Microbial Source Tracking for Recreational Water Quality

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OVERVIEW

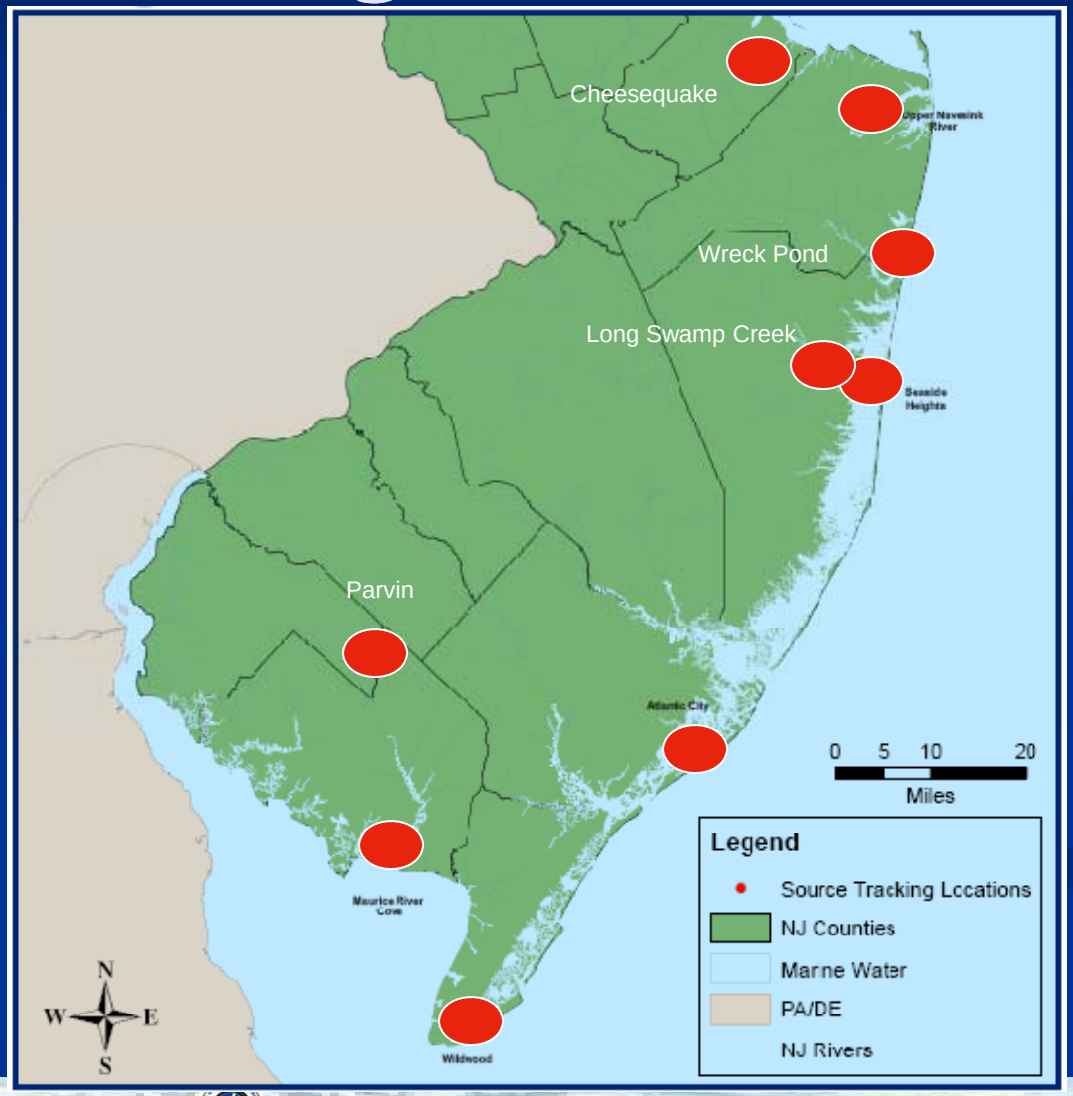
New Jersey's Application of Microbial Source Tracking Techniques

- New Jersey's tiered approach to microbial source tracking studies
- Laboratory methods used to distinguish sources of fecal contamination
- MST case study at impaired recreational waters

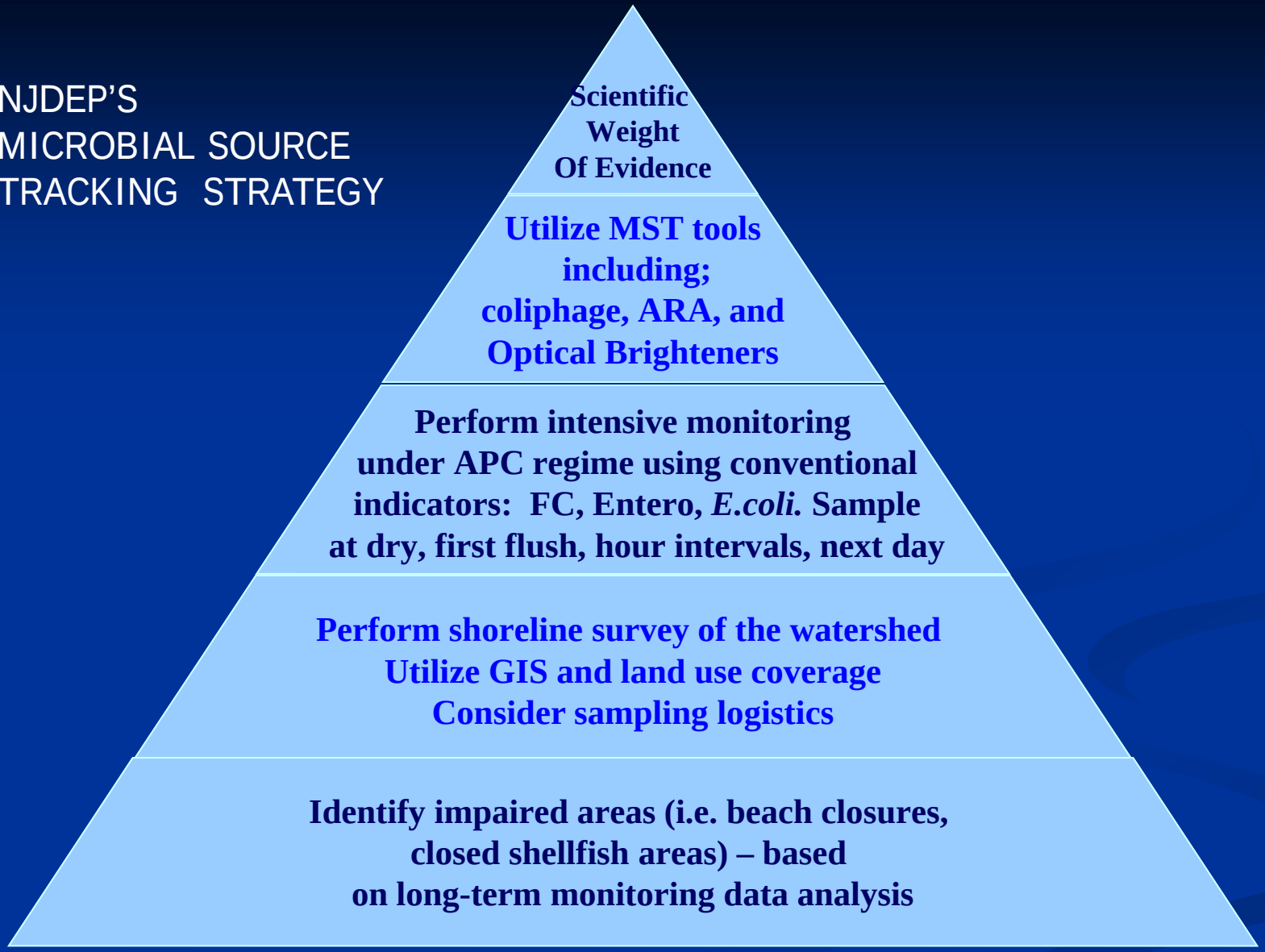
Nonpoint Source Microbial Source Tracking

