Bacteria TMDL Solutions
North Central Texas Council of Governments

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Bacteria TMDL Solutions
Agenda

› Experience in SoCal

› New Tools

› Discussion

      Application to North Central Texas Council of Governments

› Questions

South OC
CHWSRS

South OC Water Quality Improvement Plan

Pathogen Health Risk

Applies to recreational waters in dry weather and wet weather conditions. Strategies focus on addressing human sources of pathogenic microorganisms to reduce health risks to swimmers, surfers, and other water recreators

Unnatural Water Balance

Applies to streams and estuaries, particularly during dry weather. Strategies focus on reducing unnatural flows to these systems to restore natural flow regime, decrease pollutant loads, and improve water quality, riparian habitat, and biological condition.
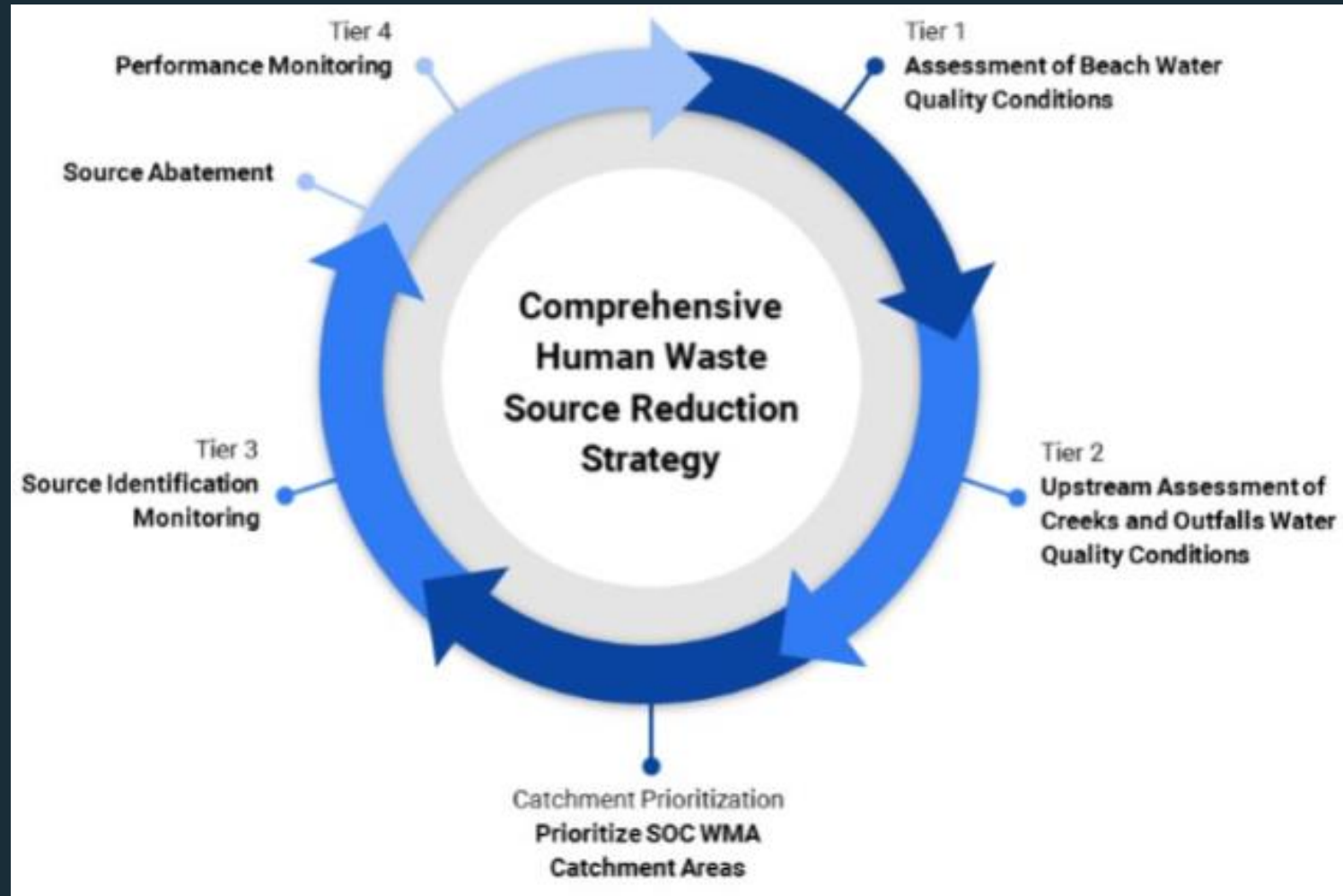
Channel Erosion

