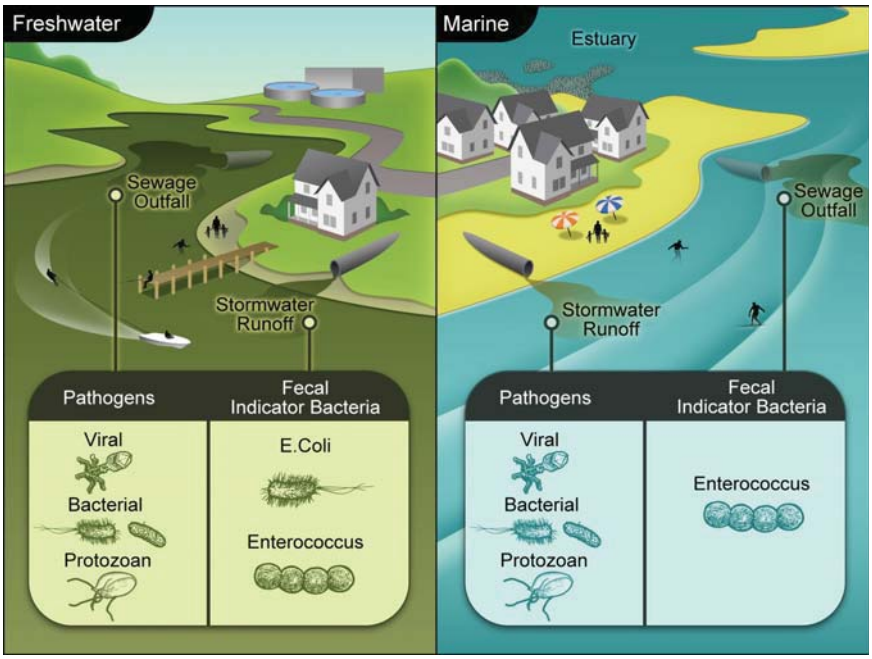
HRSD
Cleaning wastewater every day for a better Bay.

Pathogen Program: Molecular Tools for Environmental Management

12.2.2015

Microbial Source Tracking



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Microbial Source Tracking

A **set of techniques** used to determine the sources of **fecal indicator bacteria** in the environment

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State of the Science

RATIOS	CHEMICAL/ BIOCHEMICAL	LIBRARY DEP. METHODS	LIBRARY INDEP. METHODS	NEXT GENERATION SEQUENCING
FC:FS	Optical Brighteners	PFGE Ribotyping Rep-PCR Antibiotic Resistance	Bacteriophage Viral PCR Viral qPCR Bacterial PCR Bacterial qPCR	Illumina Roche 454 Ion Torrent

host-specific qPCR

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Origins

HRSD formed to protect public health

- Contaminated oysters were a serious problem

Vision: Future generations will inherit clean waterways and be able to keep them clean

Commission approved Pathogen Program in June 2015

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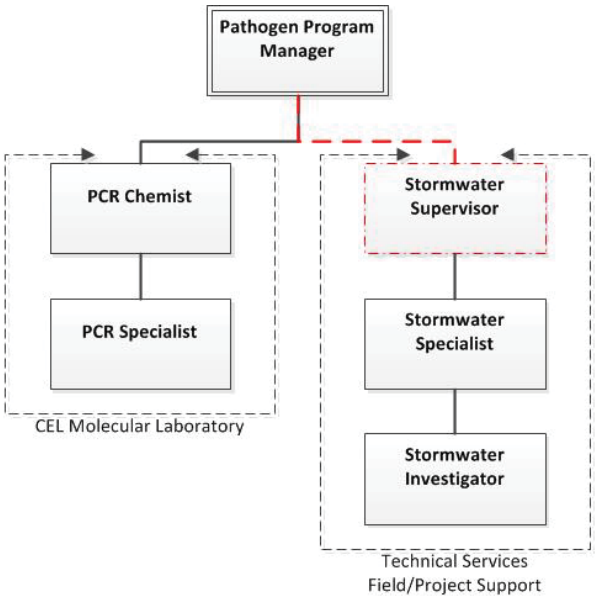
Pathogen Program Basics



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Pathogen Program Basics Cont.