A high percentage of NJ's water quality impairments are related to pathogens.

Microbial source tracking efforts are becoming increasing common in NJ surface waters.



NJDEP'S MICROBIAL SOURCE TRACKING STRATEGY



F+ RNA Coliphages

- Viruses that infect bacterial cells
- Similar in size, shape and morphology to HEV including; HAV and Norwalk therefore: good viral pathogen indicator
- More resistant to chlorination than the conventional indicators

  therefore: good wastewater effluent indicator

Coliphage - NJDEP Findings

- Monitoring at known fecal contaminated sites
  - point human - wasterwater discharge outfall
  - point animal - wildlife refuge discharge
  - non-point human - malfunctioning septic tank discharge
  - non-point animal - rural creek w/animal population

  - Findings:
    - Verified the presence of coliphage at these sites and validated the procedure
    - Genotyping of the phages provides a promising system for distinguishing human and animal fecal contamination

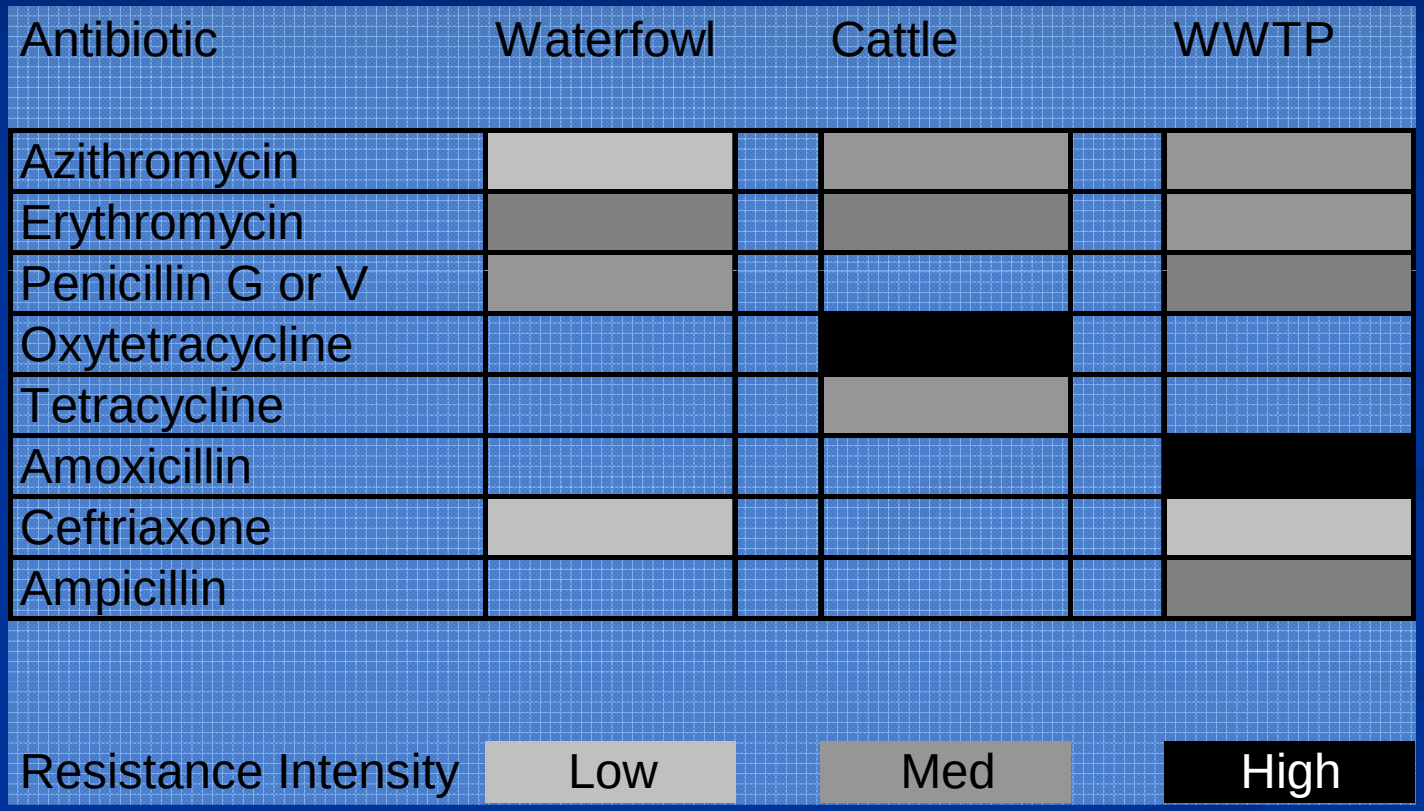
Genotyping of coliphages

- Group I - Animal
- Group II - Human
- Group III - Human
- Group IV - Animal

ARA – Antibiotic Resistance Analysis

- **ARA - Antibiotic Resistance Analysis**
  - identifies *E. coli* that are resistant to antibiotics used to treat bacterial infections in humans and domesticated animals.
  - Procedure uses NOAA's 96 well microplate containing 26 antibiotics typically administered to humans and domesticated animals

