



# SOUTHERN NEVADA WATER AUTHORITY

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## **WRITTEN STATEMENT**

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**Before the**

**House Natural Resources Committee**  
**Subcommittee on Water and Power**  
**U.S. House of Representatives**  
**Washington, D.C.**

**On**

**Finding Solutions to Minimize the Impacts of Invasive Quagga Mussels  
on Water Rates, Water Infrastructure and the Environment**

**June 24, 2008**

Good morning. My name is Ronald E. Zegers and I am the Director of the Southern Nevada Water System, which is the operations and maintenance arm of the Southern Nevada Water Authority. The Southern Nevada Water Authority is a cooperative agency, formed in 1991 to address Southern Nevada's unique water needs on a regional basis. The Authority is a wholesale supplier to two million people in the Las Vegas Valley, and is governed by a seven-member agency, comprised of one representative from each of the wholesale customers, that also serves as its Board of Directors. In addition, the Authority also provides potable water to the 250,000 visitors who occupy Las Vegas Strip resorts on the average day. Ninety percent of the drinking water supply for the Las Vegas Valley comes from Lake Mead, above Hoover Dam, whose source supply is the Colorado River. The quagga mussel invasion of Lake Mead has a huge economic impact on the Southern Nevada Water Authority requiring capital investment, as well as annual operating and maintenance costs.

## **The Quagga Mussel Invasion of Lake Mead, Nevada-Arizona**

On January 6, 2007, quagga mussels were first discovered in Boulder Basin of Lake Mead, expanding their range from the Great Lakes to this Southwestern reservoir without invading water bodies of the states in between. This was the first known occurrence of quagga mussels in the Western United States. Within two weeks of the report of quagga mussels in Lake Mead, divers from the Metropolitan Water District of Southern California (MWD) found them in fairly low densities (1 to 10 mussels/m<sup>2</sup>) on the intake structure for the Colorado River Aqueduct (CRA) 150 miles downstream of Lake Mead. With the large spring spawn from Lake Mead and probably also Lake Mohave, densities of settled mussels have rapidly and significantly increased in Boulder Basin and they are now found at densities in the hundreds of mussels per m<sup>2</sup>, and the mussels have penetrated further into the CRA. Mussels have spread extremely rapidly with quaggas now detected throughout Lake Mead, with densities of mussels near 500 mussels/m<sup>2</sup> in Boulder Basin. They are also now found in several reservoirs of San Diego County, California. Recreation is being severely impacted by this invasive species as Lake Mead is a primary recreation destination for California boaters, and concerns developed immediately that the adult mussels would attach to the hull of watercraft, or that larval veligers would survive in the craft's ballast water, and move from Nevada to California. There are more than 8 million visitors who recreate at Lake Mead National Recreation Area every year, with a majority of these visitors using the reservoirs. In the summer the number of vessels on the water at any given time averages more than 3,000; on holiday weekends, this number rises to 5,000 vessels.

Populations of quagga mussels typically expand exponentially and can quickly colonize new areas. The population growth of quagga mussels is increasing more rapidly than some predicted. Depth distribution is from surface to >150 feet, with the highest density at 25–35 ft. In Lake Mead, quagga now make up nearly 40 percent of the macroscopic animal population in Boulder Basin while none were found prior to March 2007.

More than 90 percent of the water used in the Las Vegas Valley is pumped from Lake Mead. The pumping plant was pumping about 330 million gallons per day when collections were made, which translates to more than 750 million veligers per day being pumped through the plant in March, and more than 30 billion veligers per day being pumped in May 2007. Surface water samples suggest that there were over 27 trillion veligers in Boulder Basin during this time. Results of ageing investigations indicate that the main invasion occurred in 2004 or perhaps 2003, and that the population is currently undergoing the rapid increase and expansion of range often associated with successful colonization by invasive species. Data presented here confirm that dismaying prospect.

The zebra/quagga mussel has become arguably the most serious non-indigenous biofouling pest ever to be introduced into North American freshwater systems. It has the ability to tolerate a wide range of environmental conditions, is extremely adaptable and has a very high growth rate. It has the potential to significantly alter the ecosystem of any

body of water it invades and wreak havoc in all water delivery systems that it enters. It has been broadly stated by the best experts that the invasion of the lower Colorado River is a “giant experiment” because these are the first large reservoirs invaded by quagga mussels.

The anticipated effects of quagga infestation are both profound and far-reaching. Experts predict that the quaggas will deplete natural food resources for the existing microscopic zooplankton community. This food chain alteration is expected to completely disrupt fishery resources, including listed endangered species, in Lake Mead and downstream Colorado River reservoirs. Additionally, desirable forms of algae/phytoplankton will likely be replaced by undesirable species such as blue-green algae, which thrive on the phosphorus-rich quagga mussel pseudo feces and increased availability of sunlight at greater depths.