Focus:

1. **Microbial Source Tracking Studies**
2. Pathogen/Virus Quantification Support

Program Mission: To partner with localities to focus source identification efforts

Project Types: infrastructure identification, spill delineation, sewage presence confirmation

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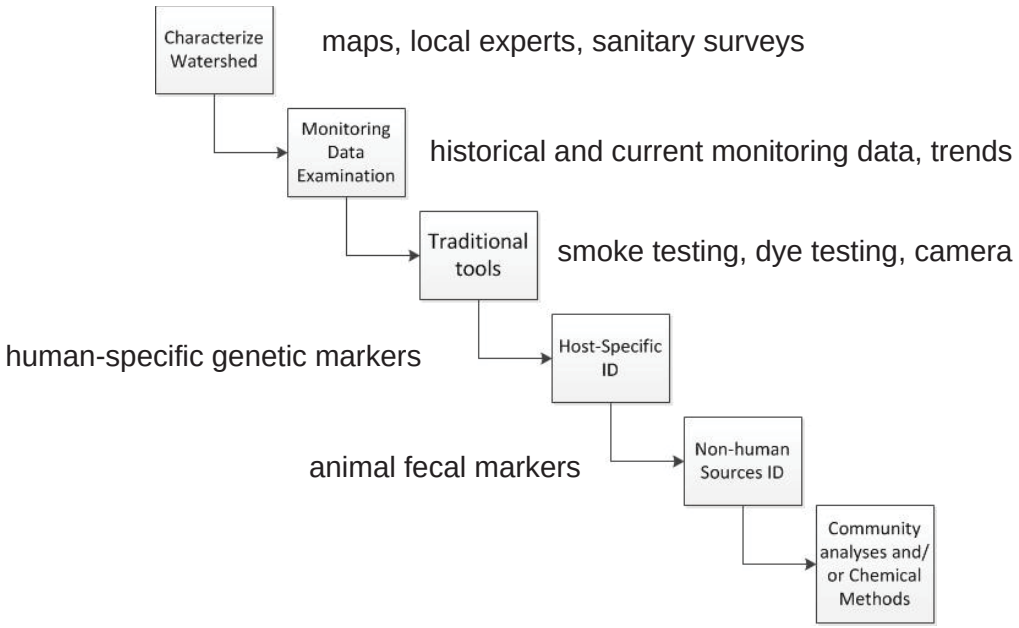
Chronic Contamination

MST—The Tiered Approach



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HRSD's MST Capabilities

Currently

- Fecal *Bacteroides* spp.
- HF183
- Human Polyomavirus (HPyV)
- EPA's HumM2 technology

In the Works

- Other sources
  - Gull
  - Dog
  - Geese
- Pathogens
  - Norovirus (G1 & 2)
  - Adenovirus
  - Hepatitis A Virus

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Program Logistics

- **Partnership**: locality must commit resources to put "boots on the ground"
- **Cost**: HRSD pays for sampling and analyses
- **Contract**: Model agreement will be drafted to guide future work
- **Prioritization**: Highest priorities→ chronic bacterial exceedances, public health risk
  - Project prioritization: ?

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Wayne Creek: A Microbial Source Tracking Case Study

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Chronic Contamination

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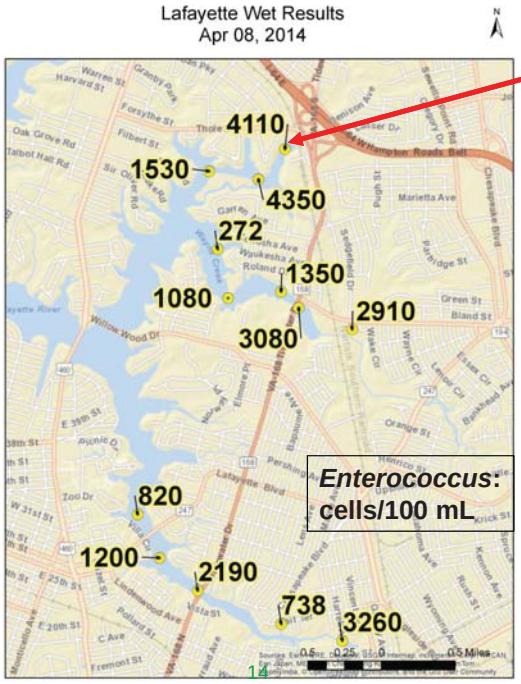
Elizabeth River Project Monitoring