ARA Results

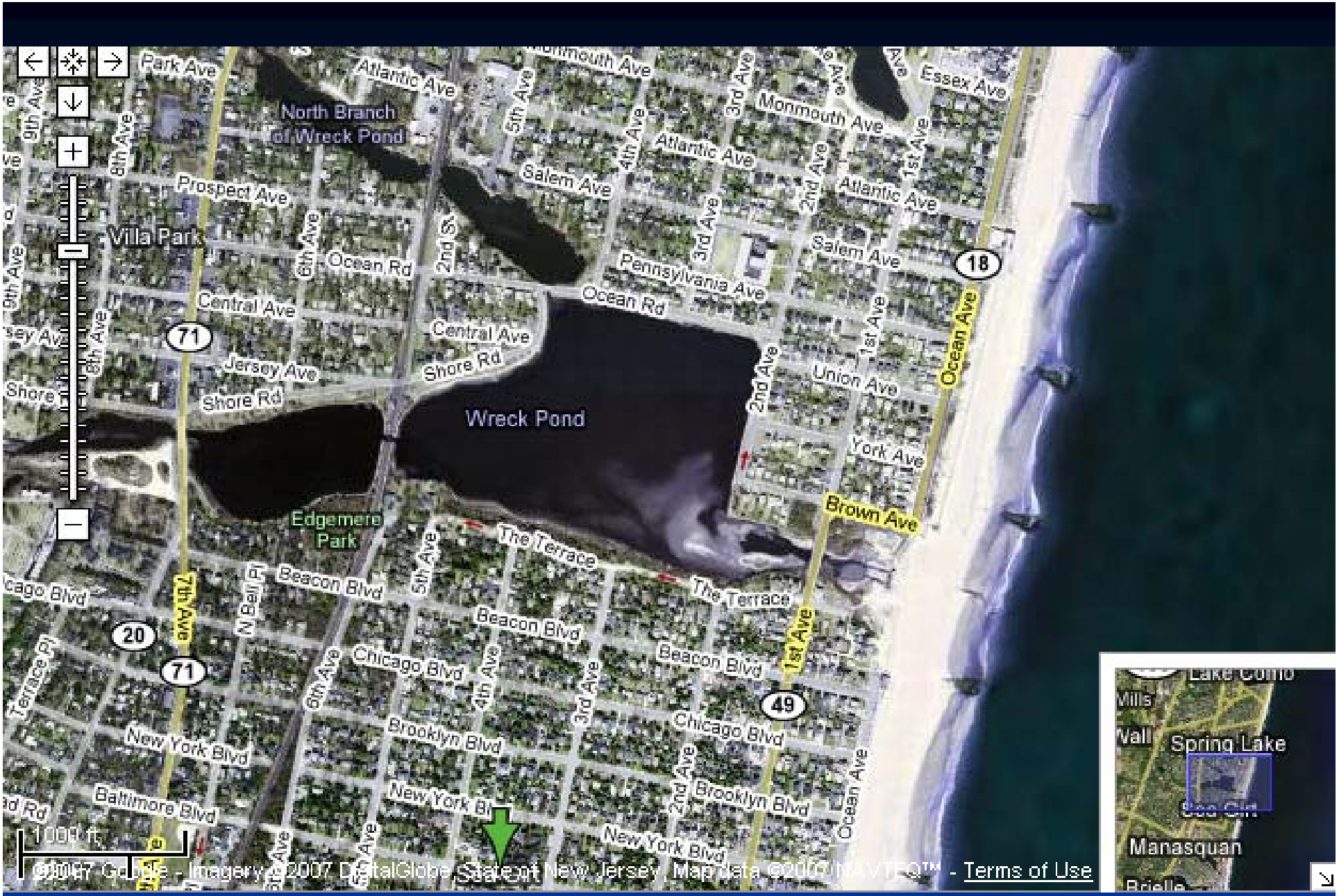

Antibiotic
Waterfowl
Cattle
WWTP
Azithromycin
Erythromycin
Penicillin G or V
Oxytetracycline
Tetracycline
Amoxicillin
Ceftriaxone
Ampicillin
Resistance Intensity
Low
Med
High

Optical Brighteners

- Fluorescent Whitening Agents (FWAs) are compounds that can be measured and studied as an indicator of human sources of pollution
- Laundry detergents contain FWAs and are discharged in substantial quantities with household wastewater
- Fluorometric Detection – Turner Fluorometer

CASE HISTORY-IMPAIRED RECREATIONAL OCEAN BATHING WATERS OF SPRING LAKE AND SEAGIRT

- Wreck Pond – discharges via a spillway and 300’ outfall to the ocean
- Elevated bacterial levels (enterococcus) following rainfall, impacts ocean bathing beaches in the vicinity of the outfall
- This has resulted in a “precautionary closure” of these beaches following rain events >0.1”


