

W S T B

A newsletter from the Water Science and Technology Board

National Research Council

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GROUNDWATER FLUXES ACROSS INTERFACES

by William Logan

Atmospheric, surface, and subsurface portions of the hydrologic system are dynamically linked, but have very different time and space scales. Although scientific advances have been made in understanding each of these reservoirs, many challenges remain in understanding and measuring the interchanges among them. Interchanges with the subsurface, i.e., groundwater recharge and discharge, can be particularly problematical. While considerable attention has been given to both the theory and measurement of groundwater fluxes to and from surface water bodies, obtaining accurate estimates of the spatial and temporal distribution of these fluxes is often difficult. Similarly, there are no standard procedures for measuring recharge to the groundwater system from precipitation.

Problem Definition and Motivation

The measurement difficulties arise in part because of the diffuse nature and spatially

large extent of most recharge and discharge areas. Challenges in addressing issues related to groundwater fluxes also arise because the subject cuts across many different disciplines including soil science, hydrology, oceanography, geochemistry, geophysics, and wetland ecology. Estimates of recharge/discharge fluxes are needed at many different scales and for many different purposes, including evaluating local risks of landslides, basin-scale sustainable use and management of groundwater resources, management of nuclear waste, and global budgets of water and greenhouse gasses for climate studies. Because of these many issues, various scientific committees and federal agencies have identified groundwater fluxes at interfaces as a priority area for research.

To respond to this need, the Committee on Hydrologic Science (COHS) organized and convened a workshop in Egg Harbor, WI in May 2002. The participants were asked to

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James J. Morgan Will Deliver the 13th Abel Wolman Lecture on January 26, 2004

James J. Morgan, professor of environmental engineering science from California Institute of Technology, will deliver the 13th Abel Wolman lecture, *What Water Quality Is. We Must Go to the Matrices of Sources, Uses, Criteria, Standards, and Technology* on January 26, 2004.

Abel Wolman tackled the concept of a quality index for drinking water 85 years ago on the basis of just three characteristics: coliform bacteria, watershed protection, and the reliability of the treatment works. Today we are a long way "down river" from Wolman's pioneering concept. Many new obstacles to what Wolman called "the struggle for quality" have had to be faced and overcome in protecting human health and aquatic ecosystems throughout the past century. The historic water quality paradigm of criteria, standards, and treatment faces a growing challenge in the form of a seemingly ever-growing catalog of potentially harmful chemical substances. How should the water profession respond?



Over a 40-year career, Dr. Morgan has made many contributions to engineering and society through basic research and applications of chemistry to water purification and pollution control.

The program will begin at 4:00 p.m. in the Auditorium of the National Academies, 2101 Constitution Avenue, NW, Washington, D.C. A reception will follow the Lecture in the Great Hall. The event is free and open to the public. In order to accommodate our audience, please RSVP to Anita Hall at the WSTB at either (202) 334-3422 or ahall@nas.edu.

Groundwater Fluxes...

examine and assess current and proposed methods of estimating recharge and discharge rates and identify methods that hold the most promise for addressing three general issues related to groundwater recharge and discharge: diffuse vs. focused fluxes, climate feedback functions, and spatial and temporal scales. Prior to the meeting participants provided written material, which were presented during the workshop and accordingly revised after discussions. These discussions and written materials provided much of both the structure and the content for the recently published NRC report, *Groundwater Fluxes Across Interfaces* (the report will soon be available at <http://www.nap.edu>). The report includes discussions on spatial and temporal variability in diffuse and focused groundwater recharge and discharge, the interaction of groundwater with the climate system, and the spatial and temporal scales of recharge and discharge fluxes.

Findings and Recommendations

Spatial and Temporal Variability of Recharge and Discharge

Our ability to quantify spatial and temporal variability in recharge and discharge is inadequate and must be improved given the importance of groundwater in the hydrologic cycle, its contribution to base flow in streams and inflow to lakes, and society's reliance upon it for water supply. Also, the spatial distribution of recharge fluxes influences the vulnerability of aquifers to contamination and the discharge of groundwater into wetlands influences associated ecological and biogeochemical processes.

A key science question is how landscape heterogeneity controls spatial and temporal variability of recharge and discharge. Addressing this question requires consideration of geology, biology and climate including variability in soils, topography and vegetation. Since there are

no uniformly applicable methods for measuring and quantifying recharge/discharge fluxes in space and time, this limits our understanding of its distribution and process.

Experimental benchmark sites should be established with the goal of improving both measurement techniques and the understanding of the processes of groundwater recharge and discharge. These sites should include a wide range of geologic, climatic and landscape types and should be integrated with existing NSF, USDA/ARS and similar experimental watersheds. The proposed experimental benchmark sites program should also work cooperatively with field programs connected with large-scale hydroclimatic studies—for example, the WCRP Global Energy and Water Experiment (GEWEX) and with studies conducted under the NSF-supported CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc.) initiative.

A study/workshop should be initiated with the goal of developing scientific and implementation plans for such experimental benchmark sites, perhaps as part of CUAHSI. Such an activity would determine which sites would be most valuable to improving the science of groundwater discharge and research, the relevant science questions specific to particular sites, the range of measurement and modeling that would be undertaken and an evaluation of the historical data available for designing experiments.

Scaling of Recharge and Discharge

Groundwater measurements are needed across a range of temporal and

spatial scales—measurements at one scale are often needed to address questions at another scale. For example, remote sensing techniques provide extensive, spatially complete data sets that hold promise for addressing many of the unresolved questions identified in the NRC report. However, these data often provide information at large regional scales, like the information soon to be available from the NASA-supported micro-gravity mission GRACE (Gravity Recovery and Climate Experiment), and must be integrated with information generated at smaller scales. This will require an understanding on how groundwater processes scale spatially and temporally. For example, it is unclear how the variability measured at small scales will change as one moves up in scale, and whether there are thresholds of continuity or uniformity that correlate with practical scales of measurements.

Another caveat is in order. Much of the new technology to address spatial scaling issues relates to near-surface measurements. Such measurements may provide ways to estimate net infiltration, by measuring surface evaporation and plant consumption, not by measuring net recharge directly. However, more accurate recharge estimates may be made not at or near the soil surface but deeper underground where flow is less coupled to other mass and energy transfer processes than is flow in the soil-plant-atmosphere system. At depth, the effects of evapotranspiration, and spatial and temporal fluctuations in infiltration are attenuated, rendering

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Watermarks

Congratulations to WSTB staff officer **Stephanie Johnson** for receiving her Ph.D. in environmental sciences from the University of Virginia August 2003. Her thesis is titled "Influence of Microorganisms on the Fate of Soil-Aged Atrazine."

Congratulations also to WSTB research associate and newsletter associate editor **Ellen de Guzman** for receiving an NRC Distinguished Service Award for 2003.

Review of the Desalination and Water Purification Technology Roadmap

by Stephanie Johnson

In order to minimize future regional and international conflicts and maintain economic development, the United States will need sustainable supplies of high-quality fresh water. The *Desalination and Water Purification Technology Roadmap* (Roadmap) was developed by the Bureau of Reclamation (BuRec) and Sandia National Laboratories as a strategic pathway for future desalination and water purification research so that desalination technologies might “contribute significantly to ensuring a safe, sustainable, affordable, and adequate water supply for the United States.” BuRec plans to use the Roadmap to guide investment decisions and to help structure the selection of desalination research and development projects.

Over the last nine months, a WSTB committee has studied the Roadmap and provided its preliminary assessment in the *Letter Report on the Review of the Desalination and Water Purification Technology Roadmap*. The report addresses whether the Roadmap presents an appropriate and effective course to help address future freshwater needs in the United States and provides recommendations regarding the vision statement, targets for critical research objectives, desalination technology needs, and implementation. A more detailed review of the Roadmap will be provided in the committee’s final report, which is in review and expected to be released in January 2004.

Desalination technologies have the potential to become important components of future water supply management; thus, the report notes that a national research plan for desalination and water purification technology is important and necessary to help meet the nation’s future water needs. The report concludes that this Roadmap and its underlying process appear to present an appropriate framework for advancing research in several areas of desalination and water purification technology to help address future water needs

in the United States, and recommends their continuation.