Applies to streams that are experiencing excess channel erosion and associated impacts to streams' physical structure. Strategies focus on restoration of priority segments to help arrest further degradation and improve physical conditions for habitat regeneration to occur.
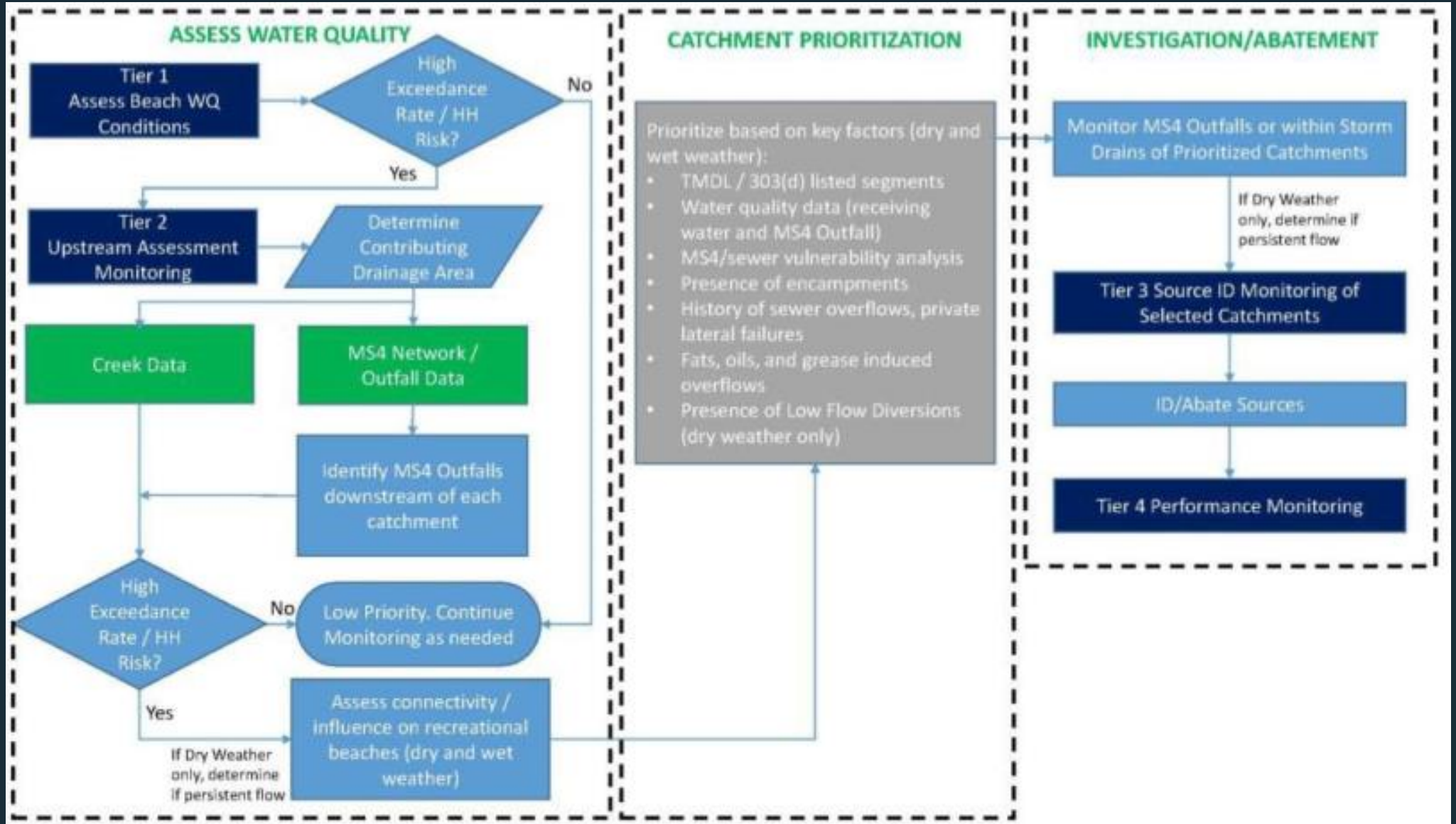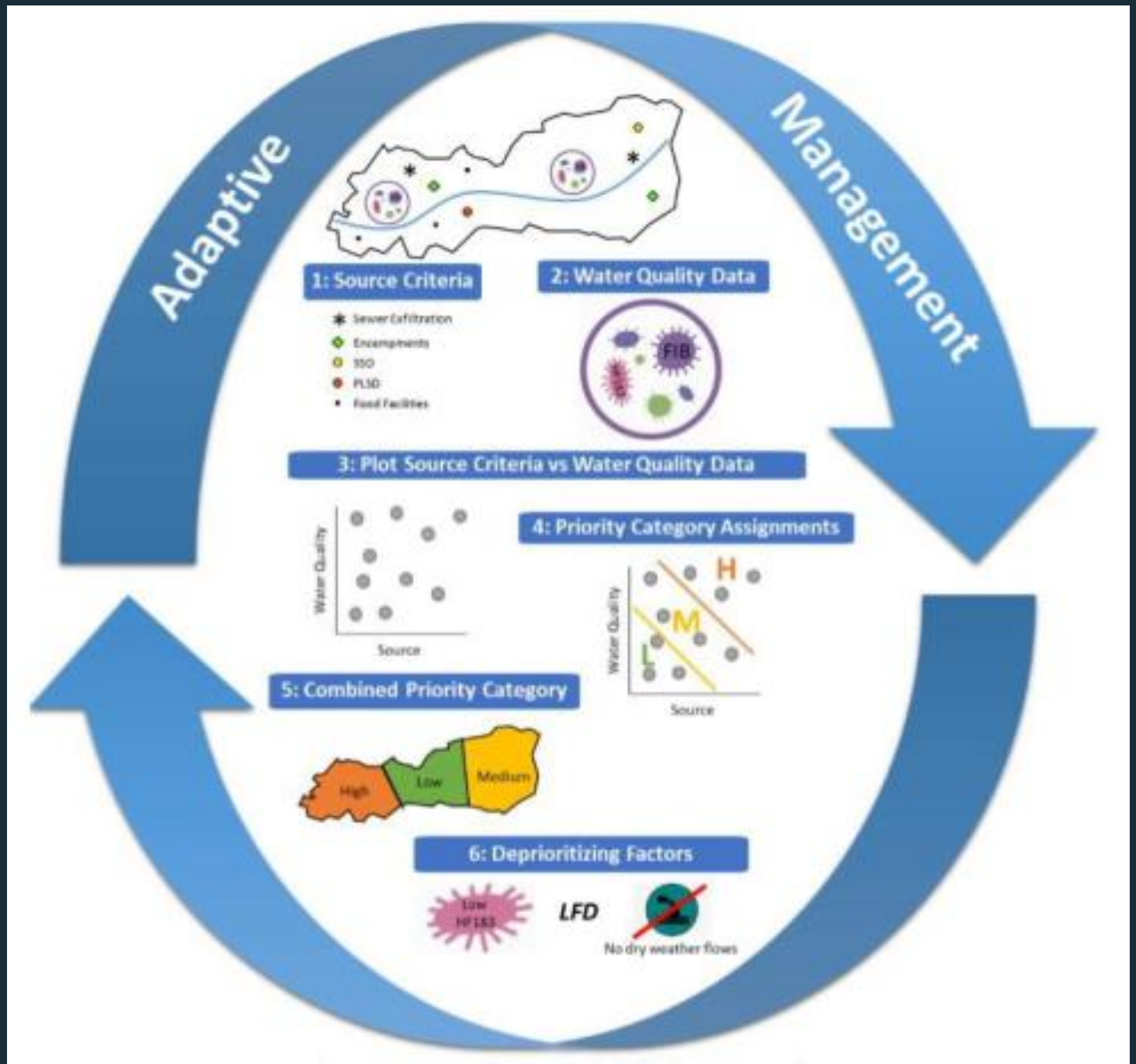
Organization