Park Ave
Atlantic Ave
North Branch of Wreck Pond
Monmouth Ave
Essex Ave
Prospect Ave
Salem Ave
Villa Park
Ocean Rd
Pennsylvania Ave
Central Ave
Jersey Ave
Shore Rd
Wreck Pond
Union Ave
York Ave
Brown Ave
Ocean Ave
Edgemere Park
The Terrace
Beacon Blvd
Chicago Blvd
Brooklyn Blvd
New York Blvd
Baltimore Blvd
1000 ft
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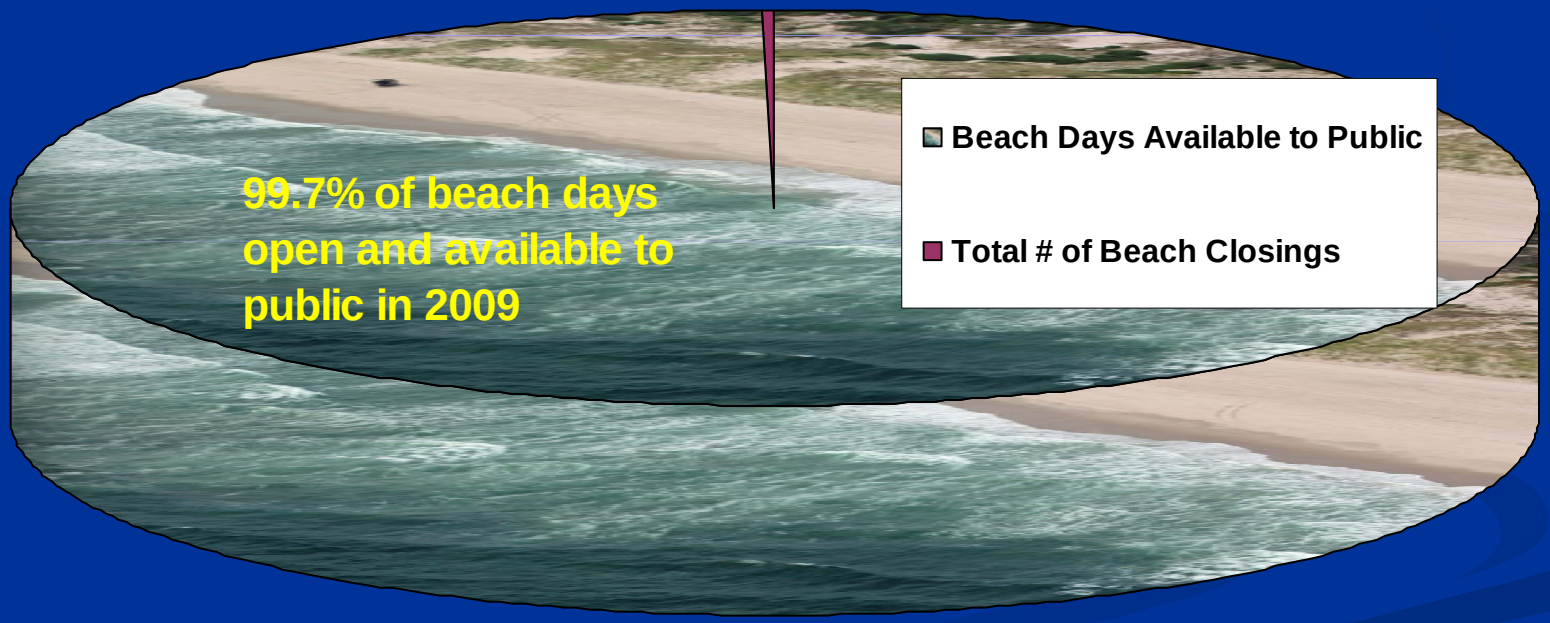
Spring Lake
Manasquan

Total Beach Days Available to Public in 2009

New Jersey has **700** lifeguarded ocean and bay beaches - more than any other state in the country.

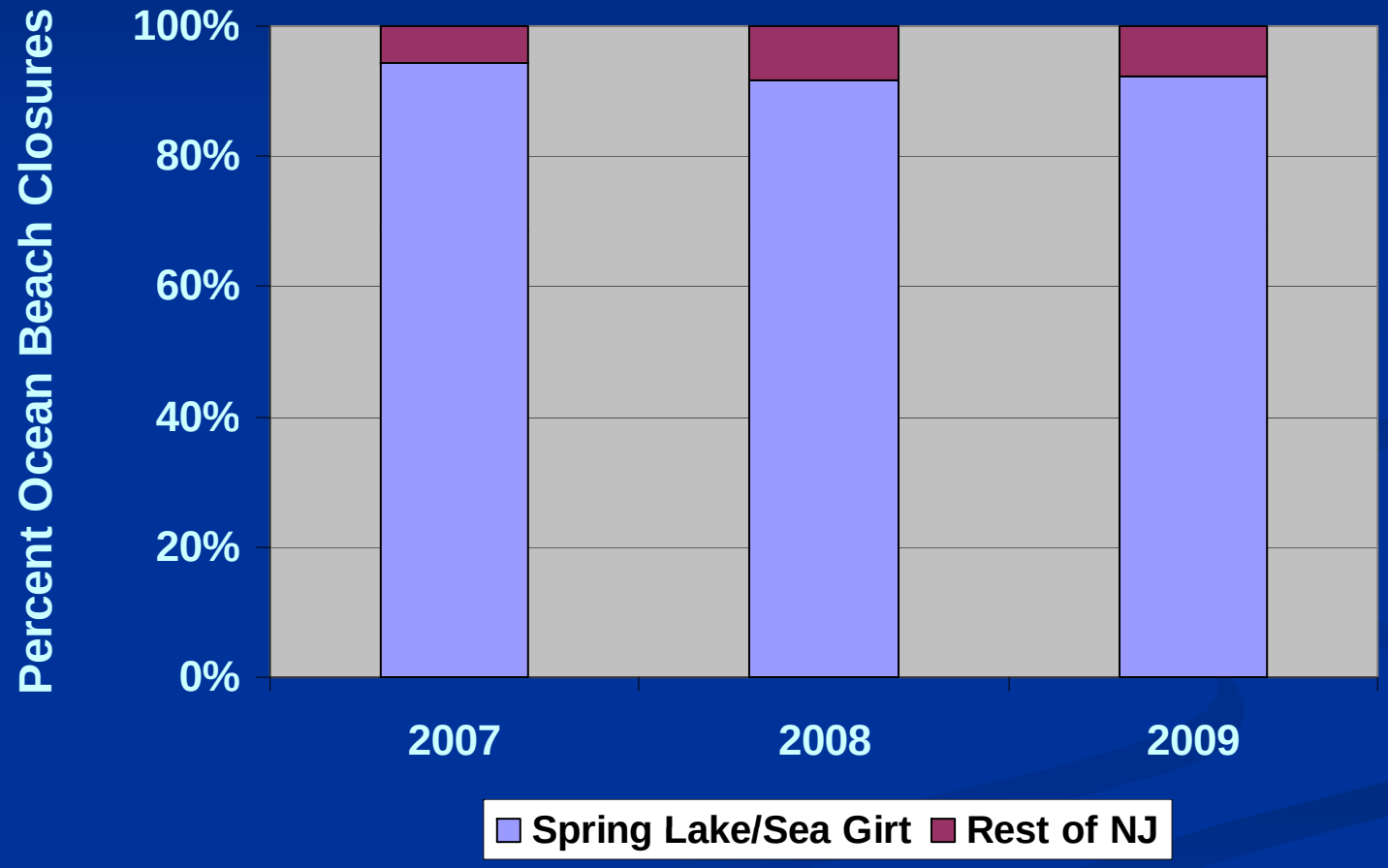
173 total beach closings in 2009 (6 for bacteria in excess of standard, 135 precautionary)



