21st Century Water Infrastructure and Fiscal Stimulus

A fiscal stimulus package in early 2009 offers several opportunities for advancing a more sustainable approach to water, stormwater, and wastewater management. 21st Century systems will use, treat, store, and reuse water efficiently at small scales and blend designs into restorative hydrologies. Infrastructure that embeds efficient water, energy, materials, and transportation technologies into buildings and neighborhoods can lighten the environmental footprint of cities and towns, recover and recycle increasingly-scarce resources, restore livability of communities, and dramatically cut the economic costs of providing basic services in the U.S. High-quality jobs will be created in a wide variety of building, construction, and research sectors.

Three distinct approaches will advance an innovation agenda:

- Grants and loans to "ready" projects in the states
- Research and development, and demonstration projects in 21st Century infrastructure
- Tax incentives, retrofits of federal, state, and local buildings, and loan guarantees – "just add water" efficiency, stormwater management, and reuse designs to the policy tools under consideration for building a low-carbon economy

President-Elect Barack Obama and Congressional Committees have articulated the need for a fiscal stimulus bill to put unemployed Americans back to work and to improve our nation's deteriorating infrastructure. Here, we address questions about the design of a stimulus bill and recommend $1 billion in funding for 21st Century (smart, clean, and green) water infrastructure projects and $200 million for research and development and demonstration projects to advance the state of practice in the water management sector. We also recommended that water technologies be added to energy-related tax incentives, public building retrofits, and loan guarantees.

We agree that the primary goal of a fiscal stimulus bill is to provide a counter-cyclical infusion of funding into the economy. If properly implemented, an infrastructure stimulus package goes further by investing in necessary physical infrastructure that protects public health and safety, enhances economic growth potential, and improves quality of life. Concerns about the capacity of state and local governments to immediately invest these funds in ready-to-go projects, and the ability of industry to meet the challenge and quickly ramp up operations, are well placed. Our proposals will utilize established funding channels to restore employment in industry sectors that are separate from the traditional infrastructure construction trades, with projects that are typically built or can be allocated within very short timeframes. As a bonus, these projects will serve as templates for future green energy, water reuse, and low-cost sustainability projects in this industry.

The Case for a Sustainable Water Infrastructure

Throughout the nation, there is a growing realization that our nation's natural water systems and services are deteriorating. Signs of stress are seen in falling groundwater levels and decreasing stream flows, culturally induced eutrophication of lakes and estuaries, 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. Climate change is expected to exacerbate patterns of droughts and heavy rainfalls, putting both existing inadequate water supplies and flood control measures at risk. Already, 39 states have predicted water supply shortfalls in the near future.

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. 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 wasteful of scarce water resources and disruptive of a broad variety of ecosystems. Destruction of natural ecosystems such as wetlands, forests, and prairies to make way for expanding cities that use excessive amounts of land per unit of population, causing such development to be unattainable to anyone but the rich, 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.

In parts of the country, examples of 21st Century water infrastructure are already being implemented. In response to water shortages and the high direct and indirect costs of centralized water and wastewater infrastructure, decentralized wastewater and stormwater treatment, dispersal, and reuse is being increasingly used for infill developments in older major urban areas including New York City, Seattle, and Dallas. Water-efficiency and conservation programs are have been implemented in water-short states, such as Colorado, New Mexico, and Utah. Decentralized water reuse systems are being incorporated into new and infill developments throughout the water-short areas of California, Texas, Georgia, and North Carolina. Water rich states, such as Minnesota and Wisconsin, have long recognized the connection between well managed small scale wastewater solutions and water quality protection.

Green infrastructure, including rain and roof gardens, tree plantings, stream buffers, and other natural systems that mimic natural phenomena, is becoming more common in cities such as New York, Chicago, Portland, Cincinnati, Philadelphia, and Kansas City. These measures can greatly reduce the cost of and need for conventional storm sewers and their negative impacts on local water courses. Such approaches are in lieu of hugely expensive conventionally engineered solutions, such as underground storage tunnels. Green infrastructure can also improve quality of life in urban and suburban neighborhoods through improved air and water quality, reductions in the oft-cited heat island effect of major urban areas, creation of neighborhood parks, and other means.

Despite these gains in understanding and implementation of smart, clean, and green water infrastructure, major challenges remain. Directing a portion of the fiscal stimulus package towards addressing these challenges, instead of pouring additional federal funds into repairing or extending failing and unsustainable conventional water infrastructure, can stimulate local economies while making communities more resilient to future water and climate disturbances.

The national value of such projects also includes their prototypical value to other cities that will be addressing these problems in the decades to come.

