM; meetings with EUCOM country desk officers; host of EUCOM Warsaw Initiative Funds meeting; and visit to EMERCOM of Russia's southwestern region to observe flood fighting.

#### **INTERNATIONAL ASSOCIATION (PIANC)**

#### **NAVIGATION**

The International Navigation Association (PIANC) is an organization consisting of approximately 40 member nations. From its headquarters in Brussels, Belgium, it acts as a clearinghouse of technology and experiences relating to ocean and inland navigation improvements which are exchanged among engineers, scientists, port operators and marina and vessel owners, to name a few. Its objective is to advance, on a worldwide basis, the sustainable development of all kinds of navigation through the exchange of technical information on port and waterway development. The objective of the Association is met by holding International Congresses and by publishing technical bulletins and special reports. Special reports are published describing the results of the work of international research teams, or working groups, composed of those national members interested in the particular subject under study. The organization also serves as an excellent source of identifying individual and corporate expertise throughout the world on PIANC-related subjects.

The United States, a member of PIANC since 1902, provides an annual appropriation for the support and maintenance of the organization. This includes an annual subvention to PIANC and payment of a portion of the travel expenses of officially appointed U.S. delegates (Commissioners) to meetings of the Annual General Assembly and Congresses. Total annual

## INSTITUTE FOR WATER RESOURCES

appropriation for the U.S. Section PIANC is currently \$45,000, including the annual subvention of approximately \$15,000. The U.S. Section is administered by law under the auspices of the USACE. It is located at the IWR NCR Humphreys Engineer Center facility. The U.S. Section is composed of dues-paying individual and corporate members. U.S. Section membership on September 30, 2007 totaled 236, consisting of 202 individual members and 34 corporate members.

**United States National Commission:** The United States National Commission constitutes the governing body of the U.S. Section. In 2007 the ex-officio officers of the U.S. National Commission were: Chairman, John P. Woodley, Jr., Assistant Secretary of the Army (Civil Works); President, MG Don T. Riley, Director of Civil Works; and Secretary, Ms. Anne Cann, an employee of IWR.

In 2007, U. S. National Commissioners were: Mr. Shiv Batra, Vice President representing the Western Region and President, INCA Engineers, Inc.; Dr. Thomas H. Wakeman, III, Vice President representing the Eastern Region and Program Manager, Regional Port Programs, Port Authority of New York and New Jersey; Dr. Robert Engler, Vice President representing the Central Region and Senior Environmental Scientist, Moffatt-Nichol; Ms. Doris J. Bautch, Director, Great Lakes Region, Maritime Administration, U.S. Department of Transportation; Mr. John Headland, Senior Vice President and Regional Manager, Moffatt and Nichol; Mr. Joseph H. Pyne, President, Kirby Corporation; Dr. Robert H. Randall, Texas A&M University, and Mr. Dave Sanford, Director of Navigation Policy and Legislation, American Association of Port Authorities.

**PIANC Activities:** In March of 2007, MG Don T. Riley made a presentation on how partnership works for solving complex challenges at the Coasts, Oceans, Ports, and Rivers Institute - American Society of Civil Engineer's "Ports 2007 Conference" in San Diego, CA. The U.S. Section co-sponsored the conference with COPRI/ASCE. The U.S. Section has a permanent MOU with COPRI/ASCE, as well as a specific MOU in place to partner with COPRI/ASCE on the Ports 2007 Conference.

In April of 2007, the PIANC International Annual General Assembly was held in Cochin, India. The U.S. Delegation composed of Mr. John P. Woodley, Jr., MG Don T. Riley, Mr. Bruce Lambert, Mr. Shiv Batra, Mr. John Headland, Mr. Tom Wakeman, Mr. Thorndike Saville, Dr. Robert Engler and Harry Cook.

Another major initiative for the U.S. Section was the "Smart Rivers 2007 Conference", held in September 2007 in Louisville, KY. This was the first time the U.S. Section has organized a major industry conference and the outcome was a resounding success with more than 200 navigation professionals in attendance. The theme of the conference was "Positioning Inland Navigation as a Powerful Link in the Global Supply Chain." MG Riley and Sean T. Connaughton, U.S. Maritime Administrator, were the keynote speakers. Conference participants were able to tour the on-going lock replacement project at McAlpine Locks, Jeffboat Shipyard and the Falls of the Ohio. In conjunction with the conference, the U.S. Section also organized a technical workshop entitled "The Future of the U.S. Inland Navigation System – Meeting the Challenges."

As part of the U.S. Section's Latin American outreach activities, Mr. David Grier, USACE IWR, attended the fifth meeting of the Organization of American States, Inter-American Committee on Ports (OAS-CIP), held in Brazil in September, 2007. He also attended the Executive Committee Meeting in Peru in December, 2007. The U.S. Section PIANC signed an MOU with OAS-CIP in 2005.

