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House Science Committee
21st Century Water Planning: The Importance of a Coordinated Approach
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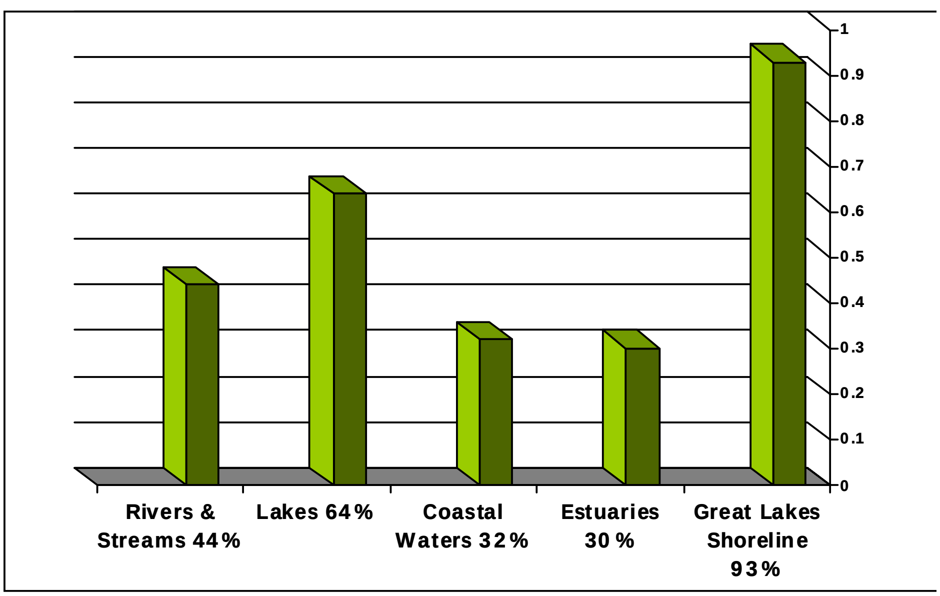
Good morning, Mr. Chairman, and members of the Committee. I appreciate the opportunity to appear before you today to discuss the challenges facing U.S. water resources today and the role of scientific research in addressing those challenges. I will also specifically address the legislative proposals under consideration by this Committee to enhance water research in the U.S.

