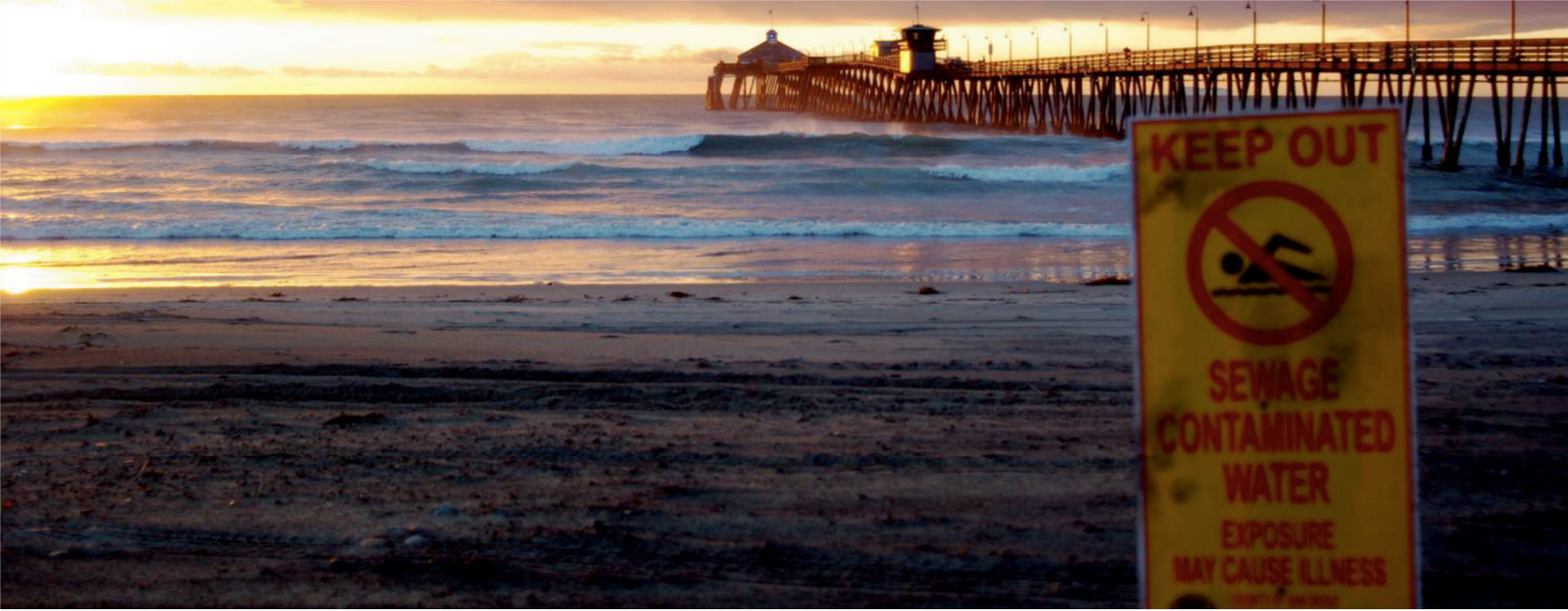

Evidence-based guidelines for Microbial Source Tracking projects

Beyond Nutrients: Case Studies and Tools for Addressing TMDLs
06/08/2016

Source Molecular

Leader in Microbial Source Tracking

Our mission is to fill the void between source identification research and real-world implementation of the technology.

Experience

- Leading commercial practitioner of Microbial Source Tracking services
- >70 Source Tracking Studies Completed in 2014 and 2015
- Founded in 2002

Research

- Commercial partner for California Source Identification Project (SIPP)
- Participated in US EPA Method Standardization Study
- Collaboration with SCCWRP on Digital PCR study (publication pending)

Methods

- US EPA-Developed
  - Human
  - Cattle
  - Chicken
  - Dog
- 8 additional hosts available
  - Bird
  - Ruminant
  - Elk
  - Goose
  - Gull
  - Pig
  - Horse
  - Beaver

