



Toxicity and Aquatic Community Impacts of Membrane and Ion Exchange Water Treatment Effluents in Coastal North Carolina

The application of reverse osmosis (RO) and ion exchange (IE) water treatment of groundwater to meet the growing potable water demand in eastern North Carolina has prompted interest in the environmental impacts of these unique water treatment processes. These processes generate a waste water enriched in ions, including concentrated salts, metals (iron, copper, and arsenic), and other constituents (ammonia and chlorine). Toxicity due to ion imbalance, a condition when effluent ion concentrations exceed normal ranges is an important concern in streams receiving water treatment plant (WTP) waste waters. Effluent and receiving stream samples were collected at three IE and two RO membrane WTPs in freshwater and estuarine streams.



Effluent from a reverse osmosis water treatment facility comprised of concentrated salts, metals, and other constituents is discharged to a freshwater stream.

This study was recommended by a 2003 multiagency workgroup evaluating potential concerns with WTP facilities; the U.S. Fish and Wildlife Service's Environmental Contaminants Program worked with partners to fill the gap and improve knowledge to better manage these facilities. Our final report* concludes that ion concentrations in RO and IE water treatment plant effluents are a primary source of toxicity. The disparity between the water quality of effluents relative to receiving stream characteristics at existing facilities suggests a need to reevaluate discharge options.

* **Ward, SE. 2008. Assessment of Potential Toxicity and Aquatic Community Impacts Associated with Membrane and Ion Exchange Water Treatment Facility Effluents in Coastal North Carolina. U.S. Fish and Wildlife Service. USFWS, Raleigh, NC**

The following are highlights of the assessment:

- Routine water quality characteristics, ion, nutrient and metal concentrations were documented in 15 effluent and 30 receiving stream samples between 2004 and 2005
- Effluent ion concentrations varied dependent on the cycle of the IE treatment process (sodium regeneration > final rinse > backwash cycle)
- RO effluent characteristics were relatively uniform at each WTP; facility-specific differences were evident (likely based on source water chemistry)
- 15 whole effluent toxicity (WET) tests were conducted; only one effluent sample was not toxic to test organisms during the baseline WET tests
- Toxicity tests using whole effluent and synthetic effluent test mixtures were performed to identify the potential for major ion imbalance as a source of toxicity in the baseline tests
- Results indicated that sublethal toxicity in 13 (of 14) samples appeared to be related to ion imbalance
- This study provides sufficient evidence that ion concentrations in RO and IE water treatment plant effluents are a primary source of the effluent toxicity
- Management recommendations proposed focus on closely matching effluent and receiving stream ion characteristics at WTPs by diluting effluents prior to discharge (in freshwater environments) and maximizing instream dilution through outfall design and placement

The report is available from the USFWS at www.fws.gov/nc-es/ecotox/ecotoxpub.html. For more information, contact Sara Ward, USFWS, Raleigh, NC (Sara_Ward@fws.gov or 919/856-4520 x.30).