The report offers several suggestions to improve the effectiveness of the Roadmap. A stronger emphasis on research to support advances in technology is encouraged, since little attention is devoted to the technologies and the associated research needed to meet the identified Roadmap’s water supply objectives. For example, the Roadmap presents targets for research, but the origin and plausibility of these targets are not explained. The Roadmap could be strengthened as a whole by more thorough descriptions of the technologies and associated research opportunities, along with a list of technical references supporting the technologies identified in the report.

Overall, the report concludes that the five broad areas of desalination and water purification technologies identified in the Roadmap (membrane, alternative, thermal, concentrate management, reuse/recycling) represent top priority areas for research and development, but the issues of corresponding energy use and air emissions resulting from these energy intensive technologies should also be addressed. The report also notes that the overarching vision for the Roadmap appears to stray into formulation of national water policy rather than remaining focused on a research plan to address desalination and water purification technologies related to future national water supply needs.

The report further concludes that the effectiveness of the Roadmap will ultimately depend on its future implementation plans, which are not yet resolved. The report recommends that a general plan of implementation for the research initiative be developed that should include mechanisms for setting priorities for research, engaging a

wide range of scientists and engineers, and funding research projects through a rigorous peer-review process. Information developed through the Roadmap should be communicated effectively to industry, decision makers, and the general public in order to advance new desalination technologies and maintain support for the program.

The committee’s final report will include an overview of water availability and desalination, a general assessment of the Roadmap that expands on the letter report, and a review of each of the broad desalination and water purification research areas identified in the Roadmap. It will present opportunities for cost reductions by further research in each of these areas, topics that deserve further study, and priorities for future research. The report will also provide suggestions for implementing the Roadmap and communicating the results of the initiative.

David Marks of the Massachusetts Institute of Technology chairs the committee. For more information, contact Stephanie Johnson at (202)334-3385 or sjohnson@nas.edu.

Stephanie Johnson is a staff officer with the Water Science and Technology Board.

Important Notice to Our International Subscribers

The WSTB regrets that it will no longer be able to offer paper copies of the newsletter to our international subscribers due to the growing cost of international mail. Instead, we will offer an electronic version of the newsletter through our website <http://nationalacademies.org/wstb/> or through email subscriptions by writing to edguzman@nas.edu with subject “subscribe to WSTB newsletter.” We thank you for your understanding and we hope that you will continue to be interested in receiving copies of the newsletter.

Groundwater Fluxes..

deeper subsurface flow more uniform and therefore easier to quantify (Figure 1).

A graph or series of graphs of flux rate vs. spatial or temporal averaging scale might be drawn analogous to those that show the scaling behavior of porosity or correlation length in heterogeneous porous media. By examining the relative magnitude and variability of groundwater fluxes at increasing spatial and temporal scales, we may discover thresholds of continuity or uniformity that correlate with practical scales of measurement and/or application.

A broad and coherent strategy for the observation of groundwater recharge and discharge across scales is needed. This includes developing sensors that measure recharge and discharge at “point” scales, supporting research to increase scientific understanding of the scaling of these measurements and underlying processes, developing procedures for integrating measurements and observations across scales, and generating mathematical tools to assimilate and synthesize observations at all scales into groundwater process models. Such a strategy could be tested on both the benchmark sites (as mentioned above) and on aquifers of regional extent.

Interactions of Groundwater with Climate

The roles of groundwater storage, and recharge and discharge fluxes in the climate system are under-

appreciated and poorly understood. Because groundwater is the largest reservoir of fresh water in the hydrologic cycle, characterization of the linkage between groundwater and climate is crucial. Groundwater plays an important role in the carbon cycle and related subsurface biogeochemical processes, and therefore the variability and fluctuation in groundwater levels can influence climate. For example, the net accumulation (or depletion) of peat (and the sequestration or release of its stored carbon) depends on the depth of the water table, and whether peat is under aerobic or anaerobic conditions. Climate change may alter the temporal and spatial distributions of groundwater recharge and discharge and, therefore, availability of the groundwater resource. Better understanding of the linkage between groundwater resources and paleoclimatic conditions would be helpful in understanding past climate and its variability and would supplement information derived from study of tree rings and ice cores.

Research should address the relationship between long-term fluctuations in groundwater levels in aquifers at a regional scale and climatic variability. Such efforts would include the preservation and study of historical data on groundwater levels, and related hydrologic data such as streamflow records and lake levels, in areas unaffected by direct human influence. These efforts should include a broad range of techniques including paleoclimatic research such as reconstruction of paleolake levels and isotope geochemistry of old ground-

water to provide insights into climatic variables such as paleo-temperature.

Research is also needed to allow for better representation of groundwater processes in climate models, including more realistic storage parameters, landscape partitioning into recharge and discharge areas, groundwater uptake by vegetation, and fluxes to wetlands, lakes and streams. Data from the benchmark sites discussed above could be utilized to test the improved parameterizations.

Additionally, a better understanding of the effects of human use of groundwater for water supply on climate is needed. This would require comprehensive tabulation of regional, continental and global groundwater withdrawals and the extent of the area of wetlands drained during the past century accompanied by evaluation of the effects of the withdrawals and drainage on climate.

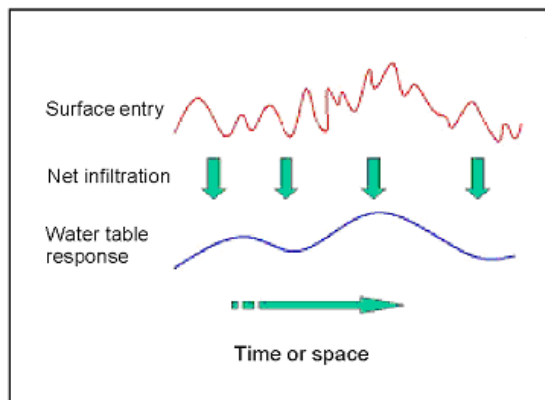
The workshop was co-chaired by Mary P. Anderson (University of Wisconsin, Madison) and John L. Wilson (New Mexico Tech). Other COHS members were Dara Entekhabi (chair through December 31, 2002; Massachusetts Institute of Technology), Eric F. Wood (present chair; Princeton University), Victor R. Baker (University of Arizona), Nancy B. Grimm (Arizona State University), George M. Hornberger (University of Virginia), Dennis P. Lettenmaier (University of Washington), William K. Nuttle (consultant), Kenneth W. Potter (University of Wisconsin, Madison), and John O. Roads (Scripps Institution of Oceanography).

Acknowledgements

The COHS gratefully acknowledges those who participated in the various phases of the workshop, including: Jean M. Bahr, Kenneth R. Bradbury, Michael D. Dettinger, Christopher J. Duffy, Hendrik M. Haitjema, Stacy E. Howington, Randall J. Hunt, P. C. D. (Chris) Milly, Shlomo P. Neuman, Matthew Rodell, Guido D. Salvucci, Bridget R. Scanlon, John S. Selker, Donald I. Siegel, Leslie Smith, and William W. Woessner.

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FIGURE 1
Schematic illustration of the smoothing of the recharge signal as water enters the subsurface as infiltration and some component of this arrives at the water table after percolating through the vadose zone.



