

## **Opportunities for Water Security Research: The Aftermath of Hurricane Katrina -- Letter Report**

Committee on Water System Security Research,  
National Research Council

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November 10, 2005

Mr. Kim Fox  
Director  
Water Infrastructure Protection Division  
National Homeland Security Research Center  
U.S. Environmental Protection Agency  
26 West Martin Luther King Drive  
Cincinnati, Ohio 45268

Dear Mr. Fox:

The National Research Council (NRC) would like to offer this letter report on opportunities for water security research afforded by the occurrence of Hurricane Katrina. The NRC's Committee on Water System Security Research (see Attachment A) was created to advise Environmental Protection Agency's (EPA) National Homeland Security Research Center (NHSRC) and its Water Infrastructure Protection Division. This committee builds upon the work of a previous NRC panel, which reviewed the initial water security activities of the NHSRC and issued two reports in 2004.<sup>1</sup> Our new committee has the opportunity to advise the NHSRC as it transitions from a three-year "temporary" research center to a "permanent" center with a longer-term vision and the potential for more complex research endeavors. The committee is currently working to review the progress of EPA's water security research and to identify short- and long-term research priorities (see Attachment B), and its final report is anticipated to be completed in September 2006. However, the committee was also asked to provide letter reports on issues of particular concern for which more immediate advice could be given.

Between our committee's second and third meetings, the nation witnessed the traumatic and catastrophic occurrence of Hurricane Katrina. This natural disaster affected, and in some cases completely destroyed, critical infrastructure including many large and small water and wastewater conveyance and treatment systems in a huge area along the coast of the Gulf of Mexico. Hurricane Katrina also brought two water security issues into dramatic focus: the effects of a total breakdown in drinking water and wastewater systems and the problems brought about by failures of critical interdependent infrastructures (transportation, power, supply chain, etc.).

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<sup>1</sup> National Research Council. 2004. A Review of the EPA Water Security Research and Technical Support Action Plan—Parts I and II. Washington, DC: National Academies Press.

Hurricane Katrina's lessons are real and not speculative. At our committee's third meeting in October, we discussed with EPA colleagues how the experience of Katrina could be used to mine important lessons and data and thereby advance the nation's abilities to prevent, mitigate, or respond to future water and wastewater system emergencies, including deliberate attacks. It is difficult to imagine prior to an actual event the cascading and compounding impacts on several co-located infrastructure components. The hurricane disaster is a chance to learn from a worst case scenario where entire systems have been simultaneously destroyed and large populations left without service. This is, thankfully, a highly unusual occurrence; therefore, this opportunity should be used to the fullest extent possible to better understand how intentional acts of a similar nature would impact a community and how a community could most effectively recover from such an event. The lessons learned from Hurricane Katrina also have important "dual use" applications for both terrorism and other natural disasters, such as earthquakes.

Several NHSRC personnel who were deployed to the Gulf Coast region were able to see the results of the destruction first hand, and the NHSRC staff clearly recognized the value of the opportunity offered by the Katrina experience. We strongly encourage EPA's NHSRC to organize a systematic review of researchable questions related to the vulnerabilities of water and wastewater systems and examine lessons learned for response and recovery in the aftermath of Hurricane Katrina. Questions are suggested below in three major areas that could serve to focus such a review:

*Vulnerabilities:*

- What parts of the water and wastewater systems failed (e.g., pumps, treatment plant, the distribution network, or the total system)? What caused the failures?
- What were the key vulnerabilities in the water and wastewater systems revealed by this event? Are these components of the system just as vulnerable to intentional destruction?
- What were the outstanding interdependency issues revealed by this incident (e.g., power, transportation, supply chain)?

*Impacts and Mitigation Strategies:*

- What steps could have been taken to prevent or mitigate the damage? For example, could an alternate distribution system design, such as built-in redundancy, have significantly reduced the impacts to the system integrity or the time required for system recovery, and if so, what are the costs of such measures?
- What was the extent of the pollution resulting from the shutdown of wastewater systems? What were the public health implications of this pollution? Were available monitoring tools sufficient to assess the situation quickly and notify the public in a timely manner? What design changes or response efforts would have been necessary to contain or limit this pollution?

*Response and Recovery:*

- Were alternative potable water supplies available in sufficient time to meet the needs of the impacted populations? What characteristics should be developed in future emergency portable systems to better respond to water security incidents or natural disasters? Were there institutional or regulatory barriers to the deployment of alternative supplies?