The U.S. Section produces a quarterly newsletter, *PIANC Bulletin*, containing U.S. Section information and industry news. Editor is Edmond J. Russo, Jr., U.S. Army Corps of Engineers, ERDC.

**PIANC Executive Committee:** PIANC International's Executive Committee ensures the executive management of the Association and monitors the decisions and directives of the AGA and the Council. The U.S. Rep. on the ExCom is Mr. Shiv Batra, President, INCA Engineers, Inc. (Vice President of Western Hemisphere).

**Representatives to Committees and Commissions:** The principal business of PIANC is the sponsorship of technical working groups. The U.S. Section is represented by Principal and Co-Principal Members of the Commissions managing technical working group activities. The U.S. representatives were:

**Environmental Commission** — Mr. Edmond J. Russo, Jr., U.S. Army Corps of Engineers, ERDC.

**Inland Navigation Commission** — Mr. John Clarkson, U.S. Army Corps of Engineers, Huntington District; Mr. William Ronald Coles, Hanson Professional Services.

**Maritime Navigation Commission** — Mr. E. Dan Allen, Moffatt & Nichol.

**Recreational Navigation Commission** — Mr. Bob Nathan, Moffatt & Nichol; Mr. Jack C. Cox, HDR.

**International Cooperation Commission** – Mr. John Headland, Moffatt & Nichol; Bengt Bostrom, Consultant.

**Promotion Commission** – Dr. Thomas Wakeman, Stevens Institute of Technology.

**New Technical Working Groups:** In 2007, two new Working Groups were formed. The groups are listed below along with the name of the Principal U.S. Representative.

InCom Permanent WG on River Information Services (RIS) – Mr. Richard Lockwood and Mr. Jeff Fritz  
EnviCom Expert Group 3 (Climate Change and Navigation) – Dr. James Corbett

**Working Group Reports Published in 2007:**

There were no working group reports published in 2007.

**2007 Active Working Groups and the names of the U. S. Representatives:**

**InCom 27** (Guidelines for Environmental Impacts of Vessels) — Dr. Thomas Keevin

**InCom 28** (Developments in Automation and the Remote Control of River Works) — Ashok Kumar

**InCom 29** (Innovations in Navigation Lock Design) — Dale Miller and YP Michael Tarpey

**InCom 30** (Inventory of Inspection and Repair Techniques of Navigation Structures) — Robert Willis, Ron Heffron, and YP Chad Linna

**InCom 31** (Organization and Management of River Ports) — Deidre McGowan and Jim McCarville

**InCom 32** (Performance Indicators for Inland Waterways Transport) — William Harder

**InCom Permanent RIS WG** (River Information Services) – Richard Lockwood and Jeff Fritz

**MarCom 39** (Monitoring of Breakwaters) — James D. Prehn

**MarCom 42** (Implementation Manual for Life Cycle Management of Port Structures) — Valery M. Buslov

**MarCom 43** (Minimizing Harbor Siltation) — John Headland

**MarCom 46** (Maritime Freight Transshipment) - Doris Bautch

**MarCom 47** (Criteria for the Selection of Breakwater Types and their Optimum Damage Risk Level) — Dr. Jeffrey A. Melby

**MarCom 48** (Guidelines for Port Constructions, Related to Bowthrusters) — Marcel Hermans and Gary Greene

**MarCom 49** (Horizontal and Vertical Dimensions of Fairways) — Michael J. Briggs

**MarCom 50** (General Principles for the Design of Maritime Structures) — Bill Papis

**MarCom 51** (Water Injection Dredging) — Timothy L. Welp

**MarCom 52** (Criteria for the (Un-)Loading of Container Ships) — Dan Allen

**MarCom 53** (Design and Construction of Maritime Structures in Tsunami Prone Areas) — John R. Headland and Michael J. Briggs

**MarCom 54** (Use of Hydro/Meteo Information to Optimize Safe Port Access) — Robert Weeks and Majid Yavary

**MarCom 55** (Safety Aspects of Berthing Operations of Oil and Gas Tankers) — Larry Cunningham, Sarah Rollings, and YP Larry Wise

**MarCom 56** (Application of Geotextiles in Waterfront Protection) — Doug Gaffney

**MarCom 57** (Stability of Pattern Placed Revetment Elements) — Margaret Boshek

**RecCom 15** (The use of Alternative Materials in Marina Construction) — Terrence Browne

**RecCom 16** (Protecting Water Quality in Marinas) — Jack Cox

**RecCom 17** (Guidelines for Marina Design) — Dennis Kissman

**EnviCom 11** (Management, Dredged Material Re-use and Transformation of Existing Confined Disposal Facilities) — Dr. Michael Palermo and Dr. Paul Schroeder