Water Resource Challenges in the U.S. in the 21st Century

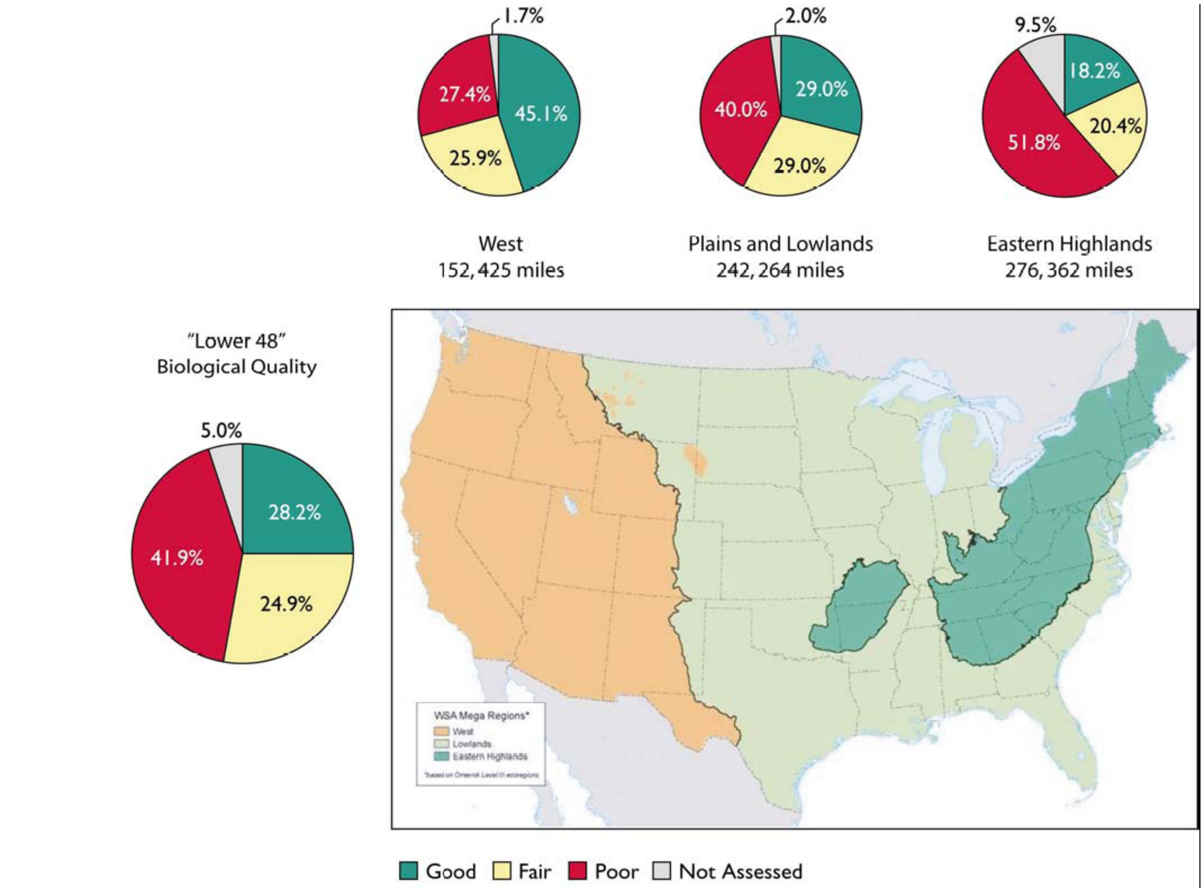
Earlier this year, EPA released its 2004 National Water Quality Inventory Report to Congress. Unfortunately, it demonstrates that very high percentage of our nation's surface waters continue to be unsafe for swimming, drinking, fishing, or other human uses.

Percentage of Assessed U.S. Waterways Impaired for One or More Uses[1]



[1] U.S. EPA, *National Water Quality Inventory: Report to Congress 2004 Reporting Cycle.*

In 2006, U.S. EPA released its first Wadeable Streams Assessment of the biological integrity of 1,392 perennial streams across the U.S. using direct measures of aquatic life. It found 41.9% of streams in poor condition, 24.9% in fair condition, and only 28.2% in good condition.[2]



These reports focus primarily on water quality. However, our natural water systems and services are also deteriorating. Signs of stress are seen in falling groundwater levels and decreasing stream flows, degradation of aquifer water quality, disappearance of wetlands, dead zones in coastal areas such as the Gulf of Mexico, and other changes in hydrologic function.

Many of these negative changes are a result of ill-conceived agricultural, land development, and energy practices—and are symptoms of man's overuse and contamination of water. Destruction of natural ecosystems such as wetlands, forests, and prairies to make way for sprawling cities that pave over the landscape destroying natural hydrology, and monoculture farming that requires excessive quantities of water and fertilizer have led to drying land masses and reduced evapotranspiration, as well as increases in polluted runoff. In order to assure secure and clean water supplies and healthy ecosystems, it will be necessary to redesign the nation's infrastructure around significantly more efficient and sustainable practices.