A Review of the EPA Water Security Research and Technical Support Action Plan

by Stephanie Johnson

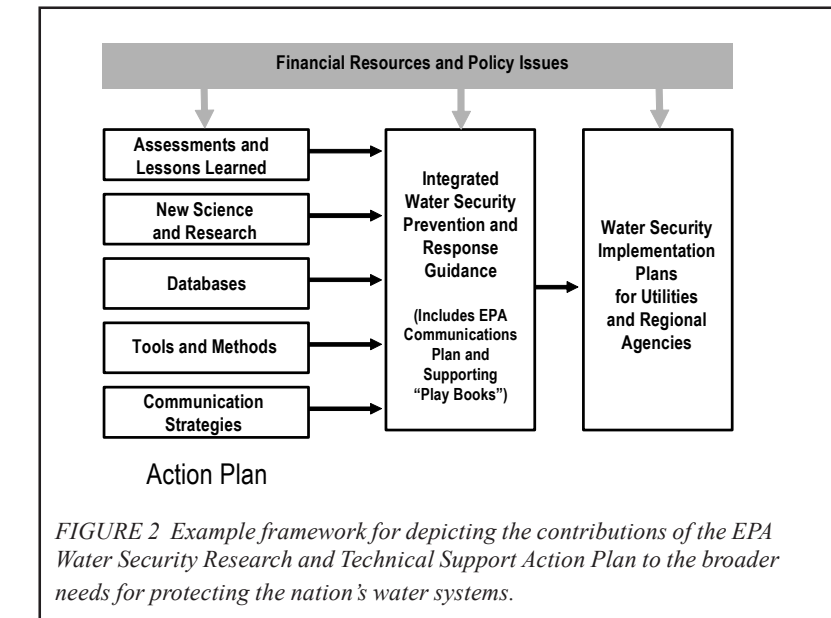
The events of September 11, 2001 heightened concerns regarding the vulnerabilities of critical infrastructures, including the nation's water systems, to deliberate attack. The Environmental Protection Agency holds lead responsibility for protecting U.S. water systems, and in support of these responsibilities, the EPA recently developed the *Water Security Research and Technical Support Action Plan*. The Action Plan outlines research and technical support needs for preventing, preparing for, and responding to physical, cyber, and contaminant attacks on drinking water and wastewater systems and presents a prioritized list of projects to address these needs. A review of the Action Plan is presented in a new NRC report, *A Review of the EPA Water Security Research and Technical Support Action Plan*.

Findings and Recommendations

Overarching Issues

The report recognizes the need to act quickly to address issues of water security and concludes that the EPA strategy to emphasize research and technical support projects that have immediate usability is a sound one. However, the Action Plan would be strengthened if it more clearly presented how the projects contribute to improving the nation's water security (for an example, see Figure 2). The report encourages the EPA to include plans for integrating the results of the Action Plan into a comprehensive preparedness and response guidance document, which would direct a utility through available prevention strategies, information resources, communication planning, and response and recovery actions.

The report recommends that the EPA water security efforts emphasize continually improving the response and recovery capacity while also identifying cost-effective preventive or mitigative countermeasures. The ability to respond to a water security event will



require a process of successive approximations that will gradually improve as information and methods improve. The report advocates that key tasks that have relatively quick and immediate value should be given higher priority over longer-term projects. To support these prioritizing principles, the EPA should emphasize projects that would:

- Mine existing data and assemble it in an accessible and immediately useable form,
- Develop early and effective information transfer,
- Assess and communicate the value of water security measures, and
- Consider the funding constraints of the end users.

In order to facilitate integration of the research findings and frequent updating of the water security guidance, the report encourages EPA to implement a water security management plan within the agency that includes adequate continuing resources and effective, stable leadership.

Several additional suggestions are provided to strengthen the overall Action Plan. EPA should pay particular attention to improving interagency co-

ordination and determining the roles and capabilities of other agencies with regard to water security. The report notes that developing an effective communication strategy that meets the needs of the broad range of stakeholders, while addressing security concerns, should be among the highest priorities for the EPA.

Assessment of Water Security Needs and Projects

The Action Plan presents 33 research and technical support needs for drinking water and wastewater security and outlines 123 supporting projects. For drinking water, these are grouped into the following categories: (1) protecting physical and cyber infrastructure, (2) identifying drinking water contaminants, (3) improving analytical methodologies and monitoring, (4) containing, treating, decontaminating, and disposing of contaminated water and materials, (5) planning for contingencies and addressing infrastructure interdependencies, and (6) targeting impacts on human health and informing the public about risks.

The report proposes two new research and technical support needs

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Water Security Research...

and 13 new projects for drinking water. The new proposed needs are:

- Assessments of costs and benefits associated with various countermeasures and assistance in communicating the value of water; and
- Explicit understanding of the role of failure of the “human subsystem” and possible contingencies.

The report evaluates the focus of each of the proposed projects, and opportunities for cross-project coordination are presented. The report does not advocate deletion of any of the Action Plan projects, although some reprioritization is suggested. Some examples of suggested new projects include: examining spatial and temporal sampling requirements for water security events, refining distribution system models to consider decay rates of water contaminants, conducting an analysis of risk communication strategies for past disaster events, and developing a national training program on risk communication planning for water managers. Several recommendations are also provided to focus the EPA effort on more reasonable near-term goals and to clarify longer-term research objectives.

There are many health-related issues related to the security of the nation’s wastewater plants, since many surface water supplies for drinking water contain treated wastewater. The wastewater collection system also serves as a potential conduit to damage numerous structures in a region. Thus, the report concludes that it is appropriate to give consideration to the security of the nation’s wastewater systems, although the human health consequences may be somewhat more indirect than in the case of drinking water systems. Nevertheless, the Action Plan contains considerably less information on the security of the wastewater infrastructure than on drinking water systems. The report suggests that more thought should be given to the wastewater systems se-

NEW REPORT

Review of the U.S. Army Corps of Engineers Restructured Draft Feasibility Study for the Upper Mississippi River-Illinois Waterway System: Phase II

by Jeffrey Jacobs

In early 2001, the WSTB, in cooperation with the NRC’s Transportation Research Board, issued the report, *Inland Navigation System Planning: The upper Mississippi River-Illinois Waterway*, which reviewed the Corps of Engineers’ feasibility study of the Upper Mississippi River-Illinois Waterway (UMR-IWW). The Corps has since been restructuring its feasibility study. In March 2003, the Corps requested the WSTB to convene another committee to review the Corps’ restructured feasibility study. Like the 2001 report (Phase I), this study (Phase II) evaluates economics models used by the Corps for forecasting future commodity prices, demands, and levels of waterway traffic. The charge to the Phase II committee, however, is of a broader scope, as it includes review of the restructured study’s environmental analyses and efforts at integrating economic, environmental, and management considerations.

The first report from the Phase II study (issued in December 2003 and summarized below) commented upon

models for calculating benefits of waterway infrastructure improvements, future demands for waterway transportation, projections of future U.S. grain exports, waterway traffic management alternatives, the feasibility study schedule, and river science and ecology. Two more reports will be issued in this study, one in Summer 2004 and one in early 2005.

Waterway Transportation Demands

The Corps has been developing a spatial model that would calculate the benefits of infrastructure improvements on the Upper Mississippi River-Illinois Waterway and calculate variations in grain shipping costs and modes of grain transport. Toward this end, the Corps has applied a traditional Corps Tow Cost Model (TCM) and has been developing its “ESSENCE” model. The committee has not been presented with detailed information on the TCM but will learn more about it as it proceeds. Fundamental conceptual flaws in the ESSENCE model render it unfit for use in the feasibility

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curity and the interdependencies between drinking water and wastewater systems. The report concludes that ongoing wastewater security projects are appropriate to meet the most pressing needs for wastewater, but several additional projects are suggested, including management and disposal of contaminated waste and sludge and the adequacy of plant worker protection during potential water security attacks.

Implementation of the Action Plan involves communicating and disseminating results, building collaborative relationships, and coordinating responsibilities with other organizations and agencies. Several additional projects are suggested to improve implementation, including an analysis of the consequences of various levels of information security, an assessment of

the benefits and limitations of existing methods of dissemination (e.g., web pages, the Water Information Sharing and Analysis Center), and research on means to utilize pertinent information from the community.

The study was sponsored by the Environmental Protection Agency, and the Panel on Water System Security Research was chaired by Gary Westerhoff of Malcolm Pirnie, Inc. Copies of the report are available from the WSTB office at (202)334-3422 or sjohnson@nas.edu.

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Upper Mississippi River-Illinois...

study. The Corps should either accelerate the development of a full spatial price model or adopt an alternative modeling approach that avoids the limitations of the ESSENCE model.

Demand Forecasts

Five scenarios of future U.S. grain forecasts were presented to the Corps in a study conducted by the Sparks Company of Memphis, TN. Of these five scenarios, four of them forecast substantial increases in future U.S. grain exports. The committee reserved judgment on the plausibility of these forecasts, discussed these projections with the Corps' consultants at its December 2003 meeting in St. Louis, and is likely to issue further comments on them in its future reports.