Quality

- Pending ISO 17025 laboratory accreditation

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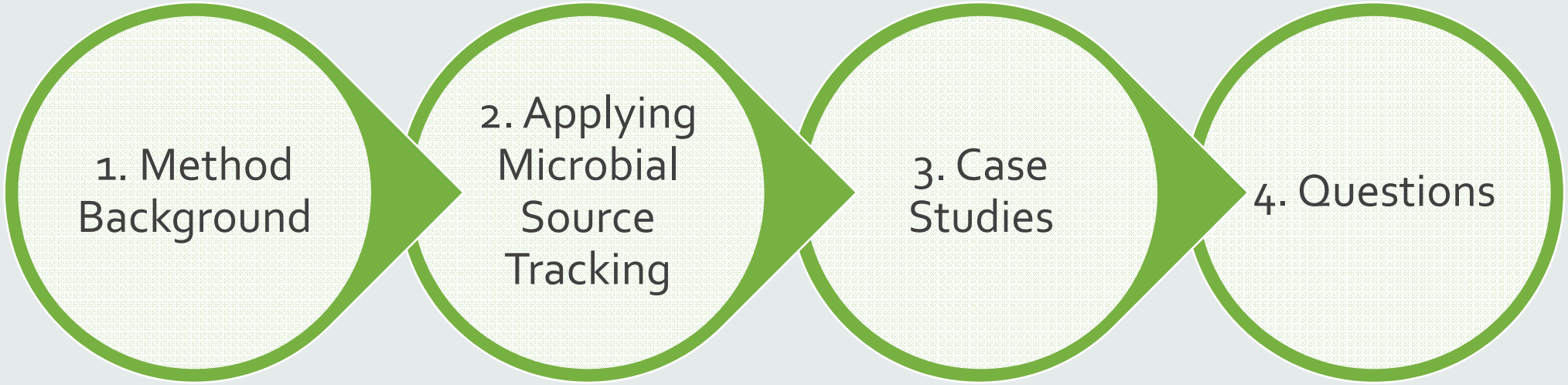
Leader in Microbial Source Tracking

Presentation Overview



- Microbial Source Tracking (MST)
- Hypothesis Driven Approach
- MST in Action
- Questions and Discussion

Method Background

Traditional Fecal Indicator Methods

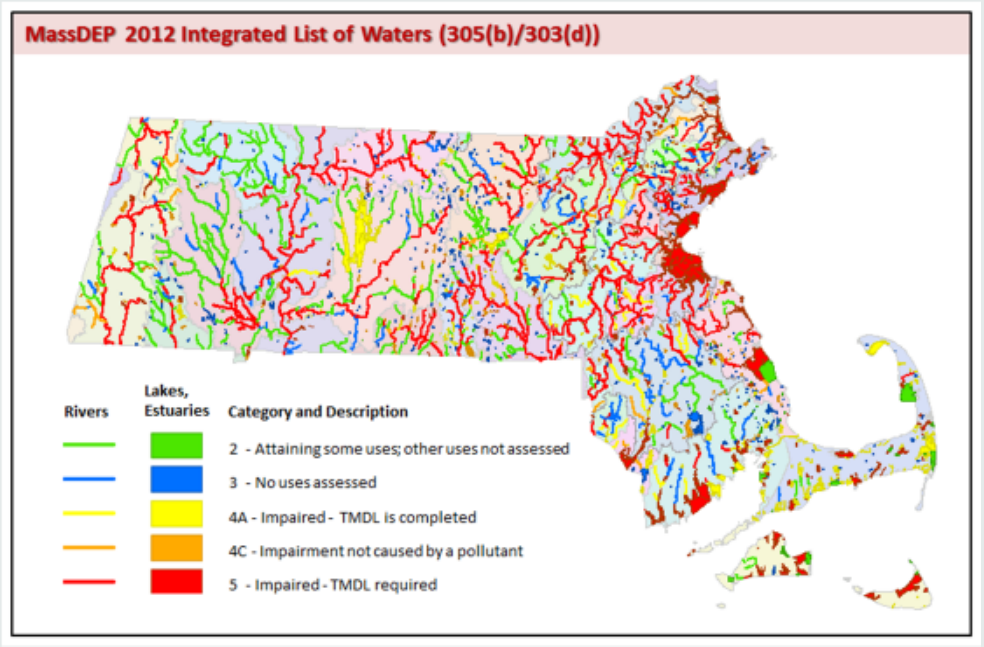
Total Coliform, Fecal Coliform,
E. coli, Enterococcus
CFU, MPN