- If appropriate response materials (e.g., computer programs, written memos, and guidance manuals) had been available, would such materials have been of value in this emergency as it unfolded?
- How effective were the communication strategies related to drinking water safety in reaching the most vulnerable populations? How did EPA's existing risk communication strategies serve this particular incident?
- What special problems were encountered prior to full restoration of water or wastewater service, such as disinfection of the system? What protocols were used to assess when the system was clean and when the water was safe for drinking, and how effective were these protocols?
- How quickly was water or wastewater service restored? What were the most significant barriers to prompt restoration of service, considering both technical and non-technical issues (e.g., availability of standby power, cash-flow to finance the recovery activities)? How could restoration of service be effected more quickly in the future? Do the results of these experiences agree with the RESTORE models currently being developed by the EPA and the U.S. Army Corps of Engineers?
- What were the outstanding workforce and personnel issues related to water and wastewater systems? Which personnel were in shortest supply and in the most sensitive roles such that back-up or redundancy in their tasks would have been beneficial?

Because there is value in understanding the lessons learned in water and wastewater systems of varying size, we suggest that this Hurricane Katrina review should include a number of smaller community water and wastewater systems, not just the systems in New Orleans.

There is a level of urgency about this reconnaissance work as physical evidence and the memory of eye-witnesses begins to fade. EPA clearly recognizes this urgency by the fact that they have recently sought internal funding to support this general initiative, and the committee commends EPA for moving forward quickly.

The above list of suggested research topics is admittedly long and varied, and the committee trusts that EPA will evaluate these time-sensitive opportunities for learning in the context of the overall information needs for water security, considering their other research needs and the availability of funding. The committee chose not to prioritize among the above topics, recognizing that EPA managers can best determine how these opportunities can complement their ongoing efforts.

The committee believes EPA has the expertise to conduct this type of review. We suggest, however, that EPA seek additional input from other relevant organizations and agencies. For example, the Centers for Disease Control and Prevention could contribute their perspective on the public health impacts from the loss of water and wastewater systems during this incident. Professional organizations, such as the Water Environment Foundation, the American Water Works Association, and the American Society of Civil Engineers, could contribute valuable insight from an industry perspective.

In summary, we believe much could be learned from a thorough evaluation of the water and wastewater system failures resulting from Hurricane Katrina that would have direct applicability to the work of EPA's National Homeland Security Research Center. As tragic as this disaster has been, it now provides a unique, real world laboratory in which to study water

**system failures and service restoration. However, there is a certain urgency to getting such a systematic review of lessons learned underway.**

This letter report reflects the consensus of the NRC committee and has been reviewed in accordance with the procedures of the NRC. We hope our report is useful to you as you move forward, and we appreciate the opportunity to advise you on this important and challenging work.

Sincerely,



David Ozonoff, Chair  
Committee on Water System  
Security Research

Attachment A: Committee membership

Attachment B: Statement of task

## **Attachment A**

### **Committee Membership**

David M. Ozonoff, *Chair*, Boston University School of Public Health  
Francis A. DiGiano, University of North Carolina, Chapel Hill  
Charles N. Haas, Drexel University, Philadelphia, Pennsylvania  
Anna K. Harding, Oregon State University, Corvallis  
Dennis D. Juranek, Centers for Disease Control and Prevention  
Nancy K. Kim, New York State Department of Health, Albany  
Bruce M. Larson, American Water, Vorhees, New Jersey  
Daniel V. Lim, University of South Florida, Tampa  
Rudolph V. Matalucci, Rudolph Matalucci Consultants, Inc., Albuquerque, New Mexico  
David A. Reckhow, University of Massachusetts, Amherst  
H. Gerald Schwartz, Washington University, St. Louis  
John P. Sullivan, Boston Water and Sewer Commission, Boston, Massachusetts  
George Tchobanoglous, University of California, Davis

## **Attachment B**

### **Statement of Task**

The National Research Council (NRC), through its Water Science and Technology Board (WSTB), has established a committee to provide expert advice to EPA on its homeland security efforts related to water supply and wastewater systems. This new activity will build on the previous, relevant work of the WSTB, including two reviews of EPA's Water Security Research and Technical Support Action Plan completed during 2003. It will be performed by an expert committee that will:

- (1) provide a readily accessible cadre of experience, knowledge, and expertise to advise EPA in support of efforts to maintain safety of the nation's water supplies and wastewater systems;
- (2) review progress by EPA on its water security activities, including the Research and Technical Support Action Plan;
- (3) identify and prioritize short- and long-term research needs in the area of water security, highlighting opportunities for EPA and other federal and state agencies; and
- (4) identify opportunities for coordination of water security related research and improved communication of the results with relevant entities.