The accumulation of pseudo feces will also adversely affect water chemistry in Lake Mead, creating an inhospitable environment for other aquatic organisms and potentially threatening the quality of municipal source water. Other impacts include the complete encrustation of the lake bed and walls, as well as all unattended hard structures in the reservoir. Recreational values will be undermined by transformation of shoreline into thick rows of dead shells and accumulation of quagga mussels on moored watercraft.

### **Infrastructure Protection**

The initial response by SNWA focused on determining the extent of infestation and gathering information about biological features of quagga mussels. SNWA personnel worked with experts experienced with quagga mussel infestation in the Great Lakes region to formulate an efficient and practical response program, including developing strategies at the treatment plants that would disable veligers upon entering. This includes designing necessary alterations to the water intake infrastructure, including points where chlorine or other disinfectants can be injected into the intake tunnel from Lake Mead. The objective is to prevent live mussels from attaching or being transported throughout the treatment system.

SNWA’s first activity following discovery of quagga mussels was to inspect the two drinking water intake pipes in Lake Mead. The first intake was constructed in the 1970s. It exits the rock face of Saddle Island about 55 feet below the water surface (elevation 1050 feet above msl) and extends to a depth of 105 feet (elevation 1000 feet above msl). The second intake was constructed in 2001 and is also 105 feet below the surface (1,000 feet above msl). Divers found quagga mussels on the steel pipe of the older intake from depths of 55 feet (where the pipe exits the rock wall) to 70 feet. No mussels were found below 70 feet. Additional inspections of the older intake in July 2007 revealed that the density and extent of mussels had increased. Many were now found at depths of 30 to 70 feet, but few were discovered on the bar screen of the intake pipes.

To determine the mussel growth potential from water entering the drinking water treatment plants, veligers were counted in a known quantity of water. Veligers were not detected in the January 2007 samples, but reached the greatest abundance so far in the SNWA raw water systems at 110 veligers per liter of water in November 2007. Using an average of 400 million gallons of water per day processed in the SNWA facilities, this equates to 167 billion veligers entering the facilities!

Initially, a risk assessment was performed that included evaluation of the raw water piping and pumping facilities, consisting of 11 miles of raw water piping and four pumping stations. Some areas were determined to be low risk due to operational practices or the materials of construction of the piping that was toxic to the mussels. Other infrastructure was deemed to be a higher risk and therefore treatment was needed to prevent infestation and the resulting operational problems. Chlorine addition at the older intake was already in place and being utilized prior to the infestation for other treatment purposes. In July 2007, chlorine application to the raw water in the newer intake system began. This application was intended to affect mussel and veliger mortality and also prevent veliger settlement in the raw water systems. To date this technique has proven to be very successful based on visual observation of pumps and piping.

The next phase of quagga mussel infrastructure protection will be to add chlorination capability before both intake pumping plants. This addition will allow for protection of the pump fore bays and the 42 intake pumps. This project is anticipated to cost between \$1 million and \$4 million.

A longer-term approach will be to incorporate chlorine addition points just past the intake screens in Lake Mead for the existing intakes and the new intake being designed. This approach will allow for protection of the entire intake tunnel for each of the intake pumping plants. This approach is projected to cost approximately \$20 million.

Chlorination has been employed as a temporary solution to the problem at the SNWA facilities. While effective at veliger settlement prevention and mussel control, it has an undesirable side effect. Chlorination, at levels required for quagga control, causes an increase in disinfection by products, namely trihalomethane formation. These chlorinated byproducts are regulated by the Safe Drinking Water act and have a maximum contaminant level of 80 parts per billion. While the water served by SNWA meets this limit, the chlorination strategy has increased the values by approximately 15 parts per billion. Therefore it is important to investigate alternative control strategies to minimize water quality impacts.

### **Economic Impact**

It is estimated that zebra mussels cost the power industry \$3.1 billion over the period from 1993 to 1999, while the impact on industries, businesses, and communities has

exceeded \$5 billion. The U.S. Fish and Wildlife Service estimates the potential economic impact at \$5 billion from 2000-2010 to U.S. and Canadian water users within the Great Lakes region alone. The potential cost implications for the Western United States are likely to be even higher due to rapid growth and proliferation of these mussels in the extensive waterway networks of the West.

Total estimated costs for invasive mussels in the Eastern United States, including ecological damage, range from \$100 to \$500 million per year. The cost to water conveyance, water treatment, and the power industry has been estimated at \$100 million per year, limited to the Eastern United States. Approximately 1,800 water systems rely on surface water from rivers and lakes west of the 100<sup>th</sup> Meridian, serving 47.5 million people. These systems are potentially at risk from invasive mussel infestations and consequently may incur cost associated with their control if mussel proliferation continues in the Western waterways. In addition to the river systems in the Southwest, there are extensive aqueduct and conveyance systems that provide water for conveyance and storage of drinking water and irrigation water. The large number of power generating facilities in the West will also be impacted by the invasion of the mussels in the Western United States. The impacts of this invasive species will increase costs by hundreds of millions of dollars per year.