Wet Weather:
4110 *Enterococcus* cells/100 mL

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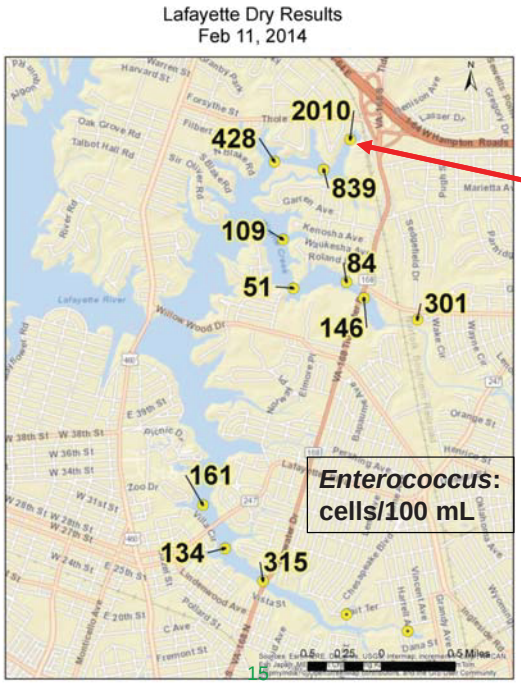
Elizabeth River Project Monitoring



Dry Weather:
2010 *Enterococcus* cells/100 mL

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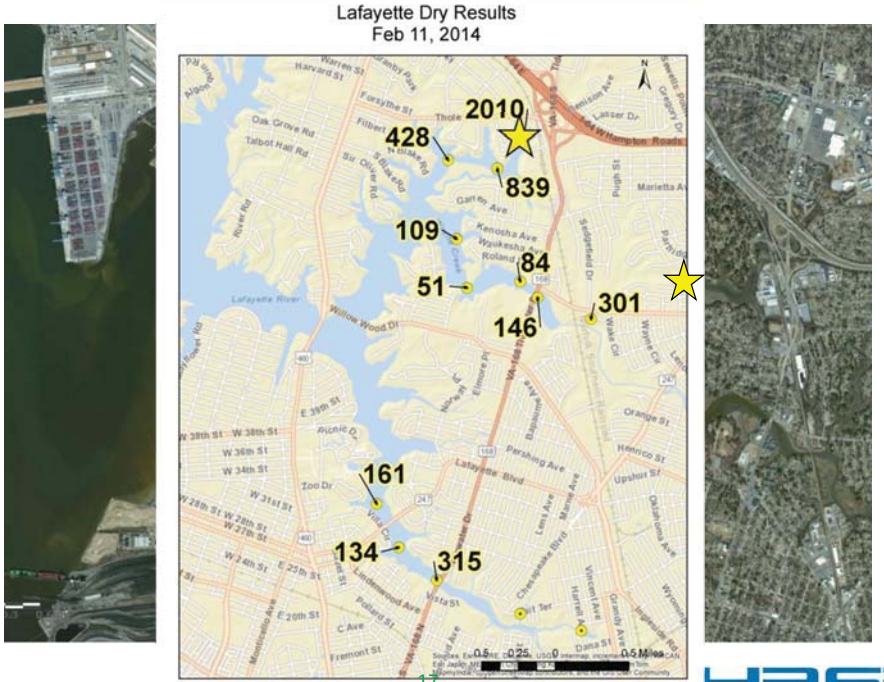
Novel Approach to Understand Causes

1. Alternative indicators
2. **Targeted in-pipe sampling**

Sampling Design



Sampling Design

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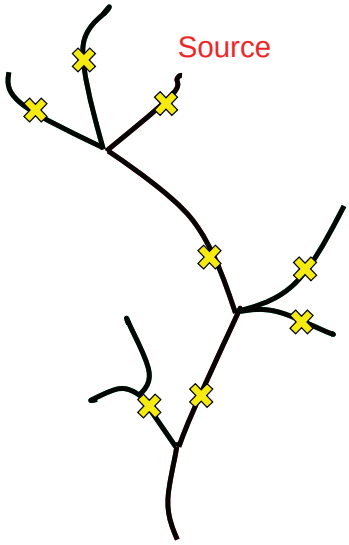
Sampling Design