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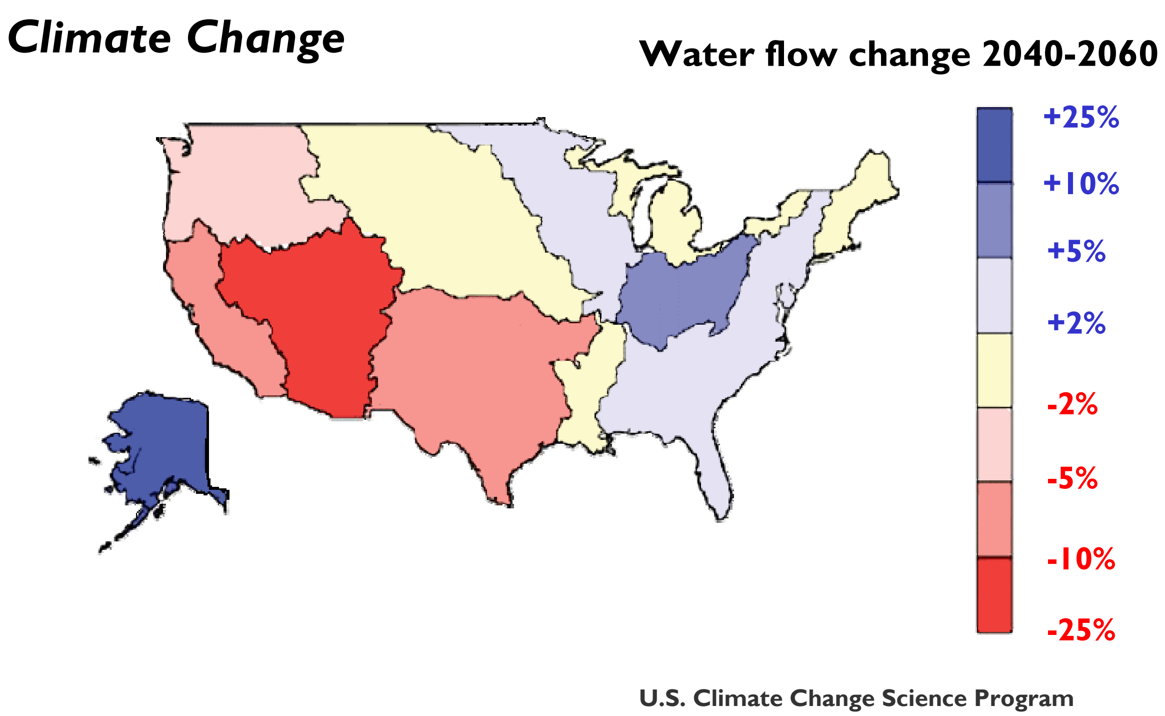
[2] http://www.epa.gov/owow/streamsurvey/.

Climate change is exacerbating stresses on water resources. From urban and agricultural water supplies to flood management and protecting aquatic ecosystems, all aspects of water resource management are being affected by climate change. Rising temperatures, loss of snowpack, escalating size and frequency of flood events, increasingly frequent droughts, and sea level rise are just some of the impacts of climate change that have broad implications to the management of water resources. Many water supply sources (rivers, lakes, groundwater basins, etc.) are already over-allocated, suffer from degraded water quality and are often not in sufficient condition to support endangered species. The past is no longer a tool for predicting future precipitation patterns. While droughts are nothing new, climate change is not only predicted to increase the frequency and intensity of droughts but will also effectively create ongoing drought-like conditions in parts of the U.S.[3] In response to a U.S. General Accounting Office survey in 2003, 36 states indicated that they anticipate local, regional, or statewide water shortages by 2013.[4]

By elevating temperatures, increasing evaporation rates and extending dry seasons, even existing rainfall patterns will yield less in terms of real water supplies. Ironically, global warming is also predicted to increase the frequency and intensity of storm events, which will in some cases provide more overall rainfall. However, intense rain events often deliver too much water at once causing it to runoff instead of soaking into the ground, making it harder to store in reservoirs. Some areas, particularly in the West and Southeast, are predicted to get less precipitation. These climate change related effects, likely in combination, will decrease water supplies both locally and regionally throughout the country.[5]



[3] NRDC 2008. *Hotter and Drier: The West's Changed Climate*; http://www.nrdc.org/globalWarming/west/contents.asp
[4] http://www.gao.gov/new.items/d03514.pdf.
[5] U.S. Climate Change Science Program, http://www.climatescience.gov/

There is also emerging research suggesting that the drying out of land and air may also have a direct effect on the rate of climate change.[6] Additional research on this topic could revolutionize the drivers for water resource management internationally. Reducing greenhouse gas emissions is essential, and the water sector can be part of any solution by reducing energy use through water conservation and efficiency, rainwater harvesting, and groundwater recharge through practices such as low impact development. Greenhouse gas emissions can also be used through practices, such as reduced fertilizer use, that also reduce nutrient pollution. However, reducing greenhouse gas emissions will take time and there is a need to address today's challenges. Implementing actions now to improve water quality and supplies, protect aquatic ecosystems and improve flood management not only make sense, but early action will also help reduce future impacts related to climate change.[7] Adaptation is not a solution to climate change but given the importance of our water resources, immediate action is needed to avert significant societal impacts. Research into the tools that communities need to anticipate impacts of climate change to their water resources and the best set of adaptation strategies to prepare for those impacts is an immediate need.