**EnviCom 12** (Sustainable Waterways within the Context of Navigation and Flood Management) — Dr. Craig Fischenich and John Clarkson

**EnviCom Expert Group 2** (Environmental Benefits of Waterborne Transport) — Keith Hofseth (chair), Alfred Cofrancesco, & Nick Pansic

**EnviCom 13** (Environmental Benefits of Waterborne Transport) — Dr. Douglas Clarke and Thomas Wang

**EnviCom 14** (Dredged Material Beneficial Use Options and Constraints) — Richard Gorini and Jack Word

**EnviCom 15** (Environmental Aspects of Dredging and Port Construction Around Coral Reefs and Cold Water Hard Bottom Benthic Communities) — Dr. Mark Sudol and Russ Kaiser

**EnviCom 16** (Management of Ports and Waterways for Fish and Shellfish Habitat) — Dr. Douglas Clarke

**EnviCom Expert Group 3** (Climate Change and Navigation) — Dr. James Corbett

**CoCom 2** (Best Practice for Shoreline Stabilization methods) — No U.S. Representative

**IWR and U.S. Section PIANC Coordination with the Organization of American States, Inter-American Committee on Ports:** IWR, through the U.S. Section-PIANC, participated in the fifth General Assembly meeting of the OAS Inter-American

## INSTITUTE FOR WATER RESOURCES

Committee on Ports (“OAS-CIP”) during FY 2007 held in September in Salvador, Brazil. The CIP serves as a permanent Inter-American forum for port related issues among the 34 member states of the OAS. Its purposes include serving as the principal advisory body of the OAS on all topics concerning development in the port sector. It proposes and promotes hemispheric cooperation policies, improvements and port sector cooperation agreements, and the collection and dissemination of data and information. The U.S. delegation to the OAS-CIP is led by the Maritime Administration, USDOT, under guidance of the State Department, and with participation by EPA, the Coast Guard and the Corps through PIANC. The CIP currently has four active Technical Advisory Groups (TAGs). These include Port Operations, Port Security (chaired by the U.S.), Navigation Safety, and, the newest one, Environmental Protection. The U.S. became a new member of the TAG on Environmental Protection at the Salvador conference and is now a member of all four TAGs. The U.S. Section-PIANC is engaging the CIP to explore opportunities to share expertise on port management, development of common standards, improving dredging technology, addressing ballast water issues, and potentially assist plans for inland waterway development in the Amazon and Parana-Paraguay basins. IWR will participate in two CIP meetings in FY 2008, including the Executive Board in Lima, Peru, in December 2007 and the Third Hemispheric Conference on Port Security in Punta Cana, Dominican Republic, in April 2008.

# INTERNATIONAL BOUNDARY WATERS BOARDS

In order to carry out United States obligations under international agreements, the Office of the Chief of Engineers and several Corps divisions and districts with jurisdiction over areas bordering Canada have representation on numerous international boards, committees, and other groups. The majority of these boards were established by the International Joint Commission (IJC) as empowered in accordance with the provisions of the Boundary Waters Treaty of 1909 between the United States and Great Britain (for Canada). IJC boards fall into two broad categories: boards of control, which are more or less permanent and supervise compliance over an IJC order; and engineering, technical, or study boards, which are usually dissolved after completing and reporting on an investigation assignment.

In addition to boards created by the Commission, other international boards and committees are created by treaties or other arrangement in matters concerned with the water resources of joint interest, and the members report directly to the Governments or establishing agency. International boundary waters boards and committees having Corps of Engineers memberships during the fiscal

year are listed in Table 45-1. For an explanation of the constitution of the various boards and committees, see the annual reports, Volume II for fiscal years 1977 and 1980.

In recent years the IJC has adopted an ecosystem approach for its Boards with a view toward amalgamating a number of its Boards, where it makes sense to do so, as a first step in the development of international watershed Boards. This approach stemmed from the Commission's recommendations in its 1997 report to the governments of the United States and Canada. This report was provided at the request of governments for a proposal on how the IJC might best assist them to meet the environmental challenges of the 21<sup>st</sup> century. Subsequently, governments asked the Commission, in a reference dated November 19, 1998, to further define the framework for operation of international watershed boards as recommended by the IJC in its 1997 report. The IJC provided governments with status reports in December 2000 and June 2005 on the matter and several of its boards have been amalgamated since 1998.