Method Background

Traditional Fecal Indicator Methods

Total Coliform, Fecal Coliform,
E. coli, Enterococcus
CFU, MPN

http://floridawaterdaily.com/2015/05/01/no-swim-advisory-issued-for-venice-fishing-pier/



http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/wbs2012.html

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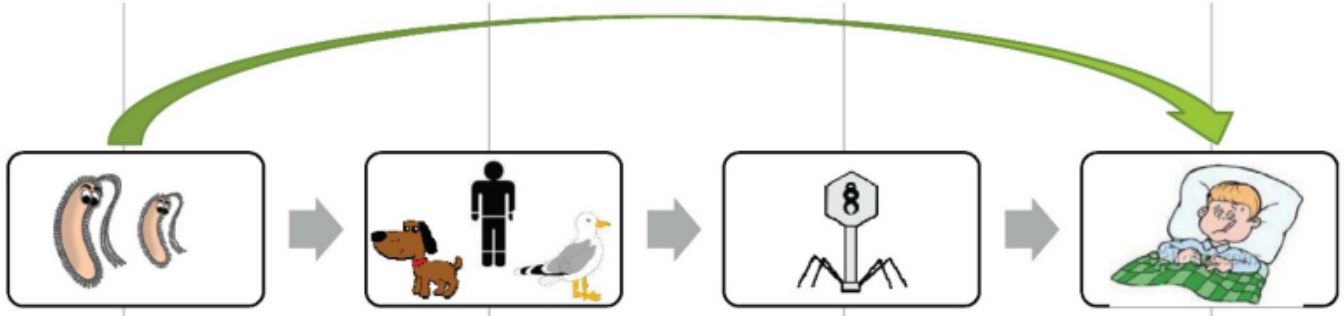
M

ds

m, Fecal Coliform,
ococcus

Geosyntec consultants
engineers | scientists | innovators

Fecal Indicator Paradigm



Fecal Indicator Bacteria (FIB) are assumed to be indicative of gastrointestinal illness, however this linkage breaks down for non-sewage impacted waters

How to measure each step in this linkage:

Culturable & Rapid Methods for FIB	qPCR markers (MST)	Direct pathogen enumeration	Epidemiology studies (or QMRA)

How MST advances this monitoring capability:

Traditional FIB approach

Modern MST approach

The near future?

8

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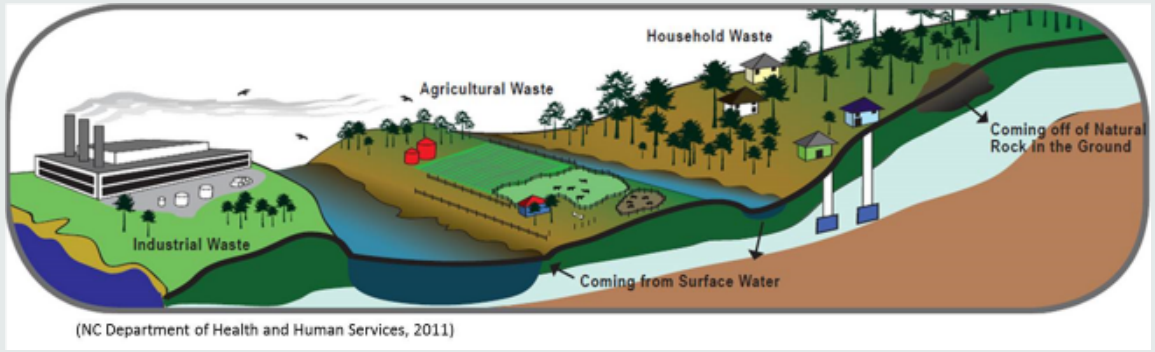
Method Background

Traditional Fecal Indicator Methods

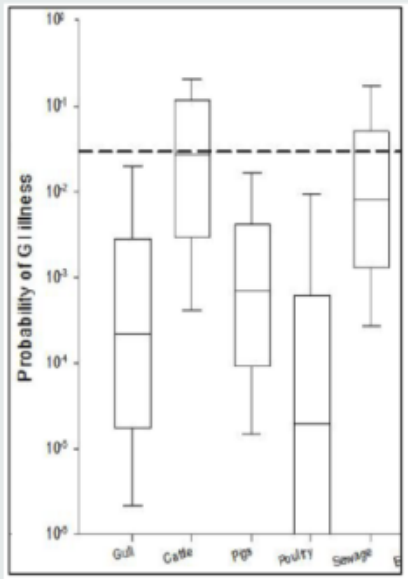
Total Coliform, Fecal Coliform,
E. coli, Enterococcus
CFU, MPN

What is the source?

