**NC AQUARIUM AT PINE KNOLL SHORES**
**WATER RECLAMATION SYSTEM**
**FACT SHEET, MARCH 2007**

Renovated and expanded in 2006, the North Carolina Aquarium at Pine Knoll Shores now features a Zenon wastewater treatment system that uses a membrane filtration and combination of ozone and ultraviolet light to purify wastewater. The "Zenon" system is used to reclaim waste water at the Pine Knoll Shores facility and re-circulate it into the building for limited uses reducing the amount of municipal water used.

**What is Brown Water?**

***Brown water*** is the wastewater stream that contains waste from any and all uses in the building including water closets and urinals. It is also called black water. The Zenon system at Pine Knoll Shores processes brown water. Other related terms are defined below:

***Gray Water***: All wastewater except that coming from water closets and urinals. Typical gray water sources include floor drains, sinks, showers and tubs.

***Reclaimed Water***: Water that has been treated and cleaned to meet or exceed human contact standards (no pathogens). The Pine Knoll Shores Zenon system produces reclaimed water.

***Recycled Water***: Typically gray water that is treated and used in a way that the general public does not come into direct contact with it. Uses include flushing toilets, fire sprinkler systems, and drip irrigation systems.

***Drip Systems***: Usually a system of pipes that carries wastewater just below the surface and allows it to drip back to nature.

***Ozone***: A gas used as a sterilizer in the wastewater treatment process.

***Ultraviolet (UV) Light***: Used in the wastewater treatment process as a sanitizer. It kills most, but not all bacteria.

***Sanitized Water***: Water that has had all pathogens killed.

***Sterilized Water***: Water that has had all organisms killed.

**What Is Zenon? How Does It Work?**

Conventional filtration usually refers to the separation of solids or insoluble particles from a fluid stream. Membrane filtration, such as is used in the Zenon system, involves the separation of *dissolved* solids from the liquid stream. The Zenon system uses the ZeeWeed® Membrane Bioreactor (MBR) Ultrafiltration system made up of a polymeric membrane cast on a porous fiber support surface. The membrane rejects contaminants as the clean filtrate passes through it. A low pressure air turbulence flow is maintained along the membrane to prevent contaminant buildup.

**What is Recycled Water Used For?**

The water is used for flushing of water closets and urinals and for land application of drip irrigation. Uses must be limited to those that do not introduce the chance of direct contact by the public. Landscape irrigation use will be added at Pine Knoll Shores in the near future. Some facilities use Zenon reclaimed water for fire sprinkler systems as well.

**What's the Capacity of the Pine Knoll Shores Plant? How Does It Compare with Other Plants?**
The Pine Knoll Shores plant is permitted for a 25,000 gallon per day (gpd) average flow and a 50,000 gpd maximum flow. Currently, the Aquarium is the only online operating system in the state of North Carolina. Four other systems for residential use in Carteret County, three on Harker's Island and one on Highway 24, are in the process of being permitted and built. The Pine Knoll Shores plant is in the small to mid range of plant capacity. Check the Zenon website for many case studies on plants built for everything from school buildings and cruise ships to large municipal systems.

**What Happens in the Event of a Power Failure?**
The system is designed with a back up system in case of an emergency shut down. An automatic valve switches the water supply over to municipal water.

**What are the Costs and Benefits?**
The Pine Knoll Shores system has been on line for nearly one year. It is not yet old enough to establish the average cost savings. Approximately 15,000 gallons of municipal water was used to bring the system on line in April 2006. Since then we have been re-using about 600 to 1,000 gpd in reclaimed water in the building for flushing water closets and urinals only. The remainder is land applied in a drip irrigation system.

**What Are the Maintenance Issues and Expected Life?**
The membrane is backwashed approximately every six months. The system design analysis covers twenty years. Assuming no drastic increases in flow rate, the system should last well beyond twenty years.

**Can Zenon Be Added to Upgrade an Existing Wastewater Plant?**
Yes! See the Zenon website for more information.

**Where Can I Get More Information?**
Aquarium Staff (252-247-4003):
Pat McNeese, Conservation and Research Coordinator, ext. 267
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Ed Lockhart, Facility Operations Manager, ext. 232
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Roy Sanders, Aquarium Plumber, ext. 247
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Zenon web site: (membrane bioreactor)
http://www.gewater.com/products/equipment/mf_uf_mbr/mbr.jsp

**NC AQUARIUM-Pine Knoll Shores ZENON SYSTEM FLOW CHART**

Building Effluent

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Equalizer Tank

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Zenon System

- Wastewater Separation
  - Bacterial Action
  - Sludge Removal
- Water Treatment

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Ozone Contact for Clarity

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UV for Killing Bacteria

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Ozone for Sterilization

- To Storage Tank for Reuse in Building
- To Overflow Tank for High Rate Drip Irrigation Field

**Tanks and Membrane Housing**

**Sludge Tank**