Nearshore Health & Nonpoint Source Pollution

Focus Area
Nearshore Health & Nonpoint Source Pollution

Process Based Predictive Models for Complex Urban Beaches

Rapid Method Data Comparison at Bathing Beaches in Ohio

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(NEORSD)
GLRI Grants

• **Rapid Method Data Comparison at Bathing Beaches in Ohio**
  – EPA-R5-GL2010-1
    • Nearshore Health and Nonpoint Source Pollution
    • Improving Beach Monitoring for Bacteria
• **Process Based Predictive Models for Complex Urban Beaches**
  • EPA-R5-GL2010-1
  • Health and Nonpoint Source Pollution
  • Beach Forecasting Models
Process Based Predictive Models for Complex Urban Beaches

Dedicated to the research work performed by Lester Stumpe

Project Managed by Mark Citriglia
Process Based Predictive Models for Complex Urban Beaches

• Existing linear regression models do not incorporate all the complex mechanisms driving water contamination at urban beaches

• NEORSD plans to develop a process-based model for predicting water quality
  – Capture new variables that appear to be critical in determining water quality
    • Quantify processes leading to contamination of beach sand
    • Quantify processes leading to contamination of water column
Research Model

Model Boundary

Variable or information affecting rate (Change agent)

Rate In (change)

Stock
(Quantity of Stuff)
(Like #E. coli in bathing water column)

Rate Out (change)

Model Boundary
Key Beach Stocks and Flow Processes

- **#E. coli in submerged sediment in bathing area**
- **#E. coli in contaminated beach sand**
- **#E. coli available from a variety of direct sources**

GROUPED FLOW PROCESSES

- **WAVE ACTION**
- **RE-SUSPENSION**
- **RAIN DRIVEN**
- **DIRECT**

**Sedimentation Rate**

**#E. coli in bathing beach water column**

Rate of beach sand contamination from a variety of sources

Data collection point

Rate of other losses
Process Based Predictive Models for Complex Urban Beaches

- Characteristics
  - Sand grain size
  - Beach slope
  - Hydraulic conductivity
  - Currents

- Attributes
  - Contaminated Sediment & Sand
  - Waterfowl Population
  - Stormwater Influences
  - Combine Sewer Overflows
  - Algae and Debris
Villa Angela and Euclid Beaches
Research Methods

- Lester and his Co-ops pioneered a variety of research methods to compile data points to support the stock and flow models.
Rapid Method Data Comparison at Bathing Beaches in Ohio

- Water samples collected at four Lake Erie beaches will be analyzed for *E. coli* and *Enterococci* to evaluate the effectiveness of the rapid methods
  - qPCR & IMS/ATP
  - qPCR,
- Utilize qPCR technology to identify if other FIB exist in quantifiable amounts
  - *Clostridium*
  - *Campylobacter*
Rapid Method Data Comparison at Bathing Beaches in Ohio

• Monitoring
  – May – September 2011
  – Edgewater, Euclid, Villa Angela and Huntington Beaches
  – Sampling Monday through Thursday
  – Event Based sampling
  – Both sand and water samples will be collected

• Correlation / Comparison
  – E. coli vs. Enterococci
  – IMS/ATP vs. qPCR
Real Time PCR vs. Culture Based Fecal Indicator Bacteria Measurements to Determine Beach Water Quality

Pathogens too diluted & varied to measure at beach. Indicator bacteria still measurable.

Filter Water Sample
Grow Indicators on Filter Membranes
Count indicator colonies on filter to determine water quality.

Filter Water Sample
Extract DNA from Filter

Amplify & measure indicator DNA by PCR to determine water quality.

24 Hours 2 Hours
Questions