MS4/Co-Permittees

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IRWM Group

WQIP

CHWSRS Work Plan

Wastewater Agencies

Human Waste Abatement Group

Area of Investigation (AOI) Teams

Comprehensive Human Waste Source Reduction Strategy Tiered Farmwork

Tiered Framework

Catchment Prioritization Approach

CHWSRS
AOI Investigations

Source ID
## Monitoring

› Targeted Source investigations focused on high priority Contaminants

› Area of Investigation (AOI) team comprising MS4 copermittees and water/wastewater agencies

› AOIs use toolbox and supplemental methods based on needs and local knowledge of watershed

AOI Team Collaboration
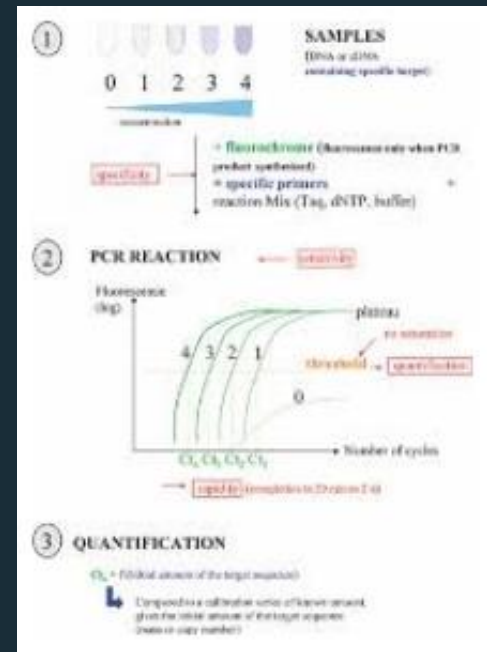
Each AOI Team help multiple workshops

- Compiled data layers into GIS
  - Agency Assets
  - Historic Study Data
- Conducted virtual tours of AOIs via GIS story maps
- Facilitated discussions about human sources within the subwatersheds
- Selected areas for sampling
- Selected additional microbial source tracking (MST) tools and special strategies for each watershed
  - Pharmaceuticals and personal care products (PPCPs) -Acetaminophen
  - Propidium monoazide (PMA)
- Reviewed and vetted the overall and AOI specific sampling and analysis plan
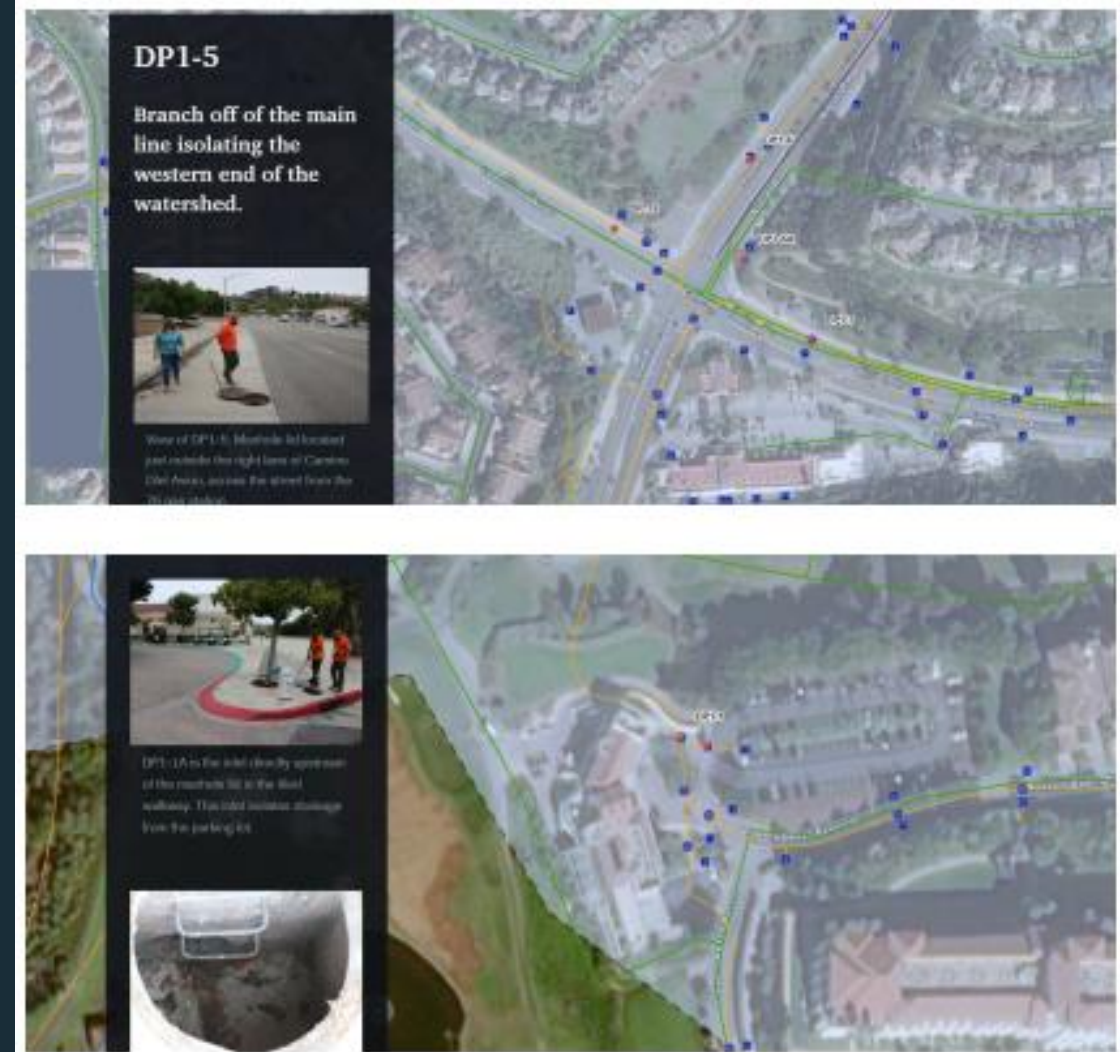
Source Tracking Toolbox