Managing Waterway Congestion

The current system for managing UMR-IWW traffic operates primarily on a first-come, first-serve basis. But alternative, nonstructural waterway traffic management measures could provide cost-effective means for reducing congestion. Measures such as scheduling systems, systems of tradable arrival slots, or a contingent fee—as challenging as their implementation may be—could be implemented as alternatives to extending locks, or could be used in combination with lock extensions. Furthermore, such traffic management measures would be needed to address reductions in capacity that would occur in the event that lock extensions were constructed. The Corps should proceed as soon as practicable toward developing and implementing nonstructural measures to help alleviate waterway traffic congestion.

Integrated Systems Planning

The Upper Mississippi and Illinois rivers and their floodplains support a variety of activities other than navigation, including boating, recreational and commercial fishing, hunting, camping, and sightseeing. The Corps should thus, to the extent feasible, consider

these and other factors such as water quality, flood damage reduction, and sediment transport in order to reflect a more holistic approach to dealing with the diverse management issues in the UMR-IWW. The Corps should also implement adaptive management concepts and approaches throughout the planning process.

Decisions, Implementation, and Institutions

The Corps is on an aggressive timetable for completing the feasibility study. Although there is a need to move forward with the study, several of this first report's recommendations that point toward a more thorough and credible analysis would require additional time. The Corps should extend its schedule for completing the feasibility study and issuing a Chief's Report.

There are literally hundreds of prospective projects within the UMR-IWW study aimed toward ecological enhancements. Not all of these projects can be implemented simultaneously, because of both financial and practical limitations. Priority should be given to those projects based upon their promise of restoring natural processes, and to those that aim to achieve multiple objectives.

Ecological restoration projects in downstream states, which have small-

er federal land holdings than states in the upper basin, require greater cost-sharing responsibilities from local sponsors. If prospective restoration projects do not receive funding, it will alter the study's benefit calculations. The Corps should, therefore, identify specific instances in which federal cost-sharing rules are likely to restrict or preclude implementation of environmental restoration projects and nonstructural measures.

The committee is chaired by John Boland, Johns Hopkins University. Members are: Patrick Brezonik, University of Minnesota; Robert Davis, consultant; Leo Eisel, Brown and Caldwell; Stephen Fuller, Texas A&M University; Gerald Galloway, Titan Corporation; Lester Lave, Carnegie Mellon University (also chaired the Phase I study); Karin Lamburg, Syracuse University; Elizabeth Rieke, Lahotan Bay Area Office, Nevada; Richard Sparks, University of Illinois at Urbana-Champaign; and Soroosh Sorooshian, University of California at Irvine. For more information on this study, contact Jeffrey Jacobs at (202) 334-3422 or jjacobs@nas.edu.

Jeffrey Jacobs is a senior staff officer with the Water Science and Technology Board.

NRC MEETINGS

Texas Instream Flows

January 12-14, 2004, San Antonio, Texas

Water Science and Technology Board Meeting

January 26-27, 2004, Washington, DC

13th Abel Wolman Lecture

January 26, 2004, Washington, DC

Water Quality Improvement in Pittsburgh Region

February 5-6, 2004, Washington, DC

Source Removal of Contaminants in Subsurface

February 23-24, 2004, Sedona, Arizona

Comprehensive Restoration of the Greater Everglades Ecosystem

February 26-27, 2004, Washington, DC

Anderson Internship Program Continues to Grow

by Dionne Pringle

Now completing its second year, the Anderson Internship Program is a component of the partnership between the National Academies and Benjamin Banneker Academic High School, Washington, DC. Dr. Warren Muir, Executive Director of the Division on Earth and Life Studies (DELS), along with Mrs. Patricia L. Tucker, principal of Banneker, and Mr. Douglas Tyson, former science teacher at Banneker, started the program to provide unique opportunities for underrepresented minorities in science, engineering, and medicine. Initially, financial support came from the three presidents of the academies, Dr. Bruce M. Alberts (NAS), Dr. Wm. A. Wulf (NAE), and Dr. Harvey V. Fineberg (IOM). Starting this year, Jack and Rose-Marie Anderson generously agreed to fund the program, now called the Anderson Internship Program. It is coordinated by Dr. William Anderson, Associate Executive Director of DELS.

Four graduated Banneker students christened the program in summer 2002. Three of these—Stella Chukwu (Spelman College), Christopher Rogers (Haverford College), and LaTeya Foxx (Juniata College)—returned to The Academies in 2003 to work with the Executive Office, the Board on Agriculture and Natural Resources, and the Board on Radioactive Effects Research, respectively. Four new interns, Danielle Greene (Stanford University), Rahel Mengh-estab (Tufts University), Dionne Pringle (Claflin University), and Amina Richardson (Stanford University), were assigned to the Board on Life Sciences, the Board on Chemical Sciences and Technology, the Water Science and Technology Board, and the Ocean Studies Board, respectively. The interns were chosen based on academic performance and a strong interest in science. The students begin their 10-week intern-

ship the summer after graduation. All Anderson Interns are invited to return to The Academies during breaks and holidays as long as they stay in school, maintain good grades, and remain interested in science, medicine or engineering.

Anderson Interns experience the range of work at the National Academies, including research, and data collection, editing reports, constructing databases, drafting project proposals, conducting searches for potential committee members, and attending board meetings. For example, LaTeya Foxx gave a presentation in Irvine, CA on potassium iodide distribution and administration policies for the 50 states during a closed session of the Committee to Assess Federal and State Guidelines for the Distribution and Administration of Potassium Iodide (KI) in the Event of a Nuclear Incident. Foxx said that it “was a wonderful experience to actively participate in developing something useful to the committee. It was also great to be able to see how the committee operates and the kind of things committees take into consideration while formulating their recommendations. I’m glad to have had this opportunity.” Amina Richardson reflected that the OSB Annual Board Meeting in Woods Hole, MA that she attended this summer “was insightful as to how presentations are given in a working en-

vironment as opposed to presentations given in a classroom.”

The potential of interns to work in different areas sheds some light on future plans for the internship program. Dr. W. Anderson stated that the program “will continue to grow. We will also bring in a new class each summer as well as retain the other interns. Our expectation is that in future years, we can move our interns into other divisions within the Academies.” The interns could not agree more with Dr. Anderson. As Christopher Rogers says, “The Anderson Internship program is definitely on its way to becoming one of the preeminent internships for undergraduates interested in science.” Not only does it let students be involved, but it provides them with a significant insight into the working world of science, engineering, and medicine.

Dionne Pringle is a 2003 graduate of Banneker, and is currently attending Claflin University, where she intends to pursue a degree in computer engineering. Dionne interned with the WSTB. The WSTB heartily thanks her for her contributions last summer, and wishes her the best of luck at school and all her future endeavors.



The Andersons spent time with the 2003 Banneker Interns and NRC staff during a luncheon sponsored by DELS.

WSTB to Develop Web-based Information Center for Developing Country Scientists

by William Logan

The WSTB, in collaboration with the Office of Communications, was recently chosen by the National Academies to develop a Web-based information center dedicated to water-related issues. The site will be oriented toward scientists, engineers, policy makers, and managers in academia, government, and non-governmental organizations in developing countries. Funding will come from the Academies' internal funds.

The site will be anchored by sections of National Research Council consensus reports carefully selected for the target audiences. Supporting this core offering will be audience-appropriate material that provides context and identifies applications for the reports; report abstracts; derivative products; and possibly some links to other quality-checked outside sources. Some components of the site might be translated into other languages. It will be created by NRC staff with guidance from WSTB members and other experts.

The idea had its origins in a 2001 address by the president of the National Academies, Bruce Alberts, who challenged WSTB staff and members to consider strategies for rearranging and aggregating our reports in ways to increase their value to the developing world. Although most of these reports have been written for U.S. policymakers, they also contain important advice of broad application internationally. Unfortunately, dissemination of our reports in the developing world has been limited and this great resource has not been as accessible as it potentially could be. The site will serve as a complement to the Academies' recent initiative of making pdf versions of its reports available at no cost to people in developing countries (see box). It is intended to serve as an Academies-wide prototype that could be adapted to other topics, such as public health, medicine, or agriculture.