---

**TABLE 45-1**  
**International Boundary Waters Boards Having Corps of Engineers Members**

| <u>BOARD NAME</u>                       | <u>YEAR ESTABLISHED</u> | <u>UNITED STATES REPRESENTATION</u>  |
|---|-------------------------|--|
| 1. Int. Lake Superior                   | 1914                    | * Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer - Designated Alternate                               |
| 2. Int. St. Croix River**               | 1915                    | *District Engineer, New England  |
| 3. Int. Lake Memphremagog               | 1920                    | *District Engineer, New York   |
| 4. Int. Lake of the Woods Control Board | 1925                    | *District Engineer St. Paul  |
| 5. Int. Lake Champlain                  | 1937                    | *District Engineer, New York   |
| 6. Int. Kootenay Lake                   | 1938                    | *1. District Engineer, Seattle<br>2. Dept. of Interior, USGS, Boise, ID  |
| 7. Int. Rainy Lake Board of Control     | 1941                    | *1. District Engineer, St. Paul<br>2. Resource Biologist, Retired  |
| 8. Int. Osoyoos Lake                    | 1943                    | 1. District Engineer, Seattle<br>2. *Dept. of Interior, USGS, Tacoma, WA<br>3. Washington State Parks & Recreation Commission, Olympia, WA |

REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS ACTIVITIES FOR FY 2007

| <u>BOARD NAME</u>   | <u>YEAR ESTABLISHED</u> | <u>UNITED STATES REPRESENTATION</u>  |
|---|-------------------------|--|
| 9. Int. Red River Board ***   | 2000                    | <ol style="list-style-type: none"> <li>1. District Engineer, St. Paul</li> <li>2. * Dept. of Interior, USBR, Billings, MT</li> <li>3. Dept. of Interior, EPA, Denver, CO</li> <li>4. Dept. of Interior, USGS, Bismarck, ND</li> <li>5. Sand Hill River Watershed District, Fertile, MN</li> <li>6. ND State Water Commission, West Fargo, ND</li> <li>7. MN Pollution Control Agency, Detroit Lakes, MN</li> <li>8. MN Dept. of Natural Resources, Bemidji, MN</li> <li>9. ND Dept. of Health, Bismarck, ND</li> </ol> |
| 10. Int. Niagara  | 1953                    | <ol style="list-style-type: none"> <li>1. *Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer - Designated Alternate</li> <li>2. Dept. of Energy, FERC, Wash., D.C.</li> </ol>  |
| 11. Int. St Lawrence River  | 1953                    | <ol style="list-style-type: none"> <li>1. *Division Engineer, Great Lakes and Ohio River Division Chicago District Engineer - Designated Alternate</li> <li>2. Civil Engineer, Retired</li> <li>3. Rochester Institute of Technology</li> <li>4. Cornell University</li> </ol>   |
| 12. Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data | 1953                    | <ol style="list-style-type: none"> <li>1. Great Lakes and Ohio River Division</li> <li>2. Dept. of Commerce, Ann Arbor, MI</li> </ol>  |
| 13. Int. Niagara Committee  | 1955                    | *Division Engineer, Great Lakes and Ohio River Division  |
| 14. Int. Souris River Board ****  | 2001                    | <ol style="list-style-type: none"> <li>1. District Engineer, St. Paul</li> <li>2. *ND State Engr., Bismarck, ND</li> <li>3. Dept. of Interior, USGS, Bismarck, ND</li> </ol>   |
| 15. Columbia River Treaty Entities  | 1964                    | <ol style="list-style-type: none"> <li>1. Division Engineer, Northwestern Division</li> <li>2. *Administrator of Bonneville Power Admin., Portland, OR</li> </ol>  |
| 16. Columbia River Treaty, Permanent Energy Board                             | 1964                    | <ol style="list-style-type: none"> <li>1. *HQUSACE, Deputy Director of Civil Works, Wash., D.C.</li> <li>2. Department of Energy, Newberg, OR</li> </ol>   |
| 17. Int. Champlain-Richelieu  | 1975                    | <ol style="list-style-type: none"> <li>1. *New York Dept. Environmental Conservation</li> <li>2. District Engineer, New York</li> <li>3. Vermont Environmental Conservation Agency</li> <li>4. New England River Basins Commission, Staff Associate</li> <li>5. Dept. of Interior F&amp;WS, Boston, MA</li> </ol>  |
| 18. Lake Ontario - St. Lawrence River Study Board                             | 2001                    | <ol style="list-style-type: none"> <li>1. * Institute for Water Resources (IWR)</li> <li>2. NY Department of Environmental Conservation</li> <li>3. Cornell University</li> <li>4. Rochester Institute of Technology</li> <li>5. Saint Regis Mohawk Tribe</li> <li>6. Private Citizens (2)</li> </ol>  |
| 19. Int. Upper Great Lakes Study  | 2007                    | <ol style="list-style-type: none"> <li>1. *Institute for Water Resources (IWR)</li> <li>2. MI Department of Environmental Quality</li> <li>3. University of Michigan</li> <li>4. Johns Hopkins University</li> <li>5. Private Consultant</li> </ol>  |

## INTERNATIONAL BOUNDARY WATERS BOARDS

\* Signifies U.S. Section Chairman

\*\* In September 2000, the International Joint Commission formally combined its existing International St. Croix River Board of Control and its International Advisory Board on Pollution Control - St. Croix River and established the International St. Croix River Board.