Implementing a Smart Water Future

We recommend that a three-pronged approach be implemented in the fiscal stimulus bill. This approach couples $1 billion in grants and loans for 21st Century water infrastructure approaches (including those identified in your Committee's prior authorization bill, HR 720) with $100 million for research and development and demonstration project funding distributed via the US EPA and related agencies. Both of these proposals can be quickly implemented by US EPA, state Clean Water State Revolving Fund (CWSRF) programs, and municipalities. We also recommend that tax incentives, public building retrofits, and loan guarantees "just add water" to provisions for energy-efficiency and renewables.

21st Century water infrastructure -- $1 billion in grants and loans to "ready" projects

Several practices and methods for achieving greater efficiency and effectiveness in the nation's water infrastructure are already listed in HR 720, including:

- implementation of a sustainable hydrology management program established under Section 319 of the Clean Water Act;
- development and implementation of a conservation and management plan incorporating the hydrologic impacts of climate change on water infrastructure planning and design;
- implementation of lake protection programs and projects under Section 314;
- repair or replacement of decentralized wastewater treatment systems that treat domestic sewage and recharge groundwater locally;
- measures to manage, reduce, treat, or reuse municipal stormwater;
- measures to reduce the demand for publicly owned treatment works capacity through water conservation, efficiency, or reuse; and
- development and implementation of watershed projects meeting the criteria set forth in Section 122.

Companies working with new installations of decentralized wastewater infrastructure, including both individual home treatment units and cluster systems for new neighborhoods, have been hit hard by the housing crisis. These companies have experienced an approximate 50% reduction in work over the last year. However, one-fifth of existing homes in the United States utilize individual, on-lot wastewater treatment systems—many of which are, for a variety of reasons, failing to meet modern treatment standards. Upgrades to superior cluster decentralized systems for existing properties and neighborhoods in rural and suburban areas that are experiencing sewage problems will create substantial economic, public health, and environmental benefits.

Projects involving decentralized infrastructure will remedy existing health and environmental problems, while re-reemploying companies and workers that are outside of and will not compete with a stimulus in the traditional infrastructure construction trades. Companies involved in these approaches tend to be smaller and local, so that a restoration of full employment will lead to additional dollars circulating in local economies. Such projects engage soil scientists, system designers, landscape architects, installers, plumbers, and builders. Most manufacturers for

equipment and treatment units are located in the US, making the indirect economic benefits significant as well.

Decentralized stormwater, wastewater, and reuse projects operate under significantly shorter timeframes than traditional treatment plants and sewer projects, so stimulus dollars allocated to such projects will quickly circulate into local economies. Individual wastewater treatment units or rain gardens can often be designed and constructed within a two-week timeframe. Neighborhood-scale wastewater collection, treatment, and environmental dispersal or reuse systems may take as little as several months from initiation to project completion.

An institutional framework already exists for distributing funding to be used for 21st Century water infrastructure projects. In recent years, the US EPA has issued guidelines authorizing CWSRF funding for use in constructing decentralized and green wastewater and stormwater systems. The House Appropriations Committees have also repeatedly directed states to provide zero-interest loans for 21st Century water infrastructure approaches. As a result of these measures, many states already have the capacity to provide grants and loans both for municipal projects and for homeowners installing more sustainable systems. Section 319 is also a well-established program with effective strategies for funding nonpoint source pollution controls.

$200 million in research and development, and demonstration projects in 21st Century water infrastructure

The US 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 US, academic institutions, research institutes, and consulting firms have been reducing employment as well. Dramatic signs of this under-employment include the relocation of MIT water researchers to Singapore, where $300 million is being invested by that government in innovative technology development in water infrastructure. Graduate students, for lack of funding in the US, are accepting fellowships in South Africa and Israel. Departments of soil science have been shut down in Michigan and Oregon. A number of universities, such as Tufts University, have instituted hiring freezes in recent days. Consulting research firms have also shed numerous workers in recent months.

By a host of measures, it would be appropriate to build 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, we recommend that $100 million be appropriated for EPA to stimulate both R&D and demonstration projects in 21st Century approaches, including water conservation, rainwater harvesting and green infrastructure, optimizing energy use and water quality, and decentralized wastewater treatment and reuse. A second $100 million is recommended for innovative water management research in the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, Housing and Urban Development, Interior, and Transportation.

A $100 million research and development program coordinated by EPA can be quickly implemented to reemploy academic researchers, graduate students, and consultants. Several existing, federally mandated projects that have been de-funded in the last several years could be quickly reinvigorated. These include 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, Section 106 funding, targeted watershed funding, and academic workshop and conference funding.

Efforts to define research needs and projects related to 21st Century water infrastructure are already being conducted at the federal level. The US EPA has directed a wide-ranging series of working groups to identify critical research needs in water infrastructure, and topics for priority research projects have been identified. EPA simply needs to issue 120-day RFPs for these project areas. 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. The House Science Committee has identified research areas for water-efficiency and conservation measures. Finally, the Office of Science and Technology Policy has identified key research areas which would be developed in a revitalized water research program.