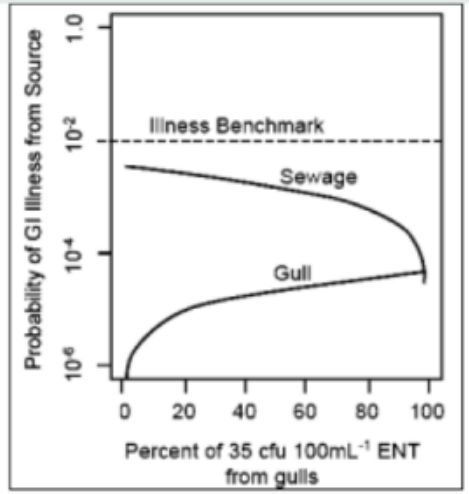


(NC Department of Health and Human Services, 2011)

What is the health threat?



Source: Soller et al, 2010

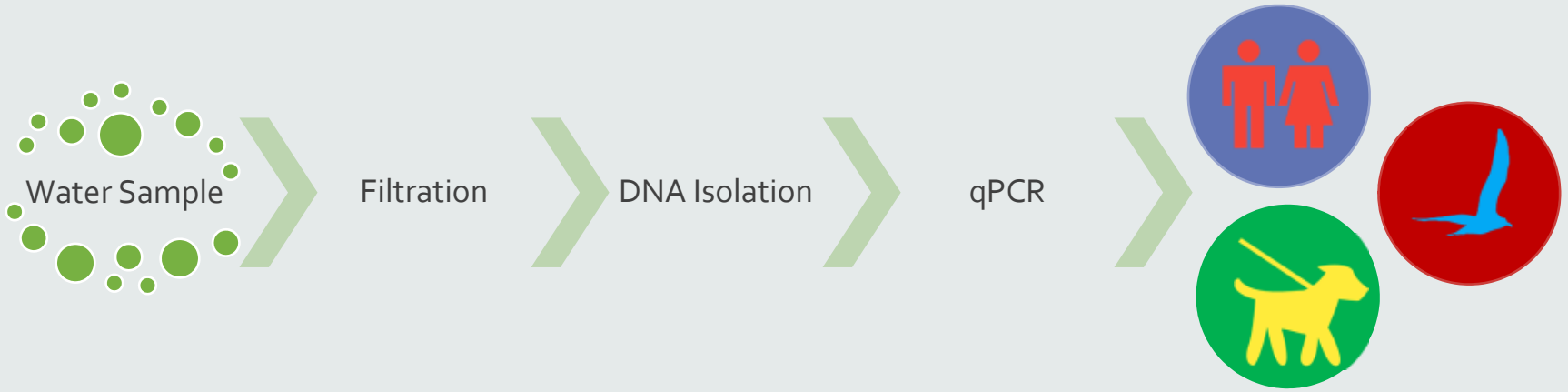


Source: Schoen & Ashbolt, 2010

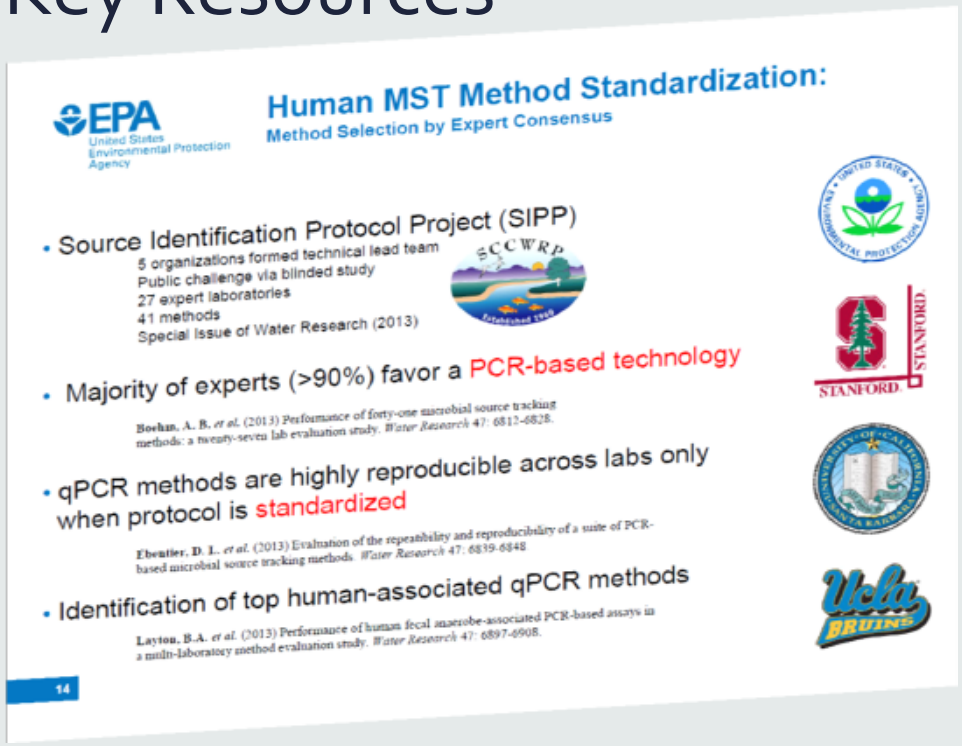
Method Background

Traditional Fecal Indicator Methods

Microbial Source Tracking Methods

