

## POTENTIAL IMPACTS OF LANDFILL LEACHATE TO ALLIGATOR RIVER NATIONAL WILDLIFE REFUGE

### ABSTRACT

Surface runoff or leachate from two landfills have the potential to impact fish and wildlife resources associated with Alligator River National Wildlife Refuge, Dare County, North Carolina. Sediments were collected from 12 locations in canals down gradient from the landfills and from two reference sites for laboratory assessment of sediment quality. Sediments were analyzed for metal (As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn) and organic contaminants (PAHs and organochlorine pesticides). Chronic toxicity of the sediments was determined using 28-d static-renewal exposures with *Hyalella azteca* (Crustacea: Amphipoda) with survival and growth as the test endpoints. Acute toxicity was evaluated using static 96-h exposures of *H. azteca* to sediment pore water. Based on the toxicity evaluation, sediments from four locations were selected for a 28-d bioaccumulation study with *Lumbriculus variegatus* (freshwater oligochaete). Solid-phase sediments were not acutely toxic to *H. azteca*, but length was significantly reduced in sediments from five locations. Sediment pore waters from four locations were acutely toxic to *H. azteca*. Bioaccumulation studies exhibited uptake of several metals and PAHs, demonstrating the availability of these contaminants to the biota. Residue analyses of the sediments showed that several metals and PAHs exceeded sediment quality guidelines, and pore water concentrations of several metals exceeded water quality criteria for the protection of aquatic wildlife. These data demonstrate that runoff or leachate from the landfills have reduced sediment quality and have the potential to adversely affect resident fish and wildlife resources associated with Alligator River National Wildlife Refuge.



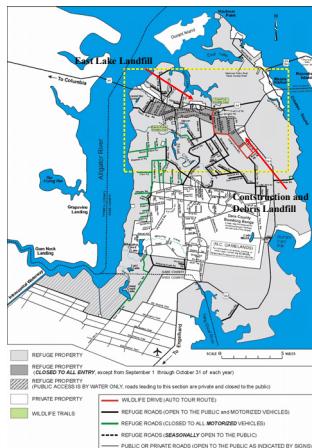
### INTRODUCTION

Contaminants in leachate and storm-water runoff from two landfills in Dare County, NC have the potential to adversely affect fish and wildlife resources associated with Alligator River National Wildlife Refuge. The mission of the Refuge, which encompasses a variety of coastal wetlands with pocosins being the most unique, is to preserve and protect the wetlands and their associated fish and wildlife species. The inactive East Lake Municipal Landfill operated from 1980 to 1993 had a history of NPDES permit violations. Fire suppression activities in 1998 at the active (since 1993) Dare County Construction and Demolition-Debris Landfill resulted in down-gradient releases of contaminated surface water from the burning debris piles. To evaluate the potential impacts of surface-water runoff and leachate from the landfills to the Refuge, the quality of down-gradient sediments was assessed using laboratory toxicity and bioaccumulation studies in conjunction with chemical analyses of the sediments and sediment pore waters.

East Lake Landfill



Construction and Demolition Debris Landfill



Static-renewal System



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### METHODS

- Sediments collected in August 2000
  - 6 sites at inactive East Lake Landfill
  - 8 sites at active Construction and Debris Landfill
  - Collected with petite Ponar grab
  - Top 10–15 cm
  - Stored in plastic (bioassays) or glass (analytical) jars
  - Transported in coolers with blue ice
- Solid-phase chronic sediment test
  - 28-d exposure
  - Static-renewal of overlying water
  - 5 replicates per sediment
  - Test animal - *Hyalella azteca* (crustacean)
  - 10 7-d old animals per replicate
  - Fed 1.5 ml YCT daily
  - Test endpoints – survival and growth
- Pore-water acute test
  - Vacuum-extracted pore water
  - 96-h exposure
  - Static conditions
  - 5 replicates per pore water
  - 10 7-d old *H. azteca* per replicate
  - Not fed during test
  - Test endpoint – survival
- Bioaccumulation study
  - Subset of samples used in toxicity assessments
  - 28-d exposure
  - Static-renewal of overlying water
  - 4 replicates per sediment
  - Test animal - *Lumbriculus variegatus* (oligochaete)
  - 1000 animals per replicate
  - Not fed during test
  - Test endpoint – body residues of metals and PAHs
- Chemical analyses
  - Metals in sediments, pore waters, oligochaetes – ICP/MS
  - PAHs in sediments, oligochaetes – HPLC and GC/MS
  - AVS, SEM, TOC
  - QA/QC – blanks, spikes, duplicates