- Downstream to upstream SW pipe network investigation
- Every SW tributary intersection and outfall
- Narrow contamination origin to manageable area



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Sampling Design

Sampling design based on infrastructure knowledge

City of Norfolk identified homes still using septic system

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Results

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7/9/14—southern segment

Active septic systems—no human signal

Evidence of northern delivery route

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9/4/14—northern segment

Human fecal signal found along one stormwater pipe segment

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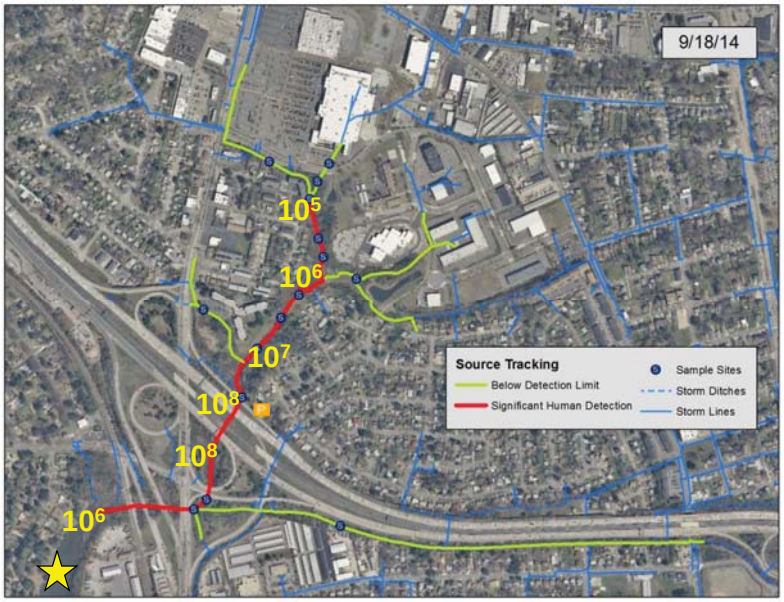
9/18/14—confirmation & delineation

Higher spatial resolution

Human contamination signal delineated—'hot spot' identified



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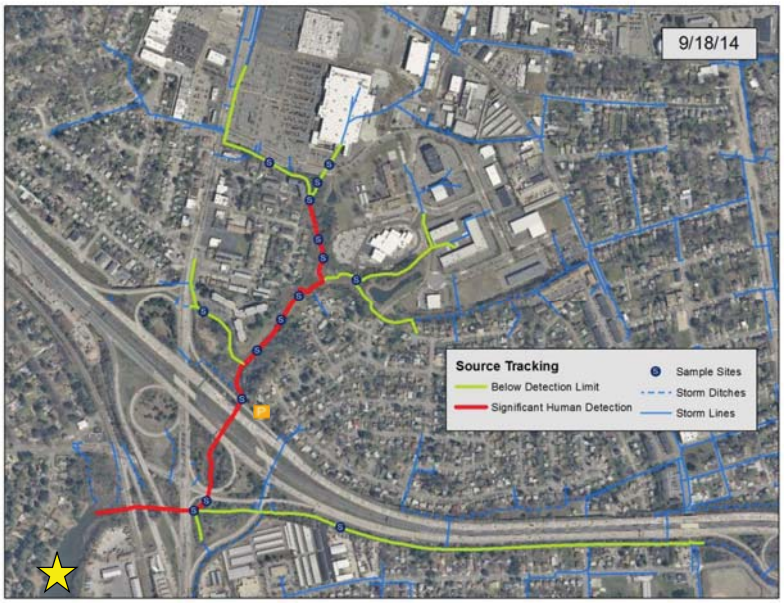
9/18/14—confirmation & delineation

Higher spatial resolution

Human contamination signal delineated—'hot spot' identified

Human marker levels near pump station levels

City of Norfolk found a leaking sewer main



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11/3/14—post repair

Water quality improved post repair

2 areas of residual signal

Areas of minimal flushing

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3/19/15—post repair

Excellent water quality:

Low Enterococcus concentrations

No human fecal markers detected

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Questions?

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