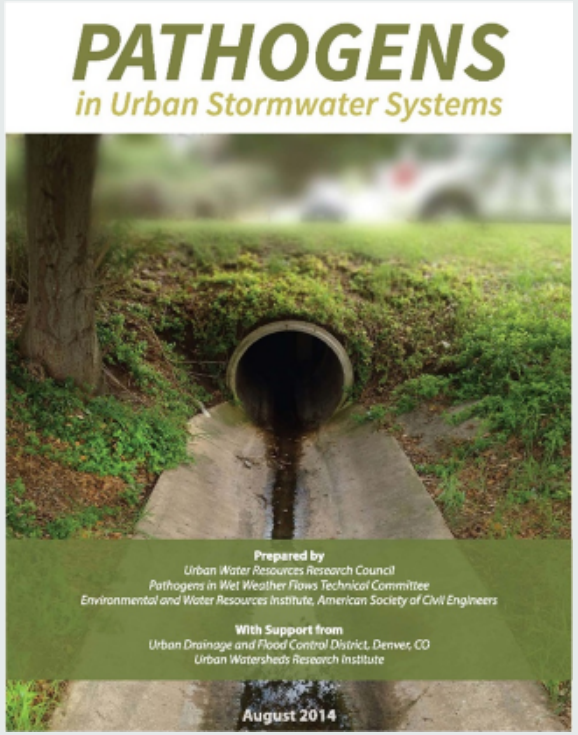


Key Resources



Source: Orin Shanks, Biological and Microbial Aspects of Septic System Pollution webinar, June 30, 2015

California Microbial Source Identification Manual



Report on state-of-the-practice on source tracking techniques and strategies
Associated webinar series May and June 2016