73,500 total beach days available in 2009

Why the focus on Spring Lake and Sea Girt Beaches?

Majority of NJ's ocean beach closings are related to these beaches

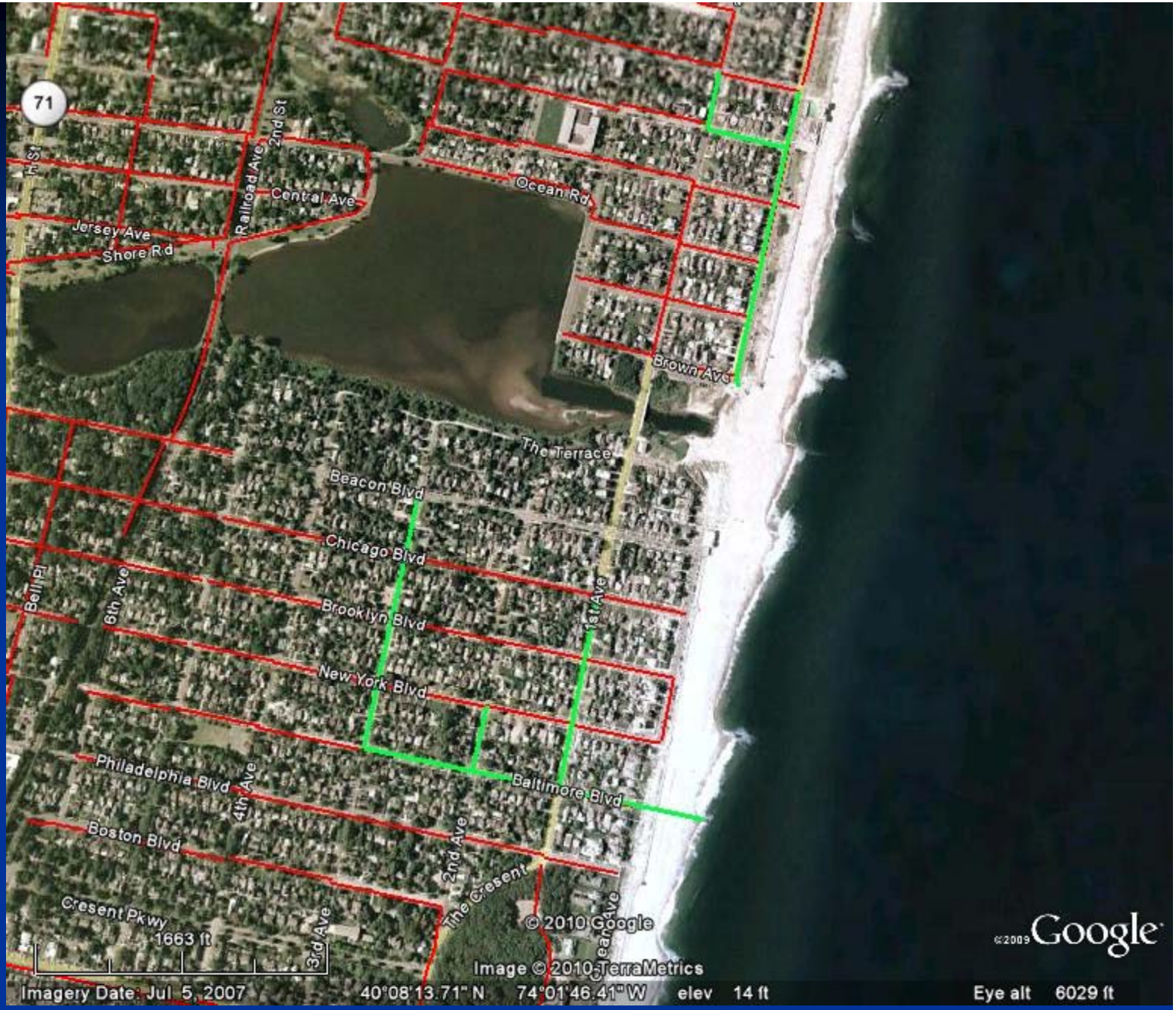


Water quality related closings only. Does not include closings due to floatables.

Infrastructure in vicinity of Wreck Pond, NJ.