### **Recommendations for Assistance from the U.S. Department of Interior**

The major effort of the U.S. Fish and Wildlife Service has been the prevention of the spread of quagga mussel in the United States. This effort has been successful for 15 years and has limited the impact of the invasive species to the Great Lakes and Northeast regions of the United States. With the invasion of the mussels in the West, a change in direction with respect to the strategies for control of the invasive species in the United States is now appropriate. The following are recommendations that should be considered by the Department of Interior.

1. Allocate resources for the development of an Invasive Mussel Control Plan (IMCP). The IMCP needs to be developed to maximize resources and coordinate activities between federal, state and local governments, water purveyors and other stakeholders. The IMCP needs to adopt guidelines within the National Invasive Species Management Plan (NISMP) to address rapid proliferation of invasive mussels in the waters of the United States. Each of the five strategic goals of the NISMP – prevention, early detection and rapid response, control and management, restoration and organization and collaboration, need to be adopted to address faster pace of multiplication and longer growing seasons of the mussels in the West.
2. The U.S. Bureau of Reclamation (Bureau) actions are key to implementing effective prevention practices in regions and waterways free of mussels to ensure they remain un-infested. In regions where waterways have already been infested,

the Bureau should provide immediate economic support for agencies impacted by quagga and zebra mussel infestation.

3. The U.S. Fish Wildlife Service can provide a leadership role to ensure that regional invasive mussel control actions are coordinated among the agencies within the lower Colorado River, the area most intensely infested in the West at this time.
4. The U.S. Geological Survey has expertise, data, and modeling capabilities necessary for development and implementation of an effective control plan in the lower Colorado River and for early warning monitoring for areas not yet infested in the Western United States. It should be considered that they work to develop an effective monitoring plan for implementation of the early warning system.
5. The National Park Service should allocate resources to further reduce the exportation of mussel larvae and adults from the Lake Mead National Recreation Area and coordinate activities with California Department of Boating and Waterways and equivalent agencies in states adjacent to Lake Mead to ensure a regional effort.

### **Research Needs**

The Southern Nevada Water Authority (SNWA) and the Metropolitan Water District of California (MWD) received grant funding from the American Water Works Association Research Foundation (now referred to as the Water Research Foundation) to host a workshop to explore strategies for responding to the presence of quagga mussels in the lower Colorado River. The facilitated workshop brought together experts in the field of zebra and quagga mussels. The workshop provided for an exchange of ideas and a current understanding of current science regarding mussels. The results of the workshop provided 15 recommendations for research in order to provide a better understanding of control of mussels in infrastructure through Chemical Inactivation and Barriers and Population Management within the natural environment. There were 34 experts invited to the workshop whom where professionals in the field of mussel research and control. In addition, there were a total of 140 in attendance at the two-day workshop, which stimulated great interest in this emerging issue in the Southwest. The following is a list of recommended research projects and the associated cost.

### **Research Recommendations**

#### Chemical Inactivation and Barriers

1. Determination of Viability in Quagga Mussel Veligers and Assessments of Chemical Treatment Efficacy \$1.25 Million



2. Hydraulic Effects on Veliger Mortality in Engineered Systems  
\$1 Million
3. Quagga Mussel Vulnerability Assessment and Response Management Tool Development  
\$ 500,000
4. Demonstrate Alternative, Non-Chemical, Control Technologies for Quagga Mussels for Deployment at Water Treatment Facilities  
\$1.75 Million
5. Molluscicides and Biocides for control of *Dreissenid* Mussels in Water Resource  
\$1.75 Million
6. Coatings and Materials for Control of *Dreissenid* Mussel Attachment in Water Resources Projects  
\$250,000

#### Population Management

1. Response of Quagga Mussel Veligers to Limnological Variables  
\$3 Million
2. Application of Biological Agents to Control Quagga Mussels  
\$2 Million
3. Applying Knowledge of System Ecology as a Control Strategy  
\$3 Million
4. Quantitative Tools for Management of Mussels in the Colorado River System  
\$1 Million
5. Quantitative Evaluation of Quagga Mussel Outreach and Education Activities  
\$1 Million
6. Shifts from Planktonic to Benthic Regimes in Response to Quagga Mussel Invasion  
\$1 Million
7. Early Detection Methodology and Rapid Assessment Protocols for Quagga Mussels  
\$1 Million
8. Impact of Quagga Mussel Invasion on the Quality of Domestic Water  
\$1.5 Million

The recommendations from the workshop for research needs that were submitted to the Water Research Foundation totaled \$20 million. The projects were prioritized with a recommendation of \$3.3 million to be funded immediately. The consensus of the experts at the workshop was that the research efforts were required in order to provide control and management of mussels in the United States. It is recommended that the Water Research Foundation be funded in the amount of \$20 million to provide the necessary

research efforts to manage the mussel issue in the United States. By generating a more through a greater understanding of technology and management practices to control zebra and quagga mussels, this research has tremendous potential to avert or mitigate potentially devastating economic consequences.

I wish to thank you for the opportunity to provide the Southern Nevada Water Authority's perspective on mussels and would be happy to answer any questions that you may have.