Common consideration for the AOI investigations

- Statistically significant sample size and frequency

- Decision on use of traditional qPCR not ddPCR method for human marker HF183 testing

- Thresholds of significance for fecal indicator bacteria (FIB) and HF183

- Identification of recycled water and dry weather flow (use of PPCPs, PMA, comparison to previous studies)

- How to handle adaptive management
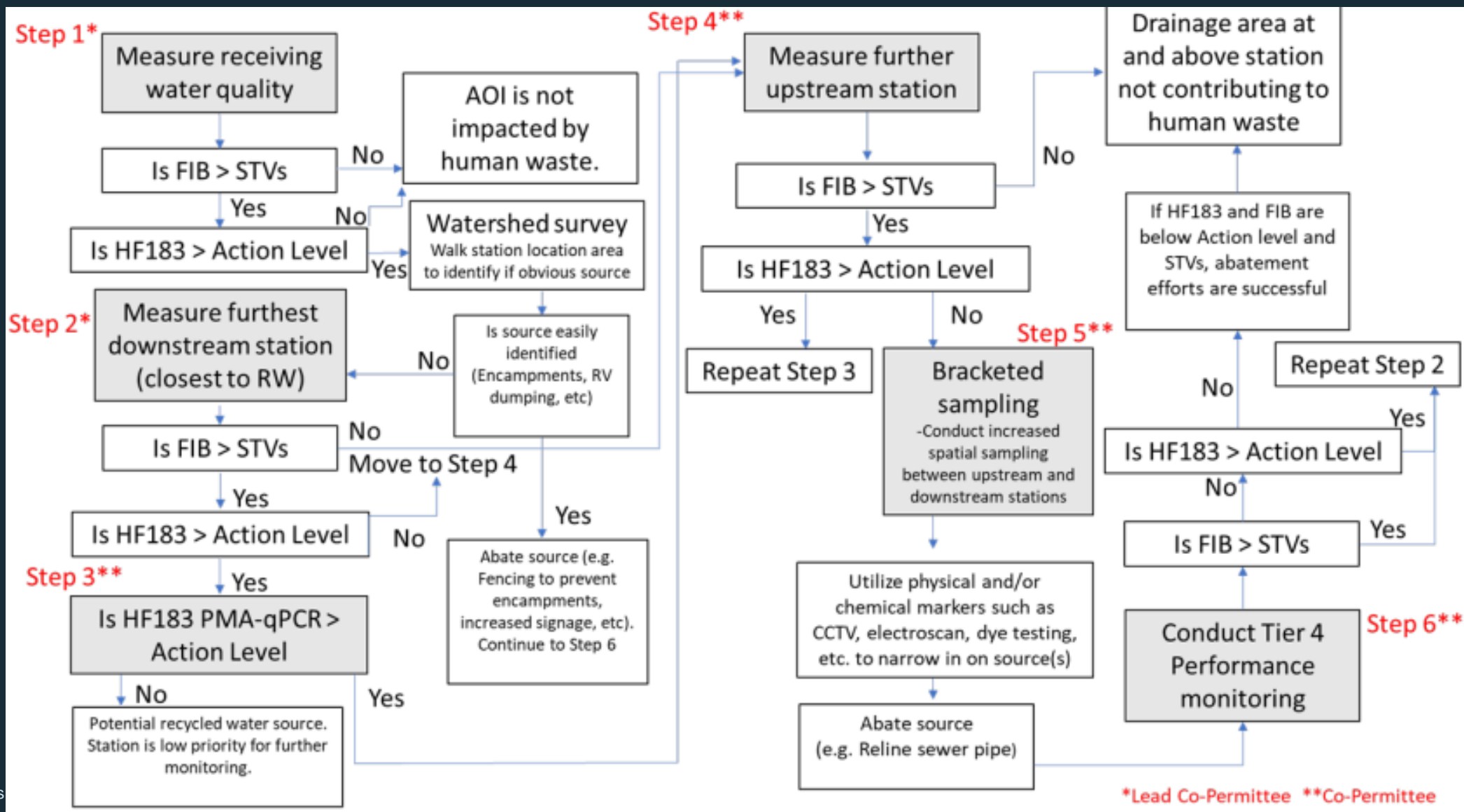 - Move to upstream sites and conduct preliminary investigations to identify any sources.