Red = Sanitary Sewer

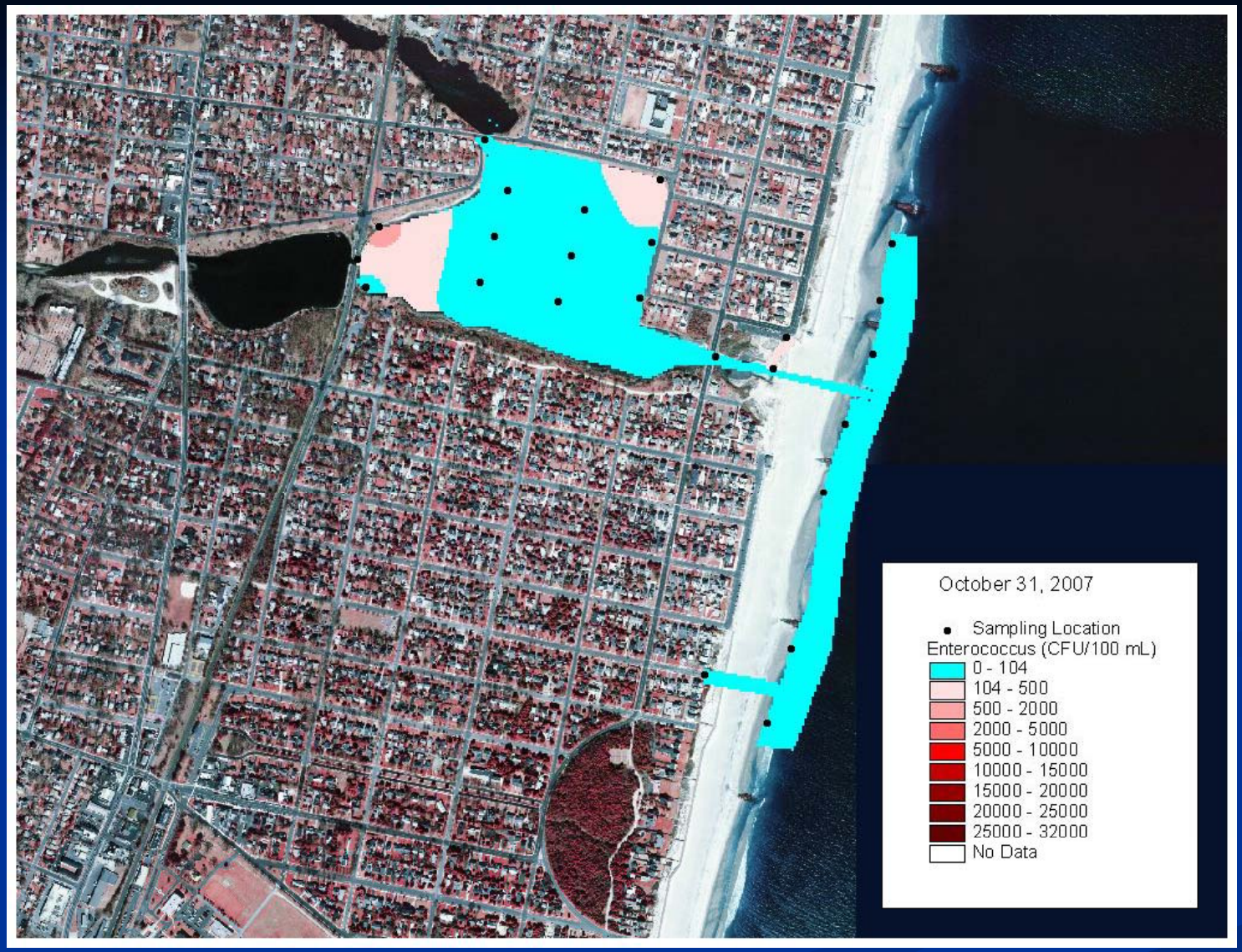
Green = partial Storm Water lines



Enterococcus Levels

Spring Lake / Sea Girt

10/31/2007 @ 10 AM



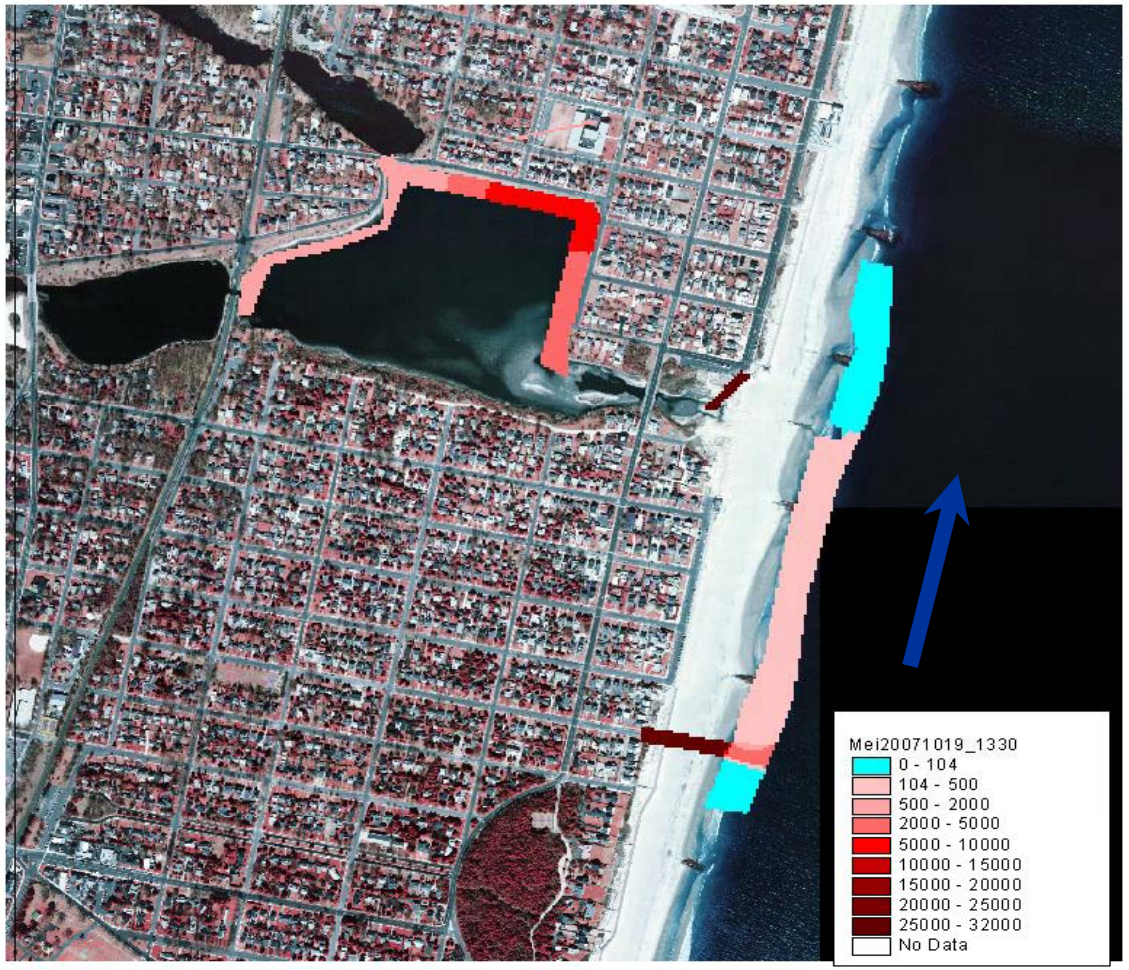
No appreciable rainfall 3 days prior.