\*\*\* Amalgamated Board Comprised of Former Int. Red River Pollution Board and Red River Portion of Former Int. Souris-Red Rivers Engineering Board

\*\*\*\* Amalgamated Board Comprised of Former Int. Souris River Board of Control and Souris River Portion of Former Int. Souris-Red Rivers Engineering Board

---

### **Comprehensive Study on Regulating Water Levels on Lake Ontario and in the St. Lawrence River**

In FY2001, the International Joint Commission formed the Lake Ontario - St. Lawrence River Study Board to undertake a comprehensive five-year study to assess and evaluate the current criteria used for regulating water levels on Lake Ontario and in the St. Lawrence River. The Study Board engaged by the IJC is a bi-national group of diverse experts from government, academia, native communities, and interest groups representing the geographical, scientific and community concerns of the Lake Ontario - St. Lawrence River system. The U.S. Director of the Study is from IWR. The Corps of Engineers leads 5 of the 9 Technical Work Groups, and participates on 2 others. The Board completed its work in FY2007. The Mission of the Study was to consider, develop, evaluate and recommend updates and changes to the 1956 criteria for Lake Ontario-St. Lawrence River water levels and flow regulation, taking into account how water level fluctuations affect all interests and changing conditions in the system including climate change, all within the terms of the Boundary Waters Treaty. The Study Board completed its studies to provide the IJC with the information it needs to evaluate options for regulating levels and flows in the Lake Ontario-St. Lawrence River system in order to benefit affected interests and the system as a whole. These studies included:

- a. Reviewing the operation of the structures controlling the levels and flows of the Lake Ontario-St. Lawrence River system in the light of the impacts of those operations on affected interests, including the environment;
- b. Assessing whether changes to the Order of Approval or regulation plan are warranted to meet contemporary and emerging needs, interests and preferences for managing the system in a sustainable manner; and
- c. Evaluating any options identified to improve the operating rules and criteria governing the system.

The Study Board provided its report to the IJC on April 2, 2006, with three candidate regulation plans for the IJC's consideration. The IJC will hold a series of public meetings and work with the State Department before implementing either a new regulation plan or a new Order of Approval for Lake Ontario regulation. In FY2007 the IJC asked technical staffs of agencies to further develop two of the proposed regulation plans. An updated version of one of the candidate plans was selected by the IJC and is expected to be released for public comment in FY2008. The IJC also worked with State Department and federal agencies to revise the Orders of Approval and seek support to implement an Adaptive Management Plan.

### **Upper Great Lakes Plan of Study**

The IJC has decided to review its Orders of Approval for Lake Superior outflow regulation and, consequently, water level impacts on affected interests from Lake Superior downstream through Lake Erie. Two recent events that might impact the study were added to the original study plan. The first issue is that of possible ongoing physical changes in the upper St. Clair River, which could impact water level changes on the upstream lake (Michigan-Huron) and downstream lakes (St. Clair and Erie). The second issue is to implement lessons learned from the Lake Ontario – St. Lawrence River Study just completed. This may provide many lessons learned to help streamline the Upper Lakes Study.

The IJC held public meetings in September 2005 to get comments on the Plan of Study. Following that, the Plan of Study was submitted to the Governments of Canada and the U.S. in October 2005. The IJC obtained funding from both Governments and named the Study Board in February 2007. The Corps Institute for Water Resources is both chairing the Study and managing its activities. Corps personnel are leading seven of the technical work groups.

# REGULATORY, SUNKEN VESSEL REMOVAL AND NATIONAL EMERGENCY PREPAREDNESS ACTIVITIES

## 1. Regulatory Activities

**Authorities.** The following authorities charge the Corps of Engineers with the regulation of various construction related activities in U. S. waters and wetlands: Sections 9 and 10 of the Rivers and Harbors Act of 1899 (structures in waterways and the alteration of waterways); Section 103 of the Marine, Protection, Research, and Sanctuaries Act of 1972 (Ocean Dumping); and Section 404 of the Clean Water Act (discharge of dredged or fill material).