Contact Us at:
info@sourcemolecular.com
Or
786-220-0379

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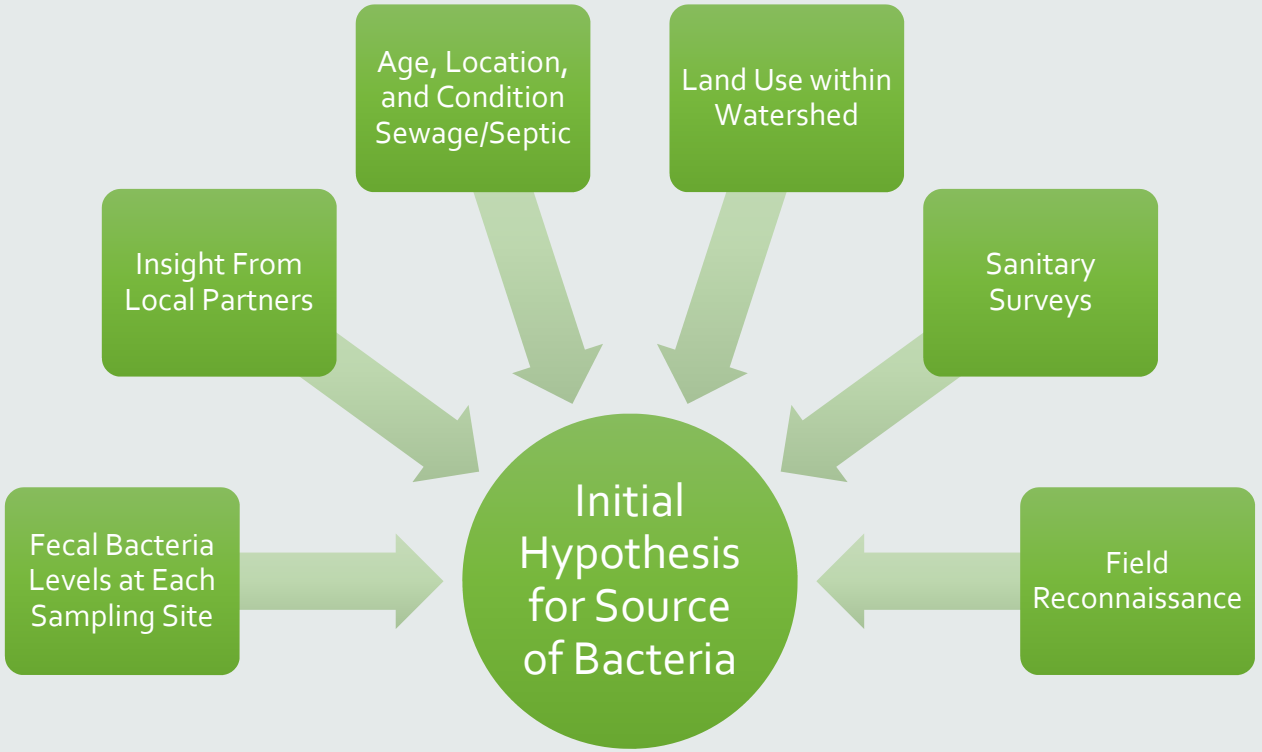
Define Project Objectives

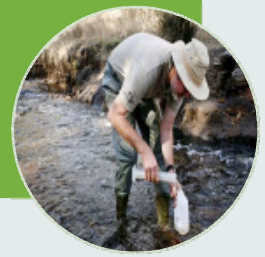
IDDE
Compliance Demonstration
Natural Source Exclusion
Site Specific Objectives
Infrastructure Asset Management



Sample and Test Plan

Sampling Sites

- Fecal Bacteria Hotspots
- Collecting Near Physical Sources

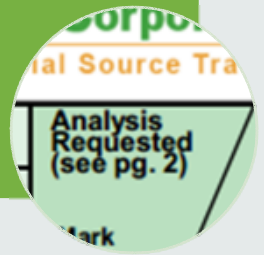


Sampling Events

- Wet/Dry Weather Sampling
- Seasonal Changes
- Statistically Significant Number of Events

Tests Per Sample

- Focus on Anthropogenic Sources (Human, Dog, Agriculture)
- Most Likely Wildlife Source (Birds, Deer, ect)



Case Study 1

DNREC Beach Source Tracking Project

Scenario

- High Fecal Bacteria
- Potential Sources:
  - Human
  - Gull
  - Dog

http://www.aboutmybeaches.com/3383/indian-river-life-saving-station-delaware-state-parks-recreation-activities-delaware-beaches-spring-programs/

Weight of Evidence Approach to Interpretation

Human Sources

- 8% of samples Positive for Human Fecal Indicators: Low Levels
- Sanitary Surveys Showed No Evidence of Leaking Sewers

Non-Human Pollution Source

- 100% of samples Positive for Gull Fecal Indicators: High Levels
- 4% of samples Positive for Dog Fecal Indicators: Low Levels
- Sanitary Surveys show systemic presence of Gulls on the beach

Outcomes

- Allocated mitigation funds to other projects
- Target BMPs to reduce pollution from birds
  - Educate public about feeding birds
  - Better trash receptacles