Our nation's water infrastructure was built around the goal of public health protection through long-distance transport of clean water into cities and of wastewater away from cities. These systems were extremely successful in improving public health in the U.S., particularly during the first half of the 20th century. Now, however, these same systems are increasingly seen as out-of-date and insufficient to meet water resource and public health goals. Scarce water resources are wasted through designs that transport water and wastewater long distances for filtration and treatment and by once-and-done treatment processes that discharge treated waters into streams to be carried out to sea instead of using it for landscape irrigation, toilet flushing, cooling water, and other non-potable needs.

The National Academy of Engineering has recently listed three of the new Century's "Grand Challenges for Engineering" as related to water: restoring and improving urban infrastructure; providing access to clean water; and managing the nitrogen cycle (including nitrogen in wastewater).[8] The Academy recognized that an integrated approach combining energy, water, and wastes (liquid and solid) into "neighborhood systems" needs consideration. These systems will rely on telemetry and information networks, and will incorporate aesthetic designs. As the Academy suggests, "proper engineering approaches can achieve multiple goals, such as better storm drainage and cleaner water, while also enhancing the appearance of the landscape, improving the habitat for wildlife, and offering recreational spaces for people."

The value of designing buildings and subdivisions with both energy and water considerations in mind is becoming more clear among green building practitioners. Water management, for example, is included in the recent Net Zero Energy Building report prepared by an inter-agency task force called the National Science and Technology Council.[9] Wastewater has heat that can be captured, and biogas can be generated at a local scale from sewage, along with food waste and

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[6] http://www.ludiaavoda.sk/dokumenty/WATER_INTOLERANCY_KRAVCIK_DEF_FEB2007.pdf.
[7] http://www.nrdc.org/globalwarming/hotwater/contents.asp.
[8] http://www.engineeringchallenges.org/cms/8996/9221.aspx
[9] http://www.bfrl.nist.gov/buildingtechnology/documents/FederalRDAgendaforNetZeroEnergyHighPerformanceGreenBuildings.pdf.

landscaping materials. Energy costs for water line and sewer pumping stations can be avoided if water is captured, recycled and reused within its natural or originating basin. It only makes sense, then, to provide tax incentives, public building retrofit requirements, and loan guarantees for both energy and water technology advancements within a single program. Other "market transformational" approaches, such as labeling and standards development for energy-efficient appliances and for solar and wind technologies, could also be adopted. EPA's WaterSense program provides data for consumers to choose water-efficient appliances and landscape irrigation services.[10] The success of this program suggests that some similar guidelines for water and wastewater reuse and stormwater management should also be developed.

Treatment approaches typically used are also insufficient to address the broad range of contaminants found in sewage, including excessive nutrients, microbials, such as cryptosporidium and giardia, and pharmaceuticals and personal care products (PPCPs) that are contaminating our waterways and have the potential to threaten public health. The problem of unintended movement of toxic and endocrine-disrupting chemicals and compounds from pharmaceuticals and personal care products to wastewater effluents and drinking water sources is neither new nor unique to the U.S. It is an international problem that has been documented and publicly reported by government experts and academic researchers for over two decades.[11] It is complicated by the fact that the contaminants come from many sources (medical waste, consumer waste, agriculture and industrial uses, etc.), have diverse toxicology profiles and biological activity, may be present in low or trace amounts (parts per trillion), and are likely to have complex and poorly understood toxic interactions (antagonistic, synergistic, additive, etc.). However, these contaminants share one very disturbing characteristic: in general, they are not effectively controlled under U.S. environmental statutes, and are usually not even subject to monitoring. Research into green chemistry, wastestream minimization, and other ways to minimize the risk to people and ecosystems from these substances must become a priority.