### RESULTS AND DISCUSSION

Sediments collected closest to the landfills elicited acute and chronic responses in *H. azteca*. Survival was reduced in solid-phase sediment exposures at one station (EL1), and growth was reduced at five stations (CD1, CD3, CDS, CDR and EL1). Survival in pore water was significantly reduced at four sites (CD1, CD2, CDR and EL1). Metal and PAH concentrations in the sediments and pore waters showed a strong concordance with the results of the toxicity tests. Concentrations in sediments closest to the landfills exceeded sediment quality guidelines and water quality criteria. *Lumbriculus variegatus* bioaccumulated metals and PAHs from sediments collected down gradient from the landfills, illustrating the bioavailability of these contaminants. Laboratory evaluations demonstrated that sediments down gradient from the landfills had reduced quality compared to reference sites. Contaminants transported in runoff from the landfills have the potential to cause adverse impacts to associated fish and wildlife resources in down-gradient canals.

### CONCLUSIONS

Preponderance of Evidence Demonstrates Environmental Degradation

- Sediments at Stations Closest to Landfills Show:
  - Reduced growth of *Hyalella azteca* in solid-phase exposures
  - Reduced survival of *Hyalella azteca* in pore-water exposures
  - Elevated concentrations of metals (As, Cr, Cu, Ni, Zn)
  - Concentrations exceeded sediment and water quality criteria
  - Metals were bioavailable – bioaccumulation by *Lumbriculus variegatus*

Runoff from Landfills Presents Potential Adverse Impacts to the Fish and Wildlife Resources of Alligator River National Wildlife Refuge

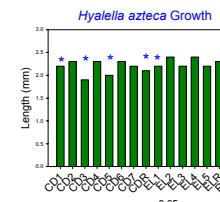
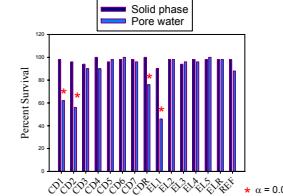
### SIGNIFICANCE OF THIS STUDY

Results from this study were used by the USFWS to develop landfill management and monitoring recommendations. Based on these recommendations, the State solid-waste regulators required the landfill operators (Dare County) to remove contaminated sediments from the drainage canals and to implement a water quality monitoring program.

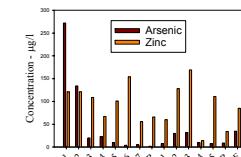
### *Lumbriculus variegatus*



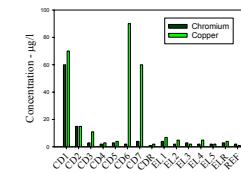
### *Hyalella azteca* Survival



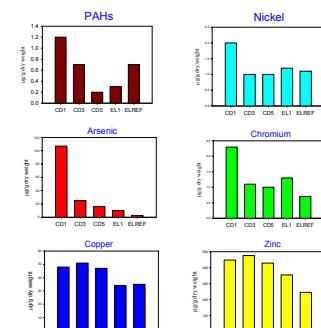
### Solid-phase Sediment



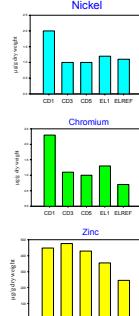
### Sediment Pore Water



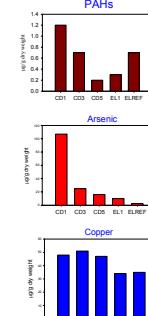
### BIOACCUMULATION



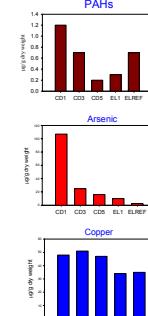
### Nickel



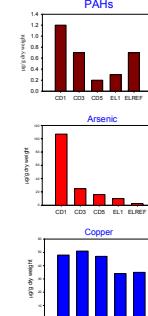
### PAHs



### Arsenic



### Chromium



### Zinc