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Case Study 2

Arroyo Burro Beach Source Tracking Project

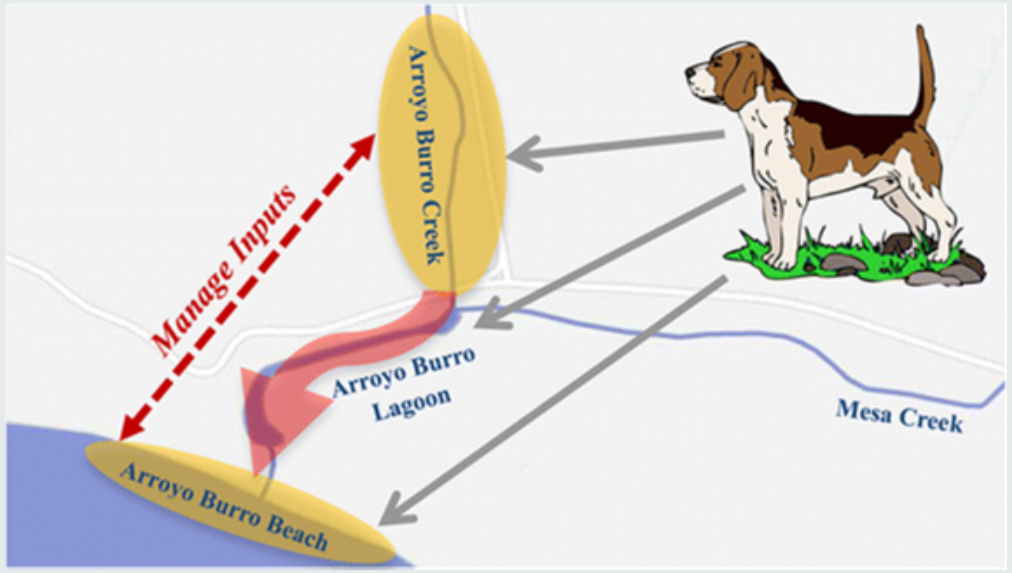
Multiple Source Markers to test hypotheses

Scenario

- High Fecal Bacteria
- Potential Sources:
  - Human
  - Horse
  - Gull
  - Dog

http://www.independent.com/news/2007/dec/01/arroyo-burro-beach/

Microbial Source Tracking in a Coastal California Watershed Reveals Canines as Controllable Sources of Fecal Contamination
Jared S. Ervin et al. 2014



Outcomes

- Horse not detected
- Gull confirmed at lagoon and beach
- Dog markers reduced after targeted public outreach
- Human markers associated with homeless encampments

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Case Study 3

San Juan Basin Bacteria Source Tracking Project

Scenario

- High Fecal Bacteria
- Potential Sources:
  - Human
  - Bird
  - Cattle

Non-Human Pollution Source

- 94% of samples Positive for Ruminant Fecal Indicators
- Few Detections of Bird Fecal Indicators

Human Sources

- 77% of samples Positive for Human Fecal Indicator 1. High Quantity
- Presence of EPA Human Fecal Indicator.
- Sanitary Surveys shows aging septic systems

Outcomes

- Targeted Public Outreach Campaigns
  - Regulatory options for municipalities (septic system inspections/maintenance)
  - Certified septic disposal professionals

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Case Study 4

San Diego River MS4 Project

Scenario

- High Fecal Bacteria at MS4 outfalls
- Potential Sources:
  - Illicit connections
  - Leaking sewer pipes
  - Homeless encampments

