Testimony Before the

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"Research to Improve Water-Use Efficiency and Conservation: Technologies and Practices"

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Mr. Chairman and members of the Subcommittee, my name is Glen Daigger and I am a Senior Vice President and the Chief Technology Officer for the Civil Infrastructure Client Group of CH2M HILL.

I want to thank you for the opportunity to speak before you today, to discuss the very important and timely issue of water resources in our country. My over 30 year professional career has been devoted to securing safe drinking water supplies and sanitation for locations throughout the United States and around the world.

I do not need to discuss the urgent need to provide clean water and sanitation for the United States and the world as water scarcity continues to be in the headlines and is a source of conflict between urban areas and agriculture and between people and the environment. Population growth, increasing urbanization, and climate change will only exacerbate the situation and dramatically increase these conflicts. Fortunately solutions are available, but we need your help to further develop, demonstrate, and more quickly deploy them. Let me provide some background and perspective.

Water has historically been managed in urban areas and public health has been protected by transporting water. A pristine water source was identified remote from the urban area and transported there. Used water (some refer to this using the more derogatory terms sewage and wastewater) was transported away from the urban area to protect public health by minimizing its contact with the public. "Mother nature" was depended on to treat the used water, thereby reclaiming it and recycling it for subsequent use. Although some think of this as an invention of the 18th and 19th century, this practice actually began with the cities of the ancient world, with gravity providing the force to convey water. The advent of mechanical devices (pumps driven first by steam and later by electrical engines) during the industrial revolution provided greater freedom in the location of cities as the dependence on

gravity was eliminated. This approach worked brilliantly when the population of the planet was less than about 1.5 billion (and the population of the US less than 100 million), and only a small fraction of the human population lived in urban areas. For example, the average life span of Americans increased by about 30 years (from 47 years to 76 years), over the 20th century, Twenty of the thirty years of added life span are attributable to clean water and modern sanitation! In fact, when the *British Medical Journal* recently surveyed public health professionals about the single greatest contribution to public health over the past 150 years, modern water systems were ranked first, above such medical revolutions as vaccinations and antibiotics. Unfortunately, this brilliant solution, which worked so well up to the early part of the 20th century, is now insufficient with more than a four fold increase in population through the 20th century and a dramatic increase in urbanization. Today we are taking too much water out of the environment, and Mother Nature is not able to reclaim and recycle the used water fast enough.

Fortunately, new approaches are available to manage water in urban settings which address these problems. Essentially, <u>treatment</u> can replace <u>transportation</u>. Increased standards of living have increased water use dramatically, but currently available water saving devices allow water to be used more efficiently, thereby reducing the net demand. While technologies have been available for decades to treat raw water for drinking and used water for return to the environment, new, more reliable treatment technologies are becoming available that allow used water to be reclaimed to potable standards , or better! Thus, we no longer need to return used water to the environment and depend upon Mother Nature to reclaim and recycle it. The historic approach of using transport and discharge to protect public health can be replaced with reclamation and reuse technologies that mimic Mother Nature. The result is more efficient use of water. Consider that urban water use in

the United States currently averages about 150 gallons per person per day. Benchmarking with experiences around the world indicates that water conservation can lower this substantially, and the use of water reclamation and reuse can lower this further to 20 to 30 gallons per person per day. The net result is that the amount of water withdrawn from the environment is reduced dramatically.

Three of the most promising treatment technologies include membranes, advanced oxidation, and ultra-violet (UV) light. We all have a treatment device inside of us called the kidney which removes waste products. Membranes function much like the kidney, cleaning water in a highly effective fashion. Membranes can be further coupled with biological treatment processes which use microorganisms to convert pollutants in the used water into harmless by-products. Sunlight is an effective disinfectant and is mimicked by UV systems. Advanced oxidation produces hydroxyl radicals which can very effectively convert recalcitrant contaminants into a form that the microorganisms can consume. These technologies, in concert, can take the most contaminated water and purify it to a quality much better than drinking water. They can be further coupled with evolving urban water management practices such as rainwater harvesting, stormwater management using low impact development, and natural treatment systems like wetlands to allow local rainfall and reclaimed water to be used for a variety of purposes and dramatically reduce the reliance of urban areas on transported water.

With all of these developments you might ask why we need your help. The reason is that the benefits of these technologies and approaches can only be realized when they are assembled together properly in an overall integrated urban water management system. Moreover, while the application principals for these new systems are general in nature, the optimum system for any given urban area is relatively site-specific. Thus, a relatively

complete system must be assembled before the full range of benefits can be achieved. In short, demonstrations in a variety of settings are required to provide the real-world examples needed by urban water managers to gain support for local implementation.

Support is needed for a second reason. The rapid advances occurring in bio- and nano-technology offer the potential to greatly increase the effectiveness of these technologies. However, support is needed to further develop these fundamental research results into practical research results that will support the development of additional break-through water treatment technologies. Research funding in the water area is also needed to stem the loss of critical research and educational capacity. Before expanding upon this, let me share some observations about the funding of water research around the world.

The US led the world in developing and implementing revolutionary water management systems throughout the second half of the 20th century. 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 Canada, Japan, the United Kingdom, 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 and who see that Federal funding of water R&D is a great public investment which returns itself many times over by both meeting critical national needs and by creating profitable national and export businesses. For example, the country of Singapore, with a population of 4.5 million people, is investing $330 million in water R&D over the next 5 years, and Korea is investing $140M/yr. The Singapore investment is attracting much larger private sector investments by industrial giants like GE and Siemens.

What really worries me is China where the need is critical and the investments they are making will inevitably create export businesses that will threaten our US-based industry.

The question before is us whether the US 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 US 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. Critical support for R&D in this area of water use-efficiency and conservation is needed to enable the demonstration of these approaches and to support academic research that will advance the technology and also support the continued growth of our educational and research capabilities. Currently the Federal government provides significant support to local governments for the construction of water and wastewater treatment facilities through the State Revolving Funds. Annual support has varied, but has regularly exceeded $1 billion/yr. A modest Federal R&D investment of $100 to $200 million/yr would catalyze a renewal of the US water industry, with at least $20 million/yr going to support academic research. This is the help that we need and, when compared to current Federal investments in water and wastewater, we see that it is well within the realm of possibility. Thus, I wholeheartedly support the Discussion Draft developed by Representative Matheson.

Again, I want to thank you for the opportunity to address this critical national need, and I'm prepared to answer any questions you might have.