Economic benefits of clean, safe water resources

Abundant, safe water resources are essential to a healthy U.S. economy as well as to human and ecosystem health. For example, a new report by scientists working with Restore America's Estuaries found that beach going in the U.S. contributes up to $30 billion annually to the U.S. economy and recreational fishing contributes between $10 and $26 billion.[12] On the flipside, economists from Vanderbilt and Duke Universities estimate the annual economic value of the decline in inland U.S. water quality from 1994 to 2000 to be more than $20 billion.[13] With the economic crisis that the U.S. is facing, we cannot afford to be throwing away valuable natural resources like clean water.

Directing federal research funding towards addressing the challenges facing U.S. water resources will make the U.S. stronger, our families healthier, our wildlife more abundant, and our

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[10] http://www.epa.gov/watersense/.

[11] Kolpin, D.W.; Furlong, E.T.; Meyer, M.T.; Thurman, E.M.; Zaugg, S.D.; Barber, L.B.; Buston, H.T. Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999-2000: A national reconnaissance. Environ. Sci. Technol. 2002, 36, 1202-1211.

[12] http://www.estuaries.org.

[13] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1084077.

communities safer and more resilient to future water and climate disturbances. Those research dollars will also provide immediate employment to scientists, technicians, equipment manufacturers, laborers, and other a whole host of other Americans who can feed their families today and contribute to the long term health and well being of the nation.

Investment in research and development and demonstration projects in 21st Century water infrastructure

The U.S. has experienced a dramatic reduction in water-related research funding in the federal government, as has been noted by both the National Academy of Sciences and the Office of Science and Technology Policy. The 1972 Clean Water Act authorized $100 million in research, which would be worth over $500 million per year in current dollars. However, starting in the 1980s, water infrastructure-related research budgets were systematically reduced, and private sector research spending declined as well.

Because of these continuing reductions in water-related research in the U.S., academic institutions, research institutes, and consulting firms have been reducing employment as well. Dramatic signs of this under-employment include the relocation of Massachusetts Institute of Technology water researchers to Singapore, where $300 million is being invested by that government in innovative technology development in water infrastructure, which will allow them to take a leadership role in capturing the estimated $3 trillion dollar water and wastewater infrastructure market.[14] Graduate students, for lack of funding in the U.S., are accepting fellowships overseas. Science departments are being shut down, hiring freezes and layoffs are occurring at campuses across the U.S. Consulting research firms have also shed numerous workers in recent months.

By a host of measures, it would be appropriate to build research and development (R&D) funding in the water infrastructure field over a period of years to a $500 million per year level. Any healthy industrial sector should be reinvesting 1-2% in science and new product development. One percent of the nation's current estimated $50 billion water and wastewater sector expenditures would be $500 million per year, while 1% of the approximately $100 billion per year that the water and wastewater sectors should be spending on traditional and green infrastructure approaches to meet current needs would be $1 billion per year.

To begin returning water infrastructure-related research to an appropriate level of funding, at least $100 million should be appropriated for EPA to stimulate both R&D and demonstration projects in 21st Century approaches, including water conservation, rainwater harvesting, green infrastructure, groundwater remediation, graywater re-use, optimizing energy use and water quality, monitoring for and treating emerging contaminants, and decentralized wastewater treatment and reuse. A second $100 million should be employed for innovative water management research in the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, Housing and Urban Development, Interior, and Transportation to look at a host of water-related issues such as ensuring safe water supply, protection of aquatic habitat, sustainable water and wastewater infrastructure in the built environment, protection of U.S.

[14] http://web.mit.edu/smart/.

fisheries, protection of and stewardship of America's farmlands, pasturelands, and forests, protection of endangered species, and, of course, monitoring our progress in achieving water resource goals. A commitment to rigorous long-term monitoring of our nation's water ways is absolutely essential for identifying contaminants, characterizing and localizing contamination patterns, identifying sources of contamination where possible, and measuring the effectiveness of mitigation measures. In summary, high quality monitoring programs are required for Congress and regulatory agencies to allocate resources wisely and effectively.