http://hiddensandiego.net/pomerado-storm-drain.php

LINK: Pathogens in Urban Stormwater Systems

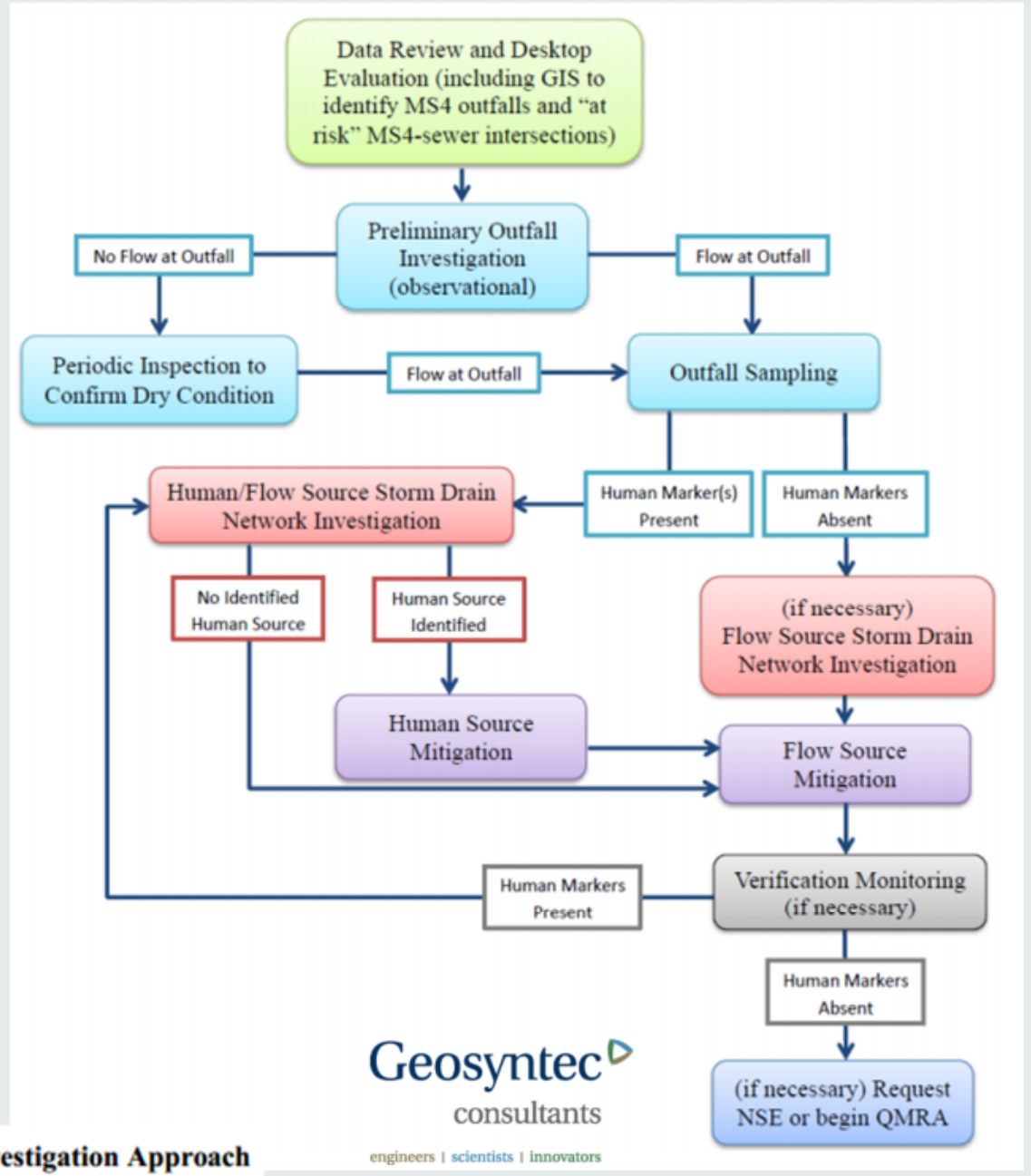

Figure 5-4. MS4 Microbial Source Identification Investigation Approach
(Source: Brandon Steets, Geosyntec Consultants)

Outcomes

- Documented absence of illicit connections and sewer leaks
- Documented human fecal pollution from homeless encampments
  - Notified local authorities

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Questions

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4985 SW 74th Court
Miami, Florida 33155
Telephone: (786) 220-0379

Presenter contact information:
Mauricio Larenas
Email: mlarenas@sourcemolecular.com

Prices

Microbial source tracking uses qPCR to detect bacterial DNA originating from 13 fecal sources:
Human, Cattle, Swine, Gull, Goose, Chicken, Dog, Deer, Elk, Horse, Bird, Beaver, and Ruminant

Each water sample can be tested for multiple fecal sources. Prices are as follows:
$175 per test when 4 or more tests are performed per sample
$225 per test when 3 tests are performed per sample
$275 per test when 2 tests are performed per sample
$375 per test when only 1 test is performed per sample

There is an additional $40 charge per test if you want to measure the quantity of fecal contamination. A list of available tests can be found here: sourcemolecular.com/tests

We provide shipping and sampling materials at no cost. Samples are sent overnight to our laboratory, and within 5-10 working days results are reported.

For projects of 15 samples or more, we offer price reductions of 15%-35% from the prices above. We provide unlimited consultation to assure that your project has the best outcome possible.