We are quite enthusiastic concerning the value and potential of this new dissemination portal, opening our program to developing world profession-

als concerned with water and sanitation issues. WSTB members and staff have much relevant expertise in water, sanitation, water quality, and public health and a high level of experience and interest in developing world applications. The WSTB has a subset of members who regularly consider needs and prospects for engagement of the board in international activities. In addition to this initial communications

effort, the WSTB is in discussion concerning two, more traditional study activities designed to lead to improved water and sanitation services (and thus public health as well) for developing nations, African in particular. Look to future issues of this newsletter or the WSTB website (<http://nationalacademies.org/wstb>) for reports of progress in this area.

Free WSTB Reports for Developing Country Scientists

Until recently, National Research Council reports had to be either purchased or downloaded one page at a time regardless of where in the world one lived. Between the cost of the report and the uncertain nature of international shipping, few reports found their way to developing countries. This limitation has now been remedied, and pdf (Adobe Acrobat) versions of most of our reports can now be downloaded from our website by interested parties in most developing countries.

The instructions are simple: From the WSTB web site (<http://www.nationalacademies.org/wstb/>), click on the "Publications" button in the left-hand column. Click on the title you want, and then click on "Read it Online - FREE!" On the next screen, people in eligible developing countries (see listing below) should see an offer for free pdf downloading under "purchase options." (People accessing the site from developed countries will instead see an offer to *purchase* the pdf version.) After filling out a very brief questionnaire, one can download the report from the next page that appears.

Please help us to publicize this service through your professional contacts in developing countries. As of October 2003, countries eligible for free NRC reports were as follows:

Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Costa Rica, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Federated States of Micronesia, Fiji, French Guiana, Gabon, Gambia, Georgia, Ghana, Grenada, Guadeloupe, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kitts And Nevis, Kyrgyzstan, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Madagascar, Malawi, Maldives, Mali, Marshall Islands, Martinique, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Rwanda, Saint Lucia, Saint Vincent and The Grenadines, Samoa, Senegal, Seychelles, Sierra Leone, South Africa, Solomon Islands, Somalia, Sri Lanka, Sudan, Suriname, Swaziland, Tajikistan, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, West Bank and Gaza Strip, Yemen, Zambia, and Zimbabwe.

CURRENT PROJECTS

Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems

The Committee on Assessing the Services and Values of Aquatic and Related Terrestrial Ecosystems was formed in early 2002 to identify and assess existing methods for defining and assigning economic values to services of aquatic and related terrestrial ecosystems. The study is reviewing the errors and biases characteristic of such methods and providing guidance to the use of such methods to improve environmental decision making.

The committee held its final meeting in August 27, 2003, in Washington, DC. The study is jointly sponsored by the U.S. Environmental Protection Agency, the U.S. Corps of Engineers, and the U.S. Department of Agriculture. The committee's report will be in review in January 2004 and be released in pre-publication by Spring 2004. Geoffrey Heal of Columbia University chairs the committee. For more information, contact Mark Gibson at (202) 334-3422 or mgibson@nas.edu.

Assessment of the National Weather Service Advanced Hydrologic Prediction Service (AHPS) Initiative

Floods and droughts cause enormous damage to the nation's economy through loss of property and lives. Property damage from the 1993 Mississippi River floods is estimated at \$12 billion. One hundred lives are lost each year due to river flooding. Droughts cause large amounts of crop damage in rural America, leading to bankruptcy and dislocation of families. Clearly, hydrologic forecasting is critical to public safety and economic planning considerations.

The Office of Hydrology of the NWS operates 13 river forecast centers in the United States to produce both short- and long-term river flow/stage forecasts at about 4,000 locations. The country's population has grown tremendously since these centers were established several decades ago. Urbanization, industrial growth, the increased habitation of flood-prone regions, pos-

sible increased severity of weather resulting from climate change, advanced technologies, applied research, and more sophisticated customers present both challenges and opportunities. In light of these changes, the NWS reassessed its hydrologic services and determined that enhancements are necessary to best provide reliable hydrologic information for decisions to protect life and property. The Advanced Hydrologic Prediction Service (AHPS) initiative grew out of this assessment.

The WSTB is just beginning a 14-month study to review AHPS. The study will assess the full scope of the program, aimed at improving the nation's river forecasts, in respect to hydrologic science and technology research, river routing and mechanics, "systems" engineering aspects, and end-user application and implementation. A panel of 11 people has been approved as the committee to review the AHPS program. It is chaired by Soroosh Sorooshian (NAE), University of California Irvine. Other members include Dara Entekhabi, MIT; Efi Foufoula-Georgiou, University of Minnesota and WSTB Board Member; Burrell Montz, SUNY Binghamton; Richard Anthes, NCAR; William Hooke, American Meteorological Society; Richard Palmer, University of Washington; Glenn Moglen, University of Maryland; George Leavesley, USGS Denver; Liming Xu, FM Global Research; and Doug Plasencia, AMEC Earth and Environmental. For additional information, please contact Lauren Alexander at (202)334-3422 or lealexander@nas.edu.

Assessment of U.S. Army Corps of Engineers' Economics and Environmental Analysis and Peer Review for Water Resources Project Planning

This activity is reviewing the Corps of Engineers' planning procedures and methods of analysis and is nearing completion. Referred to as "the 216 studies" (after Section 216 of the Water Resources Development Act of 2000 that mandated them), the panels in this multiple-panel activity have completed their meetings and have either issued reports or are responding to comments

from external reviewers. This activity is overseen by the WSTB, which has worked in cooperation with the NRC's Ocean Studies Board and with input from the Board on Environmental Studies and Toxicology and the Transportation Research Board. The activity includes a coordinating committee and four study panels that are evaluating the topics of peer review, methods of analysis for project planning, river basins/coastal systems planning, and adaptive management. The *peer review* panel issued its report in July 2002. Reports from the other four committees/panels are currently in review and are scheduled to be published in early 2004.

The *coordinating committee* is tracking progress of the study panels, ensuring consistency among them, and is producing a synthesis document of findings of the study panels and writing a report with its own findings and conclusions. Members of the coordinating committee include chairs of the four study panels, plus several other water resources management experts. The *methods of analysis for project planning* panel is reviewing the Corps' methods for project planning, which are embodied primarily in the federal "Principles and Guidelines" and the Corps' own Planning Guidance Notebook. The *river basins and coastal systems* panel is reviewing the Corps' methods and approaches for planning and coordinating water projects across watershed and river basin systems. Finally, the *adaptive management* panel is reviewing the Corps' efforts and future prospects in implementing the adaptive management paradigm in managing its water resources projects. For more information on this activity, contact Jeffrey Jacobs at (202) 334-3422 or jjacobs@nas.edu.

Assessment of Water Resources Research

In 2002, Congress mandated that the NRC conduct a study to determine the federal investment in water resources research, partly as a follow-up activity to the WSTB's report *Envision-*

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Current Projects

ing the Agenda for Water Resources Research in the Twenty-First Century. The resulting committee of 13 experts has been meeting since September 2002. In order to determine the adequacy of the nation's investment in water resources research, the committee has been collecting and analyzing budget information supplied by over 30 federal agency and non-federal organization liaisons. The committee held its final meeting December 15-16, 2003 in Washington, DC. The report is expected to go into review in late winter 2004, with a prepublication version of the report available in spring 2004. Henry Vaux of the University of California at Berkeley is serving as committee chair. The study is sponsored by the U.S. Geological Survey. For more information, contact Laura Ehlers at (202)334-3422 or lehlers@nas.edu.

Endangered and Threatened Species in the Platte River Basin

The WSTB is supporting the Board on Environmental Studies and Toxicology on a study of four endangered and threatened species of the Platte River Basin. The committee assembled is charged by the sponsors, Bureau of Reclamation and Fish and Wildlife Service (FWS), to review the government's assessments of how current Platte River operations and resulting hydrogeomorphological and ecological habitat conditions affect the likelihood of survival and/or limit the recovery of four endangered species: the interior least tern, Northern Great Plains breeding population of the piping plover, the whooping crane, and the pallid sturgeon. The committee will also consider (1) whether other Platte River habitats do or can provide the same values that are essential to the survival and/or recovery of these species and (2) scientific foundations for the current federal designation of the Central Platte habitat as "critical habitat" for the whooping crane and Northern Great Plains breeding population of the piping plover. The study will further examine the scientific aspects of (1) the

processes and methods used by the FWS in developing its Central Platte River instream flow recommendations; (2) characteristics described in the FWS habitat suitability guidelines for the Central Platte River; and (3) the Department of the Interior's conclusions about the interrelationships among sediment movement, hydrologic flow, vegetation, and channel morphology in the Central Platte River.