The U.S. Geological Survey (USGS) is responsible for the two main water-quality monitoring programs for the Nation's waterways. These are the National Water Quality Assessment Program (NAWQA) and the Toxic Substances Hydrology Program. These two programs are crucial to understand water quality. Without a long-term commitment to monitoring, the Nation will lose its ability to assess tends in water quality, impacts of climate change, impacts of new and under-studied contaminants, and efficacy of policy-decisions that impact water quality. The NAWQA is the larger of the two USGS water-quality monitoring programs, and looks at environmental contaminants using established measurement methodologies for measuring (pesticides, VOCs, metals, etc.). Budget constraints over the last eight years has forced the program to cut back from 496 surface-water fixed station water-quality monitoring sites in 2000, to only 113 sites in 2008.[15] NRDC supports reinvestment in that program.

The Toxic Substances Hydrology (aka Toxics Program) is the smaller of the two programs. It is a water quality research and methods development program that looks at new and understudied environmental contaminants, like new pesticides, hormones, pharmaceuticals, personal care products, etc. The program develops new capabilities, new methodologies, and new information that enable the cooperative water quality programs across states and the NAWQA address new issues in an effective manner.[16] A new water research initiative should invest in both of these programs, which have been devastated by budget cuts in recent years.

In addition to governmental funding, cooperative efforts with utilities, research associations, and other non-governmental entities should be part of the research agenda, including such programs as the National Decentralized Water Resources Capacity Development Project at the Water Environment Research Foundation, the National Environmental Services Center at West Virginia University, and academic workshop and conference funding.

The National Water Research and Development Initiative Act of 2009

The National Water Research and Development Initiative Act (NWRDIA) of 2009 would coordinate such a research initiative and develop a plan for identifying and prioritizing future research needs. Efforts to define research needs and projects related to 21st Century water infrastructure are already being conducted at the federal level. The U.S. EPA has directed a

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[15] USGS fact sheet: Impacts of proposed FY09 budget cuts on National Water-Quality Assessment (NAWQA) program. Provided by Judy Campbell Bird. April, 2008

[16] Data provided to J. Sass as personal communication with Donna N. Myers, U.S. Geological Survey, Chief, National Water-Quality Assessment Program. April, 2008

wide-ranging series of working groups to identify critical research needs in water infrastructure, and topics for priority research projects have been identified. Research agendas have been developed for "sustainable infrastructure," water and climate change, and green building and green infrastructure related to water systems. EPA has initiatives in related Smart Growth, source water protection, and ecological services program areas. This Committee has identified research areas for water-efficiency and conservation measures in HR 3957. The Office of Science and Technology Policy has identified key research areas which would be developed in a revitalized water research program. The NWRDIA would be helpful in coordinating these and other agenda-setting exercises into a cross-agency, cross-media, cross-sectorial strategy that gets past the historic siloed and disintegrated approaches that are currently failing to provide holistic solutions to our water and integrated resource needs.

It is vital for the U.S. to return to earlier patterns of investment in water infrastructure-related research. Our nation is clearly falling behind in the efficiency and effectiveness of its approaches relative to those of other countries. Research investments will be paid back in many ways, including reductions in costs of safe and clean water systems, revitalized local economies and community development, and in new economic opportunities for American businesses in designing and manufacturing solutions for emerging markets in Asia and elsewhere.

Conclusion

Throughout the second half of the 20th century the U.S. led the world in developing and implementing revolutionary water management systems. This occurred because of national need but was enabled by consistent Federal funding for research that built the strongest network of researchers and educators in the world. Observing the success of this approach, other countries such as Japan, the UK, and France emulated this approach in the latter portion of the 20th century, with great success. This approach continues today, especially in a variety of Asian countries which have the same compelling national need as us and who see that Federal investments in water R&D are a great public investment which returns itself many times over by both meeting critical national needs but also be creating profitable national and export businesses.

The question before is us whether the U.S. is going to give up its leadership in this critical area and fail to live up to its potential to dramatically improve the quality of life in the U.S. and around the world. This is the path that we are on, but it can be reversed with a fairly modest set of actions by the Federal government, including a substantial investment in R&D, that would be facilitated by this legislation.