**Work Completed.** During FY 2007, the Corps reviewed and authorized more than 60,000 permit activities, 80 percent of which were approved within 60 days. Approximately 5,000 projects were issued as individual permits, and the remaining 55,000 activities were reviewed and approved under regional or nationwide general permits. General permits are issued to the public at large and define types of minor activities with no more than minimal adverse effects on the aquatic environment, which do not usually require the extensive review necessary for projects authorized by individual permits. Use of general permits provides significant relief to the regulated public by avoiding red tape for small projects with minimal environmental impacts. The Corps modified over 2500 exiting permits during FY 2007. These applications received previous authorization and, due to changes in the activity, there was a need to revise and modify the authorization. The Corps determined that no permit was required on 7400 applications. This type of determination is made when the Corps has no regulatory authority over the site and/or the proposed work. The Corps denied approximately 400 permits during FY 2007 since most projects which might otherwise have been denied a permit were either modified or conditioned to meet Corps requirements, scaled down to qualify for approval under general permits, or withdrawn. About 5,000 permit applications were either withdrawn or canceled. Under the regulatory program, the Corps made

over 56,000 jurisdiction determinations in FY 2007, many of which were made in response to requests from landowners who were not applying for permits

The Corps investigated approximately 2,000 alleged illegal activities, most of which were violations of Section 404 of the Clean Water Act. Under the permit program in FY 2007, the Corps authorized the filling of approximately 10,000 acres of wetlands but required the restoration, enhancement, or creation of more than 20,000 wetland acres, as well as utilized mitigation banks on more than 460 projects.

As required by section 314 of the National Defense Authorization Act for Fiscal Year 2004 (P.L. 108-136), the Corps, in cooperation with EPA, completed final regulations issued April 10 and effective June 9, 2008, establishing performance standards and criteria for compensatory mitigation when required by Department of the Army permits. These regulations apply equivalent standards, to the extent practicable, for compensatory mitigation done by permittees, under in-lieu fee agreements and by mitigation banks.

In June of 2006, the Supreme Court issued decisions on the cases of Carabell and Rapanos, two lawsuits regarding jurisdictional issues for wetlands and tributaries. The Corps and EPA issued interim guidance in July 2006 and final guidance in June 2007. The Corps and EPA reviewed these comments and are working to determine if a proposed rule is necessary to increase clarity and predictability for the regulatory Program.

The Corps regulatory program continued work on several critically important initiatives that will improve permit processing while increasing protections for the environment. These initiatives include proposed improvements to National Historic Properties regulations, proposed changes to the definition of fill rule, and a new consolidated Clean Water Act regulation.

**TABLE A  
GENERAL REGULATORY FUNCTIONS**

|                                    |                    |
|------------------------------------|--------------------|
| Obligations                        |                    |
| Unobligated Balance - 30 Sep 06    | \$ 4,651,825       |
| Allotments                         | \$ 158,400,000     |
| <br>Total Funds Available          | <br>\$ 163,051,825 |
| Obligations                        | \$ 152,933,464     |
| <br>Unobligated Balance- 30 Sep 07 | <br>\$ 10,118,361  |
| Expenditures                       |                    |
| Unexpended Balance - 30 Sep 06     | \$ 14,927,632      |
| Allotment                          | \$ 158,400,000     |
| <br>Total Funds Available          | <br>\$ 163,051,825 |
| <br>Expenditures                   | <br>\$ 149,892,041 |
| Unexpended Balance - 30 Sep 07     | \$ 16,987,991      |

**Investigation and Removal of Sunken Vessels**

Under the authority of Sections 19 and 20 of the River and Harbor Act of 1899, the Corps of Engineers investigated sunken vessels in navigable waters and removed those obstructing navigation. For obligation expenditures, see Table B (next page)

**TABLE B**  
**REMOVAL OF SUNKEN VESSELS**  
 (\$000)

|                                 |            |
|---------------------------------|------------|
| Obligations                     |            |
| Unobligated Balance - 30 Sep 06 | \$ 4,032   |
| Allotment                       | \$ 500,000 |
|                                 |            |
| Total Funds Available           | \$ 504,032 |
| Obligations                     | \$ 29,090  |
|                                 |            |
| Unobligated Balance - 30 Sep 07 | \$ 474,942 |
|                                 |            |
| Expenditures                    |            |
| Unexpended Balance - 30 Sep 06  | \$ 160,107 |
| Allotment                       | \$ 500,000 |
|                                 |            |
| Total Funds Available           | \$ 660,107 |
| Expenditures                    | \$ 172,000 |
|                                 |            |
| Unexpended Balance - 30 Sep 07  | \$ 488,107 |

**2. National Emergency Preparedness Activities**

**Authority.** Executive Orders 10480 and 12656 and the Federal Emergency Management Agency (FEMA) under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 USC 5121 et seq. are the basis of the Federal Response Plan. The cited executive directives assign significant responsibilities for such preparation (planning, training, research and testing) to the Corps. This includes responsibility for development of comprehensive national level preparedness plans and guidance for response to all regional/national emergencies, whether caused by natural phenomena or acts of man, plans for response(s) to acts of terrorism, and the local preparedness necessary to support Corps continuity of operations. The Corps provides engineering and construction support to state and local governments in response to catastrophic natural/technological disasters. Rapid response to disasters of a regional/national magnitude requires that extensive pre-emergency planning and preparedness activities be conducted to assure the availability of a work force capable of shifting from routine missions to crisis operations and the organizational command and control structure(s) necessary to provide a coordinated and comprehensive response in the critical early stages of a catastrophic disaster.