American universities also have a pent-up demand for research and development in water technologies. The University of Illinois at Urbana-Champaign has directed an NSF-funded nationwide water technology research program involving M.I.T., University of Michigan, Howard University, University of Notre Dame, Clark Atlanta, UC Berkeley, Yale, Rose-Hulman, and Rutgers. These universities are part of a Sustainable Watershed Forum which has recommended $100 million in research funding per year. Northeastern University has led a consortium of universities seeking "new water paradigm" funding, including Tufts University, Colorado State University, Universities of North and South Carolina, University of Massachusetts in Amherst, and Tulane University. The Colorado School of Mines is involved in a $20 million multi-university proposal for water infrastructure research. Arizona State University is another leader in urban sustainability research and design.

It is vital for the US 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.

An immediate fiscal stimulus of $100 million will restore employment in American universities and research institutes. Many projects will also entail employment in the construction trades, because universities will use substantial portions of the funding to install pilot rain gardens, reuse systems, and other new approaches on their campuses and in surrounding communities. Texas A&M, for example, is now involved in the design of a 200-acre infill development in Dallas, which will utilize and develop leading-edge approaches in water reuse. The capacity of the Dallas academic, non-profit, and consulting community to absorb funding is clear. Assuming a $100 million funding allocation, for example, 1,500 design-related jobs could be created with an average salary of $50,000, and $25 million could be specified by those designs in materials and outside labor. The outcome of this funding will be both improved technologies and new solutions for sustainable water management.

EPA, in coordination with other federal agencies, is fully capable of quickly implementing a research program at the $100 million level. As suggested above, research agendas exist in multiple areas related to the need for more sustainable water infrastructure approaches. The National Science Foundation, which has received multiple research proposals in this field for many years, and other agencies are already collaborating with EPA. The House Science Committee has passed a water-efficiency and conservation research bill, HR 3957, which includes a recommendation for a $1 million study on "soft path" water solutions internationally and in the U.S. The positive fiscal impacts of these research projects would be strong and immediate.

We recommend the following allocation of $100 million to national research and development programs coordinated by EPA:

- $10 million for a second year of EPA's sustainable infrastructure research program;
- $10 million for the Water Environment Research Foundation (including $3 million for the Congressionally-authorized National Decentralized Water Resources Capacity Development Project based at WERF);
- $10 million for Drinking Water Research at the Water Research Foundation;
- $1 million for the Science Committee-recommended project on "soft path" water infrastructure at the National Academy of Sciences;
- $5 million for water-related research led by EPA in the Zero-Net Energy Building research initiative;
- $14 million for EPA's water-climate research agenda;
- $40 million for an EPA-National Science Foundation collaboration in applications of emerging science to innovative water treatment technologies; and
- $10 million to other discretionary research and education programs at EPA, including $3 million for the National Small Flows Clearinghouse of the National Environmental Services Center at West Virginia University.

An additional $100 million should be allocated to applied research in other federal agencies, which have in the recent past explored innovative technologies and designs in water management. Information on the mission and activities of these research programs can be found at: http://sustainablewaterforum.org/fed/cat.pdf. Funding for these "ready" programs and research institutions across the country could include:

- $25 million for the Department of Agriculture – Cooperative State Research, Education, and Extension Service (CREES) and U.S. Forest Service – Urban Forestry;
- $15 million for the Department of Commerce -- National Sea Grant College Program, National Estuarine Research Reserves, and National Institute of Standards and Technology
- $15 million for the Department of Defense – National Environmental Technology Test Sites
- $15 million for the Department of Energy – Energy Efficiency and Renewable Energy-water nexus
- $5 million for the Department of Health and Human Services – Centers for Disease Control – National Center for Environmental Health
- $3 million for the Department of Housing and Urban Development – Partnership for Advancing Technology in Housing (PATH)
- $20 million for the Department of the Interior -- Bureau of Reclamation Water Reclamation and Reuse Program and USGS – National Institutes for Water Resources
- $2 million for the Department of Transportation – Green Highways Initiative.

"Just Add Water" to Proposals for Energy-Efficiency and Renewables

A broad coalition of stakeholders has recommended an expansion of "market transformational" programs for higher-performance and lower-cost energy-efficient technologies and renewables to be adopted in the U.S. The Center for American Progress and Political Economy Research Institute have recommended, in particular, tax credits for private businesses, developers, and homeowners to finance commercial and residential building retrofits; direct government spending of federal, state, and local building retrofits, including schools, hospitals, and municipal facilities; and federal loan guarantees to underwrite building retrofits and investments. These approaches will create jobs and build a "low-carbon economy". New water, stormwater, and wastewater technologies should be added to these programs.

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). The Academy recognizes 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. Wastewater has heat that can be captured, and biogas can be generated at a local scale from sewage, along with food waste and 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 landscaping methods. The success of this program suggests that some similar guidelines for wastewater reuse and stormwater management should also be developed.
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