Wind Speed: ~10 kts
Wind Direction: SE
Total 24 hr. rainfall: 0.0”

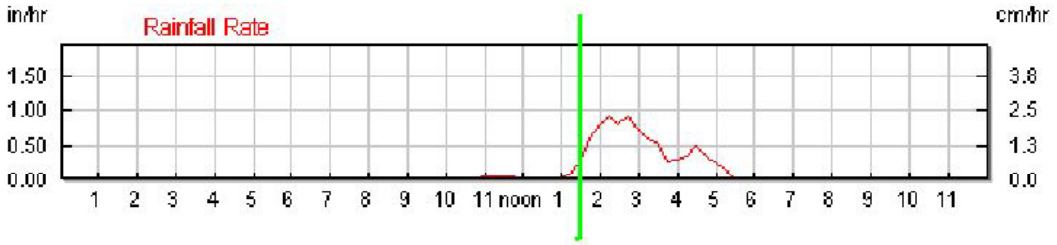
Enterococcus Levels
Spring Lake / Sea Girt
10/19/2007 @ 1:30 PM

- Early in storm event
- Elevated levels in Wreck Pond near discharge from Spring Lake
- Very high levels at Baltimore Ave. stormwater discharge
- Predominant nearshore ocean current is south to north.

Wind: S
Tide: 2.58 ft > MLW
24 hr. Rainfall: 2.20”



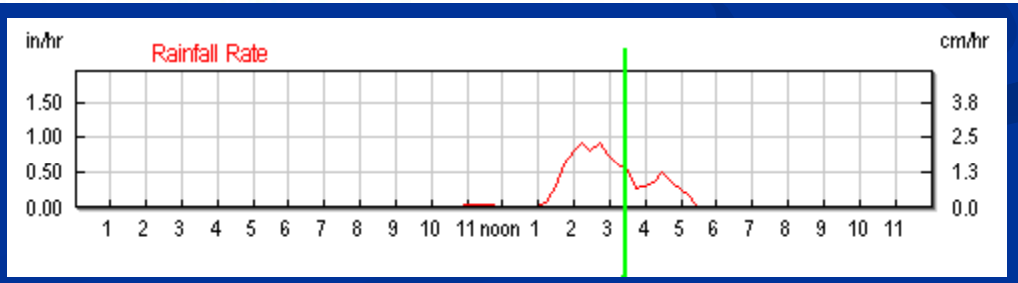
2007, NJDEP, Bureau of Marine Water Monitoring Levels reported as Enterococcus CFU/100 mL



Enterococcus Levels
Spring Lake / Sea Girt
10/19/2007 @ 3:30 PM

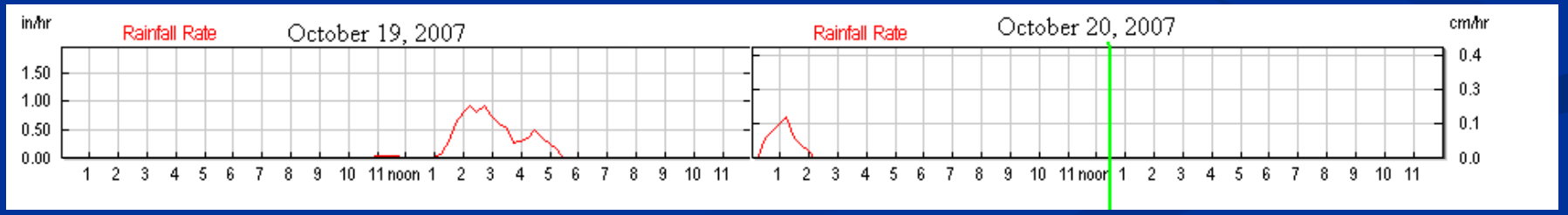
Wind: S
Tide: 4.13 ft > MLW

Green Circles show where ARA suggests human source.



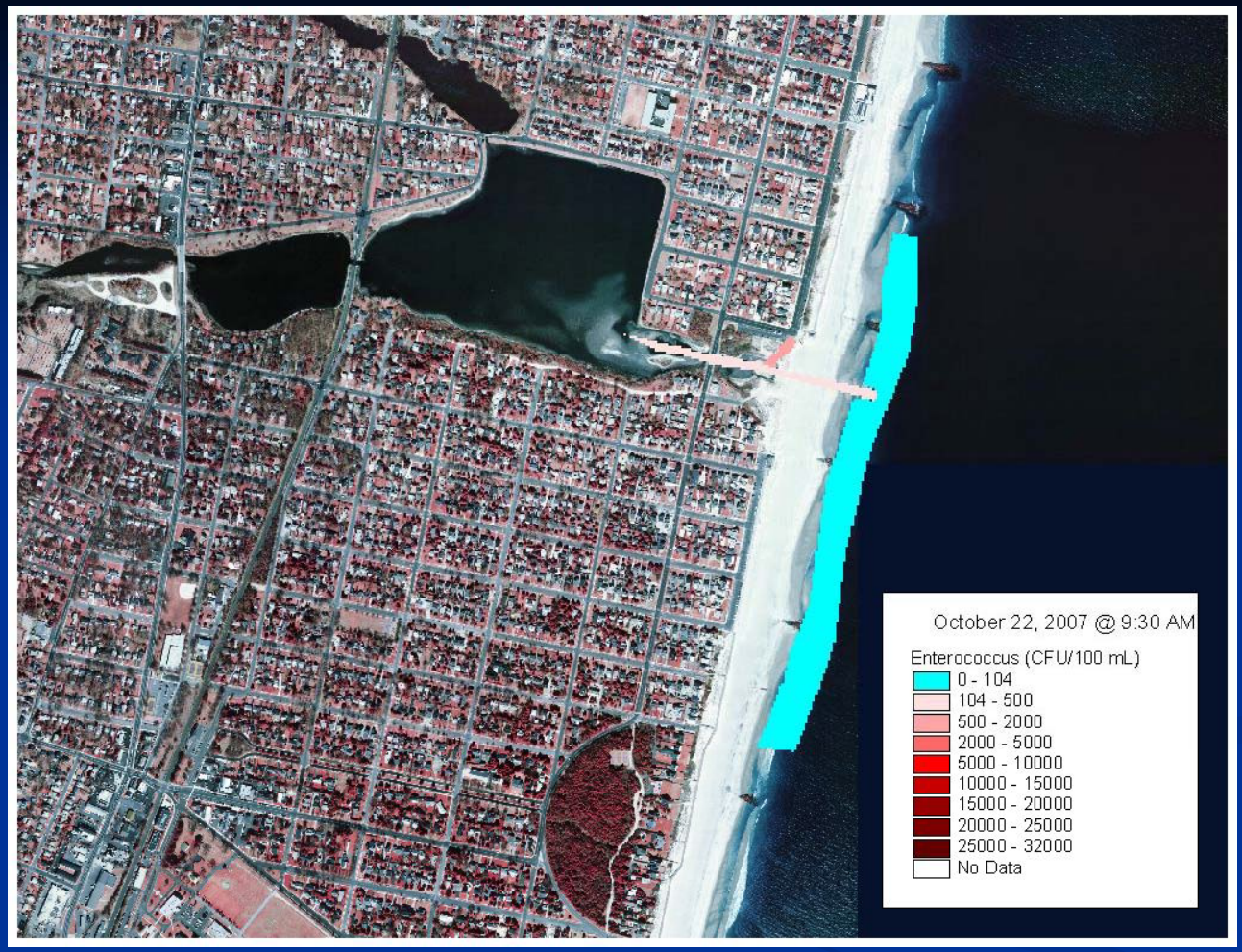
Enterococcus Levels
Spring Lake / Sea Girt
10/20/2007 @ 12:30 PM