The committee held all three of its meetings in 2003—the first in May in Kearney, NE; the second in August in Grand Island, NE, and the third in Boulder, CO in October. The committee's report is currently in review and should be released to the public in early Spring 2004. The committee is chaired by William Graf of the University of South Carolina. For more information, please contact Lauren Alexander at (202)334-3422 or lealexander@nas.edu.

Indicators for Waterborne Pathogens

Acknowledging recent advances in microbiology and molecular biology and in response to recently proposed rules and legislation concerning microbial contamination of water (e.g., the Long-Term 2 Enhanced Surface Water Treatment Rule), EPA's Office of Water contacted the NRC's Board on Life Sciences and WSTB in late 2001 to undertake a study of indicators of microbial pathogen contamination in source waters (including groundwater) for drinking water and U.S. recreational waters (including coastal marine water and marine/estuarine water). The committee is near completion of its report, which would recommend candidate indicators and/or indicator approaches for waterborne pathogens that are deemed scientifically defensible and practical to monitor and the change that might happen with future technological developments. As part of this effort, the committee also reviewed and provided perspective on the current and future importance and public health impact of waterborne pathogens both in terms of drinking water and recreational contact activities. Since its appointment in early 2002, the committee has met a

total of four times. The committee's report entered review in November 2003 and a final report is anticipated to be released in prepublication in February 2004.

The committee is chaired by Mary Jane Osborn (NAS), University of Connecticut, and vice-chaired by R. Rhodes Trussell (NAE), Trussell Technologies, Inc. For further information, contact Mark Gibson at (202) 334-3422 or mgibson@nas.edu.

Instream Flows for Texas

The Texas Water Development Board, in conjunction with the Texas Parks and Wildlife Department and the Texas Commission on Environmental Quality, recently asked the WSTB to critically evaluate the scientific methods, materials, and related technical aspects of proposed studies to determine the physical, chemical, and biological needs for instream flows within selected priority watersheds in the state of Texas. The Texas Legislature enacted a bill that established an Instream Flow Program for Texas that aims to determine flow conditions necessary to support a sound ecological environment in selected rivers. The Texas Programmatic Work Plan identifies priority studies, general methodologies for those studies, and agency roles and responsibilities, and the three state agency sponsors have prepared additional, detailed, technical descriptions of the methods and materials that are proposed for use in the studies.

A new committee is charged to evaluate the Programmatic Workplan and its technical volume and review the scientific and engineering methods proposed by the three State agencies. Considerations for establishing instream flows include hydrology, biology, geomorphology, and water quality. Additionally, the study will consider and comment on legal and policy factors related to the instream flow program in Texas.

Gail Mallard of USGS chairs the committee. The other members are Kenneth Dickson, University of North Texas; Thomas Hardy, Utah State University; Clark Hubbs, University of Texas at Austin; David Maidment, University of Texas at

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Austin; James Martin, University of Colorado School of Law; Patrick McDowell, University of Oregon; Brian Richter, The Nature Conservancy; Gregory Wilkerson, University of Wyoming; Kirk Winemiller, Texas A&M University; and David Woolhiser, consultant. The committee held its first meeting in Austin in October 2003 with an attendance of more than 100 people during the open session. The next committee meetings will be in January and March of 2004 in Texas. A published report is expected in the fall of 2004. For other information, please contact Lauren Alexander at (202)334-3422 or lealexander@nas.edu.

Restoration of the Greater Everglades Ecosystem

The Everglades was once a free-flowing "river of grass" extending from the Kissimmee lakes to Florida Bay. However, more than half the Everglades wetlands have been lost to development. The NRC's Committee on Restoration of the Greater Everglades Ecosystem (CROGEE) was formed in 1999 to provide scientific guidance to agencies charged with restoration and preservation of the Everglades. In 2003, the committee published two reports: *Adaptive Monitoring and Assessment for the Comprehensive Everglades Restoration Plan* and *Does Water Flow Influence Everglades Landscape Patterns?* Earlier studies by CROGEE and a related panel resulted in reports on aquifer storage and recovery, Florida Bay restoration issues, and the Interior Department's Critical Ecosystem Studies Initiative.

The committee is currently working on a report to be completed this summer on issues surrounding storage of water in the Comprehensive Everglades Restoration Plan (CERP), including aboveground storage reservoirs in the northern Everglades, inground storage in limestone quarries, and aquifer storage and recovery. This is expected to be the last report for the CROGEE, which has existed for over four years.

The WSTB is currently preparing to organize a new "Independent Scientific Review Panel" (ISRP) for the Everglades. This Congressionally mandated activity will provide a biennial assessment of progress in restoring the ecosystem, including significant accomplishments and challenges to be met in the plan's implementation. The NRC and Interior Department managers are also in discussions concerning prospects for another review of the DOI's science activities.

Funding for the committee's work is provided by the DOI and the U.S. Army Corps of Engineers. For more information, contact study director Stephen Parker at (202) 334-3422 or sdparker@nas.edu.

Source Removal of Contaminants in the Subsurface

Since August 2002, the WSTB has conducted a study on the effectiveness of source remediation for cleaning up contaminated groundwater and soil at hazardous waste sites. Certain aggressive technologies, including *in situ* chemical oxidation, thermal treatment, and surfactant flushing, are increasingly popular as a way to achieve partial or complete reduction of contaminant mass at sites across the country. Little is known about the overall impact of such efforts on groundwater quality and other parameters. The study is focusing on recalcitrant organic compounds, including dense non-aqueous phase liquids and chemical explosives.

At its fourth meeting held in Irvine, CA, the committee heard presentations on the water quality benefits of mass removal from Suresh Rao, Purdue University; Tissa Illangasekare, Colorado School of Mines; Lawrence Lemke, University of Michigan; and from committee members Tom Sale of Colorado State University and Gary Pope of the University of Texas. The committee was also updated on a soon to be published report from an expert panel convened by EPA to study source remediation. The fifth meeting of the committee, November 17–19, in Washington, DC, was held entirely in closed session. The committee's final meeting is scheduled

for February 23–24, 2004, in Sedona, AZ. John Fountain of North Carolina State University is serving as committee chair. The study is sponsored by the Army Environmental Center. For more information, contact Laura Ehlers at (202)334-3422 or lehlers@nas.edu.

U.S. Geological Survey Water Resources Research

The Committee on U.S. Geological Survey Water Resources Research was formed in 1985 to advise the USGS on its programs in the Water Resources Division. Previous reports of the committee included topics such as watershed research, hydrologic hazards, the stream-gaging network, groundwater research, and water use. The committee's overview of the National Streamflow Information Program (NSIP) is in review. NSIP consists of a core of streamgages funded and operated by either the USGS or other agencies that provide data that meet national needs. The committee is evaluating the appropriateness of the NSIP-selected minimum national streamflow information needs and design characteristics of the network, and the components of the NSIP plan.

A new study to advise the USGS on its programs in "river science" will be underway by March 2004 if approved. River science refers to interactions among streamflow, channel characteristics, water quality, riparian and aquatic ecological systems, and sediment erosion and deposition. It also considers how natural processes and human activities in the watershed and along the river corridor affect the characteristics of the river, its water and riparian zone, and the services (including ecosystem services) that it provides. Funding for the committee's work is provided by the USGS Water Resources Division. Donald Siegel of Syracuse University chairs the committee. For more information, contact study director Will Logan at (202) 334-3422 or wlogan@nas.edu.

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FUTURE PROJECTS

Assessment of the Science and Practice of Stream Restoration

Nationwide, there are thousands of streams and rivers degraded by human disturbance or modification. Both the public and private sectors consider restoring these waterbodies as critical to maintaining and improving water quality, sustaining fish and wildlife species, protecting wetlands, and reducing impacts of flood events. To consider this important topic, the WSTB hosted a workshop on *Stream Restoration* on August 14-15, 2003 at the St. Anthony's Falls Laboratory, University of Minnesota, Minneapolis. It was co-sponsored by the National Center for Earth-Surface Dynamics.