**Status.** During FY 2007, the Corps of Engineers continued its effort to improve the command's readiness posture and its ability to respond to various national/regional catastrophic disasters to include terrorists' attacks. Emphasis has been on those activities to prepare for catastrophic natural and technological disasters requiring major Federal support of state and local governments overwhelmed by a disaster event, and for national level emergency water planning. The primary focus during FY 2007 continued to provide support to two major national level civil planning areas: (a) support to the nation's ability to mobilize national assets to meet national/regional level emergencies and (b) support to continuity of government and continuity of operations during national emergencies. Lessons learned from past hurricanes, floods, earthquakes, and events of September 11, 2001 as well as hurricanes Katrina and Rita, indicate that improvements in response to catastrophic disasters are still required. In this regard, the Corps continues to emphasize a program that uses the deliberate planning process to develop scenario specific catastrophic disaster plans. This will result in more detailed planning and should provide for a more comprehensive response to national/regional catastrophic disasters to include terrorist attacks. More extensive coordination with Federal, state and local entities will be incorporated into plan

REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS ACTIVITIES FOR FY 2007

development. In this regard, following FEMA's program focus, USACE continues to play a key role in national security planning such as supporting Homeland Security strategic planning efforts, development of the National Capitol Region Response Plan and other plans as the New Madrid Earthquake, the South Florida Hurricane, the New Orleans Hurricane and other contingencies with national implications. Initial review of the Federal interagency community developed fifteen all-hazards planning scenarios (the National Planning Scenarios) for use in national, Federal, State, and local homeland security preparedness activities began. The Scenarios are planning tools and are representative of the range

of potential terrorist attacks and natural disasters and the related impacts that face our nation.

Additional efforts focus on continuing to strengthen COOP readiness. Exercises, involving federal, state and local officials, contribute to a more timely and effective execution of Corps responsibilities during disasters that have national impacts. Continuing to capitalize on existing planning efforts and forums, and taking advantage of the current atmosphere of urgency regarding emergency preparedness will advance preparedness among all levels of government to improve response and ensure the health and safety of citizens, workers, and visitors in the metropolitan Washington region.

REGULATORY, SUNKEN VESSEL REMOVAL AND NATIONAL EMERGENCY PREPAREDNESS ACTIVITIES

**TABLE C**  
**NATIONAL EMERGENCY PREPAREDNESS**

|                                 |              |
|---------------------------------|--------------|
| Obligations                     |              |
| Unobligated Balance - 30 Sep 06 | \$ 2,612,573 |
| Allotments FY 07                | \$ 6,050,608 |
| Total Funds Available           | \$ 8,663,181 |
| Obligations FY 07               | \$ 3,012,151 |
| Unobligated Balance - 30 Sep 07 | \$ 5,651,030 |
| Expenditures                    |              |
| Unexpended Balance - 30 Sep 06  | \$ 3,678,306 |
| Allotments FY 07                | \$ 6,050,608 |
| Total Funds Available           | \$ 9,737,914 |
| Expenditures FY 07              | \$ 3,269,364 |
| Unexpended Balance - 30 Sep 07  | \$ 6,468,550 |

# CIVIL EMERGENCY MANAGEMENT ACTIVITIES

**Authority.** Public Law 84-99 (33 U.S.C. 701n) (69 Stat. 186) provides the authority for the U. S. Army Corps of Engineers to provide a full spectrum of emergency management/disaster assistance activities using the Flood Control and Coastal Emergencies (FCCE) appropriation. Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities including disaster preparedness for all natural disasters, Advance Measures (preventive measures when faced with an imminent threat of unusual flooding), emergency operations (Flood Response and Post Flood Response), rehabilitation of flood control works damaged by flood or coastal storm, protection or repair of federally authorized shore protective works threatened or damaged by coastal storm, and provision of emergency water due to drought or contaminated water source. Under The Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.) (88 Stat. 143) (The Stafford Act), the Federal Emergency Management Agency (FEMA) may direct USACE to use its resources to provide assistance in the event of a major disaster or emergency declaration by the President. Under The Stafford Act and its implementing National Response Plan, USACE has a standing mission to provide assistance in the area of Public Works and Engineering, Emergency Support Function #3, for response to a major disaster or catastrophic event.