Tide: 2.22 ft > MLW

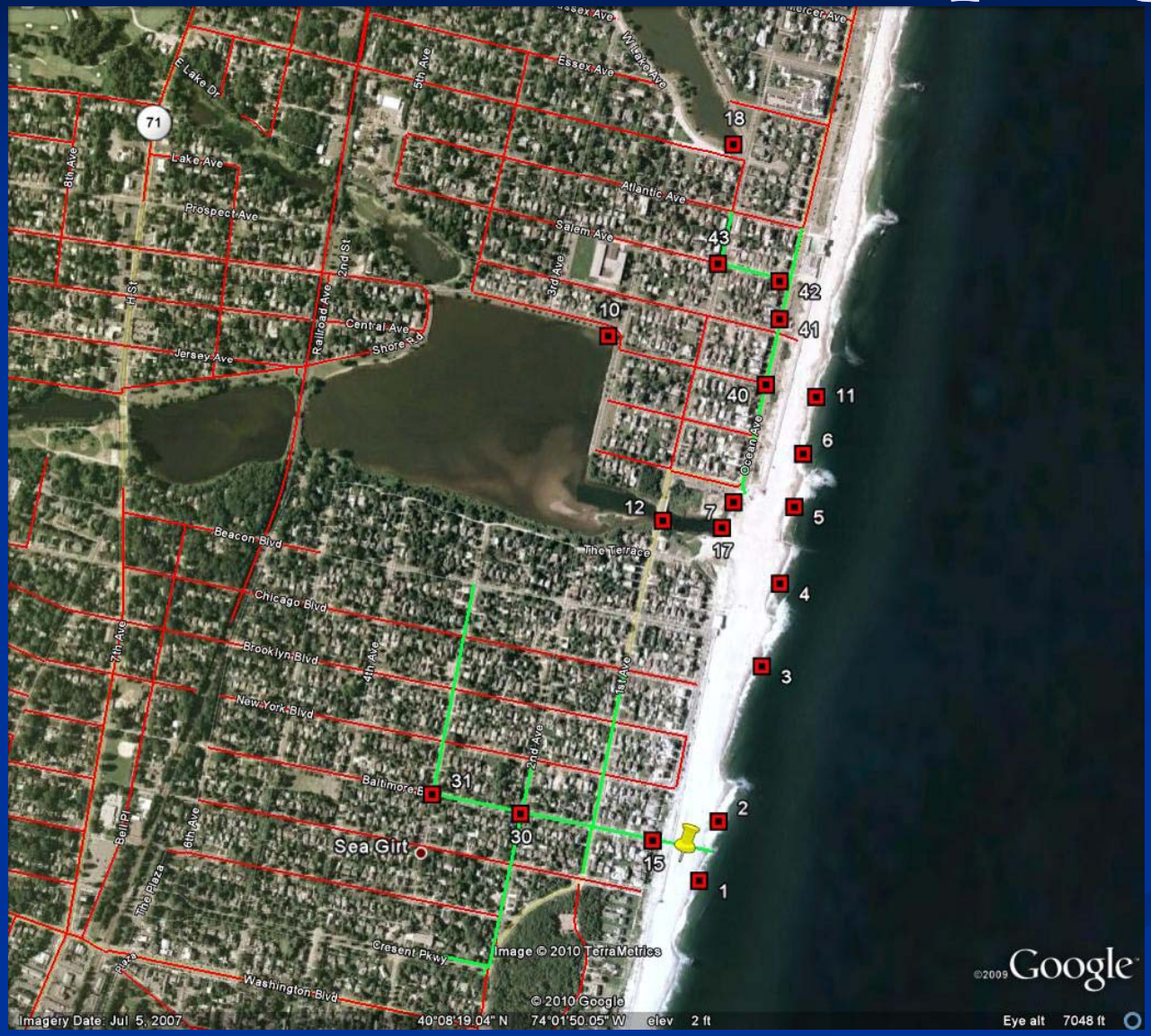


Enterococcus Levels
Spring Lake / Sea Girt
10/22/2007 @ 9:30 AM

Tide: 4.31 ft > MLW



2009 – Infrastructure Sampling



Conclusions

- Local sanitary and stormwater infrastructure is a primary source of Enterococcus levels responsible for beach closings at Spring Lake and Sea Girt's oceanfront.
- Studies to date have narrowed down the areas where investigation is needed to a few stormwater lines and a few blocks associated with these lines

Conclusions (cont'd)

- Multiple lines of evidence (coliphage, MAR, optical brighteners) support a component of stormwater pathogens loading to be sewage source(s)

Questions ?