The workshop covered four main themes: the multidisciplinary and multiobjective nature of stream restoration, the effectiveness of current restoration practices, the science requirements to support advances in restoration practice, and institutional issues surrounding stream restoration. It has led to a draft proposal for a larger NRC study on stream restoration. This is being

circulated to various governmental and non-governmental institutions for comment. For information, contact William Logan at (202) 334-3422 or wlogan@nas.edu.

Disinfection Issues and Alternatives

Disinfection of water has been a cornerstone of public health protection for over 100 years. It is accomplished by the use of chemicals (most commonly chlorine) or by ultraviolet radiation, and it is important in industry, health-care, home hygiene, drinking water, and wastewater applications. There are mounting concerns regarding the use of disinfectants because of the potential for the creation of harmful disinfection byproducts and other environmental impacts. Thus, there is a growing, widespread need for better understanding of the efficacy, benefits, and environmental costs of disinfectants and for an exploration of alternative disinfectants. This need is equally vital for industry and government.

The WSTB is making plans to assess current scientific understanding of water and wastewater disinfection processes and their alternatives. For a suite

of chemical and physical disinfectants—including chlorine, ozone, and UV irradiation—the study will summarize the current state of knowledge regarding primary disinfection, including emerging pathogens and disinfectants, the mechanisms of microbial inactivation via disinfection, and microbial resistance to disinfectants vs. microbial tolerance. It will evaluate methods used to quantify disinfection efficacy and outcome, and it will draw parallels with methods of efficacy testing used in other fields. Finally, the study will summarize the gaps in the science and practice of disinfection that limit understanding of this process.

Funding and precise focus for this study are still in discussion. For further information, contact Laura Ehlers at (202) 334-3422 or lehlers@nas.edu.

Great Lakes/St. Lawrence Seaway Studies

The Great Lakes Protection Fund approached the NRC to elicit a wide range of transportation options and concepts for the Great Lakes region that would (1) promote international com-

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Water Quality Improvement in Pittsburgh Region

The Committee on Water Quality Improvement for the Pittsburgh Region was formed in early 2002 to undertake a study of the wastewater and water quality problems of the Pittsburgh, PA area and make recommendations on how the region's needs and issues can be best addressed on a cooperative basis by multiple jurisdictions. The study intends to provide guidance to both public and private organizations of the Pittsburgh region in developing public awareness of the issues and collaborative strategies for water quality improvement and management. The study sponsor is the Allegheny Conference on Community Development.

The committee met on October 2-3, 2003 in Mars, PA. The final committee meeting is scheduled for February 5-6, 2004 in Washington, D.C. The committee's report is anticipated to enter

review in early Spring 2004 and be released in late Spring 2004. The committee is chaired by Jerome Gilbert (NAE), J. Gilbert, Inc. of Orinda, CA. For more information, contact Mark Gibson at (202) 334-3422 or mgibson@nas.edu.

Water Resources Management, Instream Flows, and Salmon Survival on the Columbia River, Washington

The WSTB, in cooperation with the NRC's Board on Environmental Studies and Toxicology, has assembled a committee that is reviewing relations between instream flows, water withdrawals, and impacts on salmon survival in the Columbia River in the State of Washington. The study was initiated in response to a request from the Washington State Department of Ecology. The Department of Ecology issues water withdrawal permits and water rights on the Columbia River within the State of Washington. Decisions regarding dozens of permit applications from the

Columbia mainstem are currently pending. The Department of Ecology must balance its water permitting decisions with environmental protection responsibilities. This study will comment on the implications of a range of withdrawals for the survival of salmon and will evaluate a range of specific water management scenarios provided by the Department of Ecology. The committee's fourth and final meeting was held in Washington, D.C. on November 3-4 and the draft report is currently in external review.

The committee is chaired by Ernest Smerdon, University of Arizona (emeritus). For additional information on this committee, contact study director Jeffrey Jacobs at (202) 334-3422 or jjacobs@nas.edu.

Future Projects

merce and (2) eliminate the introduction of additional non-indigenous species and pathogens into the Great Lakes due to ocean-going vessels transiting the St. Lawrence Seaway. The Transportation Research Board (TRB) and the WSTB together generated a proposal that has been submitted to the Great Lakes Protection Fund, and the proposal was accepted by the Great Lakes Protection Fund Board of Directors in early December 2003. A contract was recently executed. The WSTB will support the TRB in conducting this two-phase study which has as its proposed centerpiece a competition to identify transportation designs and concepts that prevent further introductions of non-indigenous aquatic species by vessels using the St. Lawrence Seaway.

In Phase I, a multi-disciplinary committee will develop criteria for the competition, design a conference at which the designs and concepts will be presented and discussed, and assemble statistics on the Great Lakes region's economy, trade, and transportation. In Phase II, the competition will be held at a major regional conference and the Phase II committee will award prizes and identify a list of promising transportation options. The final report will highlight these options, and will also provide background on the history of non-indigenous species introduced into the Great Lakes via the St. Lawrence Seaway and their ecological and economic consequences.

After the contract has been established, TRB and WSTB will constitute a committee, from within and outside the Great Lakes Basin, that will represent a blend of necessary disciplines (biology, engineering, economics, planning) and perspectives (academia, government, industry, non-governmental organizations). For other information or to nominate committee members, please contact Lauren Alexander at (202)334-3422 or lealexander@nas.edu.

State Water Quality Monitoring Program in Support of Water Quality Management

The WSTB is preparing to begin a study that will assess the adequacy of current state water quality monitoring efforts, at the request of the EPA Office of Wetlands, Oceans, and Watersheds. WSTB has submitted a formal proposal to EPA and is awaiting establishment of a contract. The proposed study will evaluate the effectiveness of current state programs for monitoring the health of the nation's waters and make suggestions for improvement, with an emphasis on better linking the water quality standard setting process and monitoring network design. Several issues will be considered, including water body segmentation, innovative or alternative means for setting water quality standards, appropriate monitoring approaches and monitoring network design, statistical approaches for making attainment determinations, and the relationship between state water quality monitoring efforts and other potentially complementary activities. The resulting report should help improve and advance the water quality monitoring efforts of EPA, states, and other entities.

Once a contract with EPA has been established, WSTB will be forming a committee of approximately 13 with expertise in the areas of aquatic chemistry, watershed and water resources management, aquatic and estuarine ecology, hydrology, statistics, and water quality monitoring (including emerging technologies). For further information, or to nominate committee members, contact Laura Ehlers at (202)334-3422 or lehlers@nas.edu.

Sustainable Underground Storage of Recoverable Water

The WSTB hosted a workshop on *Sustainable Underground Storage of Recoverable Water* on April 23, 2003 at the National Academies, Washington, DC. It was co-hosted by the AWWA Research Foundation (AwwaRF). It examined an increasingly important strategy for water management, namely temporary detention and underground storage of surface water during times of ex-

cess for release during times of need. It identified the need for a methodology or systems approach to evaluate the potential viability of aquifer storage at a given site, and for evaluation of the national regulatory framework for underground storage of water. It also identified some key research gaps for a future NRC study, including human health risks from microbes, endocrine disruptors, and other chemicals; monitoring issues such as what to monitor, how often to monitor, and whether there are chemical markers or surrogates that could be used in some cases; and modeling approaches that might be useful under variable and complex hydraulic and chemical conditions.

Grant proposals have been submitted to a wide range of foundations and federal agencies to fund an ad hoc study on the topic. For further information, contact William Logan at (202) 334-3422 or wlogan@nas.edu.

Water 2025: WSTB as Advisor

For several months, the U.S. Department of the Interior has been making plans for a new initiative known as Water 2025. The effort is intended to focus attention on the reality that explosive population growth in western urban areas, the emerging need for water for environmental and recreational uses, and the national importance of the domestic production of food and fiber from western farms and ranches may drive major conflicts between these competing uses of water. In some areas of the West, existing water supplies are, or will be, inadequate to meet the demands for water for people, cities, farms, and the environment even under normal water supply conditions.

Water 2025 will seek to provide the basis for a public discussion in advance of water crises and set forth a framework to focus on meeting water supply challenges in the future. To this end, Water 2025 will feature: conservation, efficiency, and markets; collaboration; improved technology; and removal of institutional barriers and increase inter-agency cooperation.