Activities. Overall, the Civil Emergency Management Program ensures timely, effective, and efficient disaster preparedness, response, recovery, and mitigation projects and services on a nationwide basis to reduce loss of life and property damage under DOD, USACE, FEMA/DHS, and other agencies' authorities. Major disaster preparedness activities included: the review and updating of disaster preparedness and response plans to ensure viability; training personnel to ensure their capability to respond to disasters; procurement and pre-positioning of critical equipment and supplies which would likely not be available during initial stages of a response; periodic exercises to test and evaluate plans, personnel and training; and the inspection of Federal and non-Federal flood control projects

to ensure their viability to provide flood protection. For each specific event, as needed, Headquarters augments its staff and the staffs of the impacted division/district(s) to manage the event, addressing areas such as resource allocations (dollars and people), funding emergency contracts, purchasing needed materials, providing technical and direct assistance, the logistics of moving people and materials, and coordinating with tribal/Federal/state/local agencies involved in the event. These augmentation activities include overtime for Headquarters, funding of field staff, emergency contracts, travel to the event area, purchasing materials and supplies, increased staffing to include providing Remote Sensing/ Geographic Information System (RS/GIS) services.

**Significant Events.** Work continued on the Stafford Act responses to Hurricane Katrina which made landfall twice, 25 August 2005 near For Lauderdale Florida and 29 August near Buras, Louisiana with impacts to the States of Louisiana, Mississippi, Alabama and Florida. FEMA mission assignments to USACE exceeded \$4.6 billion and at the peak more than 2,900 USACE personnel were involved in Hurricane Katrina response and recovery efforts. Hurricane Katrina mission assignments in support of FEMA for Louisiana were physically completed in September 2007.

In October 2006 Hawaii County, Hawaii experienced a magnitude 6.6 earthquake which resulted in five mission assignments totaling \$550,000 and included infrastructure assessments and dam safety assessments. Mid-October brought nearly two feet of lake effect snow to western New York and resulted in four missions totaling \$1.1M, including temporary power and oversight for the 3.2M cubic yards of debris removed. Ice Storms in January 2007 resulted in \$2M power mission for Oklahoma with 64 generators installed to critical facilities.

On 4 May a Category F5 tornado hit the City of Greensburg, Kansas physically destroying over 90% of the community. Over \$5M of missions were assigned to USACE, for landfill

## REPORT OF THE SECRETARY OF THE ARMY ON CIVIL WORKS ACTIVITIES FOR FY 2007

remediation and technical assistance for temporary housing and critical public facilities. Slow moving thunderstorms caused flash flooding during June in Delaware County, NY which resulted in a \$100,000 technical assistance mission to the state. June/July rainfalls caused flooding in southeast Kansas. Eight mission assignments were made totaling over \$2M for technical assistance with temporary housing, high water marks, waster distribution and water/wastewater evaluations. A commodities team was deployed to assist FEMA logistics.

June through September 2007 experienced an unusually calm Hurricane season. Although Hurricane Dean reached Category 4 crossing the Yucatan Peninsula dissipated much of its strength prior to landfall in Mexico.

In May 2007, the Flood Control and Coastal Emergencies program received an additional emergency supplemental appropriation of \$1.5 billion to fund specific improvements relating to the consequences of Hurricanes Katrina and Rita. These project improvements include West Bank and Vicinity and Lake Ponchartrain and Vicinity, Louisiana; and hurricane storm damage reduction, flood damage reduction and ecosystem restoration within Hancock, Harrison and Jackson Counties, Mississippi.

In October 2006, fall coastal storms threatened Kivalina, Alaska school and fuel depot. \$1.2M. was allocated in October for temporary emergency repairs of the shore protection structures.

A Pineapple Express Weather System moved through Western Washington in November 2006, bringing record rainfall to the majority of the river basins along the coast. The Nooksack River Basin experienced a flood of record. In Oregon, Wilson River, Tillamook, was above historic levels. \$2.1M was allocated to flood fight and provide technical assistance across the area. Over 40 levees were identified as needing repairs with an estimated \$20M in damages

Over \$2M was allocated for flood fighting in the Missouri River Basin in May 2007, with over 1M sandbags issued, technical assistance provided to States and local sponsors, and the loan of pumps as needed. The flooding of the Missouri River resulted in over \$26M in damages to flood control projects in Iowa, Kansas, Missouri and Nebraska.

Initiated the study and preparation for the next levee raise at Devils Lake, North Dakota with an estimated cost \$5.4M.