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WSTB REPORTS

Groundwater Fluxes at Interfaces (2004)

This report is a documentation of a workshop conducted by the Committee on Hydrologic Sciences to discuss issues relating to recharge and discharge of groundwater. The report is currently available in prepublication and will soon be released in a published format (<http://www.nap.edu>).

Review of the U.S. Army Corps of Engineers Restructured Draft Feasibility Study for the Upper Mississippi River-Illinois Waterway Restructured Feasibility Study: Interim Report (2004)

This report is a followup to a 2001 NRC study, Inland Navigation System Planning. It reviews the Restructured Feasibility Study on the Upper Mississippi River-Illinois Waterway Systems Plan. Available from the WSTB at (202)334-3422. Read-only copy available at <http://www.nap.edu>.

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The DOI-led effort plans to:

- facilitate a more forward-looking focus on water-starved areas of the country;
- help to stretch or increase water supplies to satisfy the demands of growing populations, protect environmental needs, and strengthen regional, tribal, and local economies;
- provide added environmental benefits to many watersheds, rivers, and streams;
- minimize water crises in critical watersheds by improving the environment and addressing the effects of drought on important economies; and
- provide a balanced, practical approach to water management for the next century.

The WSTB is expecting to play a significant advisory role as Water 2025 takes shape. Specifics are in discussion. For more information, contact WSTB director Stephen D. Parker at (202) 334-3422 or sdparker@nas.edu.

A Review of the EPA Security Research and Technical Support Action Plan (2003)

This report soon to be released in final published format reviews Water Security Research and Action Plan of the EPA, the lead agency responsible for the security of the national water supply. Available for \$25.88 (*see order form*).

Adaptive Monitoring and Assessment for Comprehensive Everglades Restoration Plan (2003)

This report discusses methods in identifying performance measures and system level conditions for the Greater Everglades Restoration Monitoring and Assessment Plan. Available for \$18.00 (*see order form*).

Does Water Flow Influence Everglades Landscape Patterns? (2003)

This report evaluates the Science Coordination Team White Paper on flow velocity in the Everglades ridge and slough landscape with respect to environmental significance, creation, maintenance, degradation, research needs, and performance measures. Available for \$14.40 (*see order form*).

Environmental Cleanup at Navy Facilities: Adaptive Site Management (2003)

This report looks at developing a decisionmaking framework to site clean up that is embodied within a "system engineering approach," which would allow for reconsideration of remedies over time. It is a followup to 1999 NRC report *Environmental Cleanup at Navy Facilities: Risk-Based Methods*. Available at \$37.00 prepublication (*see order form*).

Aquifer Storage and Recovery in the Comprehensive Everglades Restoration Plan: A Review of the ASR Regional Study Project Management Plan of the Comprehensive Everglades Restoration Plan (2002)

This report reviews the project management plan for the aquifer storage and recovery regional study on adequacy of the proposed scientific methods to address key issues raised by the Committee on Restoration of the Everglades Ecosystem and the ASR Issue Team of the South Florida Ecosystem Restoration Task Force Working Group. Available for \$18.00 (*see order form*).

Review Procedures for Water Resources Planning (2002)

This report is the first of a series from a larger study assessing the U.S. Army Corps of Engineers' methods of analysis and review procedures for its water resources project planning. It recommends ways to improve review procedures for Corps planning studies. Available for \$12.00 (*see order form*).

Florida Bay Research Programs and Their Relation to the Comprehensive Everglades Restoration Plan (2002)

This report evaluates Florida Bay studies and restoration activities that affect the success of the Comprehensive Everglades Restoration Plan. Available for \$18.00 (*see order form*).

Review of the Florida Keys Carrying Capacity Study (2002)

This report assesses and makes recommendations on scientific methods, principles, and data that form the independent and critical reviews of the "Florida Keys Carrying Capacity Study: Test Carrying Capacity Analysis Model. First Draft." Available for \$38.25 (*see order form*).

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Water Science and Technology Board

The Water Science and Technology Board (WSTB) is a unit of the National Research Council, which serves as an independent advisor to the federal government on scientific and technical questions of national importance. The National Research Council, jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, brings the resources of the scientific and technical community to bear on national problems through its volunteer advisory committees.

This newsletter is produced three times a year and is distributed at no charge to subscribers in February, June, and October each year. Editorial office: National Research Council, Water Science and Technology Board, Keck 607, 2101 Constitution Avenue., N.W., Washington, D.C. 20418, 202-334-3422. If you wish to receive the newsletter via email, send a request to edguzman@nas.edu.

Editor: William Logan
Associate editor: Ellen de Guzman

WSTB Reports

Compensating for Wetland Losses Under the Clean Water Act (2002)

This report evaluates mitigation practice as a way to restore and maintain quality of the nation's waters, particularly under the Clean Water Act. Available for \$49.95 (*see order form*).

Bioavailability of Contaminants in Soils and Sediments (2002)

This report assesses the current scientific understanding of processes that affect whether chemical contaminants present in soils and sediments at contaminated sites are bioavailable to humans, animals, and plants. Available for \$68.50 (*see order form*).

Privatization of Water Services in the United States: An Assessment of Issues and Experiences (2002)

This report identifies and explains the different issues and factors that drive municipalities to consider privatization as an option for providing and managing water services. Available for \$39.95 (*see order form*).

Opportunities to Improve the U.S. Geological Survey National Water Quality Assessment Program (2002)

This report reviews the U.S. Geological Survey's National Water Quality Assessment Program and makes recommendations as the program enters into its second decade. Available for \$34.00 (*see order form*).

Predictability and Limits-to-Prediction in Hydrologic Systems (2002)

This is a report of a workshop on Predictability and Limit-to-Prediction in Hydrologic Systems. The report discusses research milestones in this field. Available from the WSTB at (202)334-3422.

Estimating Water Use in the United States: A New Paradigm for the National Water-Use Information Program (2002)

This report reviews the USGS National Water-Use Information Program (NWUIP) and makes recommendations and identifies opportunities. Available from the WSTB at (202)334-3422.

Review of the USGCRP Plan for a New Scientific Initiative on the Global Water Cycle (2002)

The report reviews and provides comments on the USGCRP report *A Plan for a New Scientific Initiative on the Global Water*

Cycle. Available from the WSTB at (202)334-3422.

Missouri River Ecosystem: Exploring the Prospects for Recovery (2002)

The report reviews the Missouri River ecosystem's status and trends, science programs and status of scientific knowledge, and organizational choices for supporting ecosystem monitoring programs and for implementing adaptive management. Prepublication copies of the report is available from the WSTB at (202)334-3422.

Riparian Areas: Functions and Strategies for Management (2002)

The report discusses the characteristics, functioning, and services of riparian areas and makes recommendations on protecting and managing them. Available for \$52.00 (*see order form*).

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This report presents new conceptual approach to the generation of future Candidate Contaminant Lists and explores the feasibility of developing and using mechanisms for identifying emerging microbial pathogens for research and regulatory activities. Available for \$42.00 (*see order form*).

Envisioning the Agenda for Water Resources Research in the Twenty-first Century (2001)

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This report reviews the Corps' draft feasibility study that gauges the economic viability of extending several locks on the Upper Mississippi River-Illinois Waterway. Available for \$29.75 (*see order form*).

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This report evaluates pilot projects for ASR

in the Everglades. It makes recommendations for studies of regional impacts, water quality, and system performance. Available from the WSTB at (202)334-3422.

Investigating Groundwater Systems on Regional and National Scales (2000)

This report makes recommendations concerning the USGS Ground-Water Resources Program, which is designed to do regional groundwater assessment and science. Available for \$29.00 (*see order form*).

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This report examines new and improved noninvasive methods for characterization of the shallow subsurface of the earth. Available for \$35.00 (*see order form*).

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This report examines natural attenuation issues about such as public concerns, scientific bases, and the criteria for evaluating its potential for success or failure. Available for \$47.95 (*see order form*).

Watershed Management for Potable Water Supply: Assessing the New York City Strategy (2000)

This report evaluates the New York City watershed management plan that is allowing the City to avoid filtration of its large up-state surface water supply. A broad range of conclusions and recommendations are made, many of which are applicable to surface water supplies across the country. Available for \$56.00 (*see order form*).

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