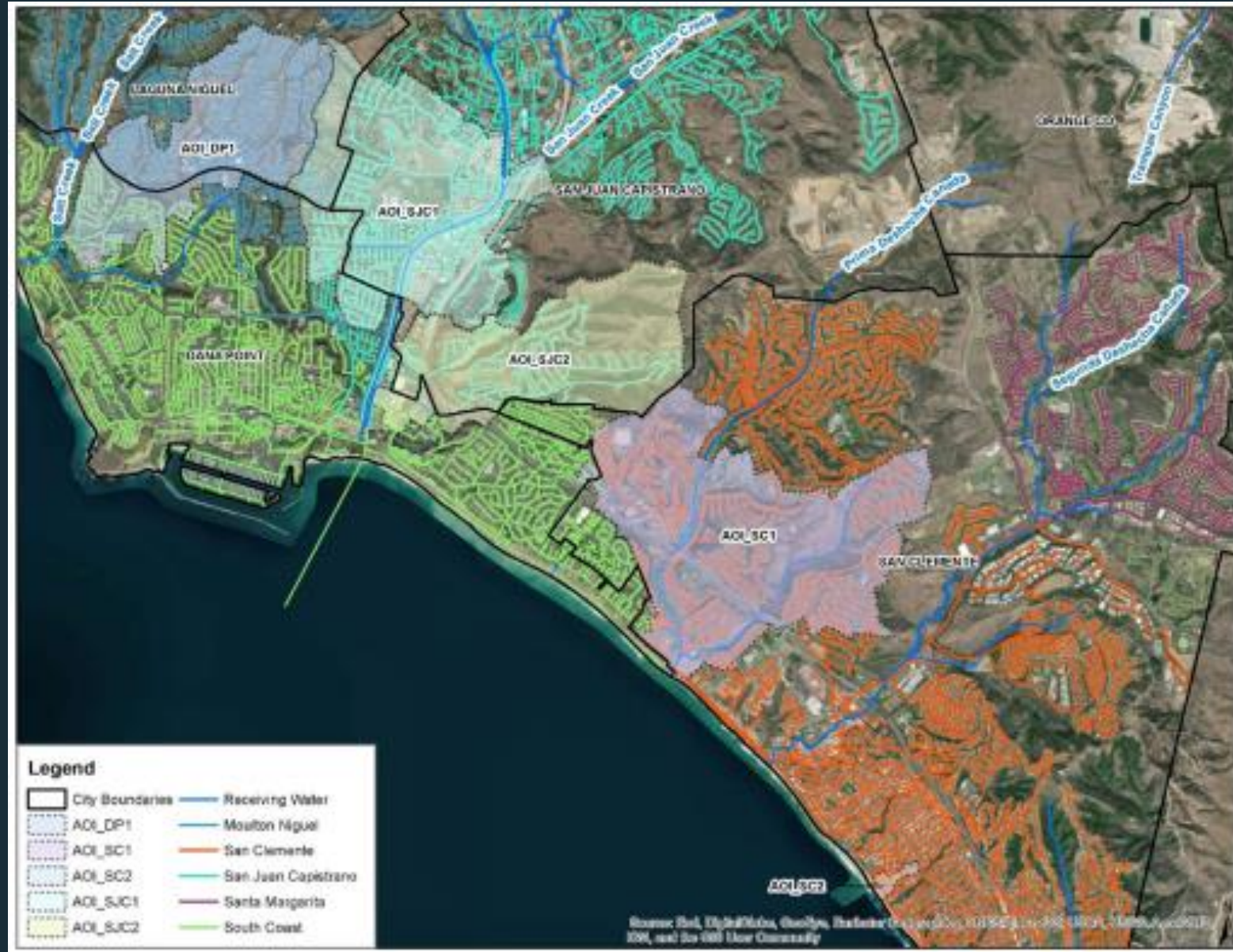| MST Method	Benefits	Drawbacks
Physical Markers		
Dye testing	• Low cost • Widely available • Proven method	• Length of time for dye to travel downstream • Dye can be easily diluted, making detection difficult
Smoke testing	• Low cost • Widely available • Proven method • Can be used to evaluate multiple lines at the same time	• Cumbersome noticing requirements of residents in dense urban areas
CCTV	• Low cost • Widely available • Commonly used	• Typically, cannot be used to detect small leaks
Electroscan Technology	• Operable during wet weather conditions and/or when debris hampers use of CCTV • Detects more leakage-related defects	• Relatively new technology that needs more field testing • Lacks the visual images of pipe features offered by CCTV
Flow-paced sampling	• Widely available • Captures sporadic pulses of dry weather runoff	• Higher one-time cost of purchasing flow gauges and autosamplers • Potential confined space work
Geographic Information System (GIS)	• Widely available • Effective planning tool	• GIS layers must be maintained
Canine Scent Tracking	• Low cost • Provides real-time field data for decision-making • Efficient coverage of the MS4	• Non-traditional method, may need to be implemented more in the field to prove its effectiveness

AOI Investigation Concept

Step 1: Sample at downstream station (n=5)

1a) If 25% of paired HF183 and FIB are above action levels/STVs, station is impacted.
- Conduct visual inspections and abate source. Continue to Step 2.

1b) If 25% of paired HF183 and FIB are below action levels/STVs, no further analysis needed at station.

1c) If FIB results are below the STVs, but the HF183 result is above action level, no further analysis needed at station.

Step 2: Assess additional lines of evidence for potential presence of human waste sources

2a) If other markers (physical, chemical, or bacterial) indicate presence of human waste, station is high priority. Continue to Step 3.
- Assess flow levels, recycled water lines, HF183 PMA-qPCR, acetaminophen.

2b) If other markers do not indicate human waste sources, set to lower priority.
- Project permitting, investigate for non-human sources (i.e. avian or canine markers).

Step 3: Sample station(s) further upstream to identify source(s)

3a) If sample results are below action levels/STVs for HF183 and FIB at upstream station, conduct bracketed investigation
- Utilize physical markers such as CCTV, to narrow in on source location between downstream and upstream stations
- If source found, abate source. Continue to Step 4.

3b) If sample results are above action levels/STVs for HF183 and FIB, then investigate further upstream
- Repeat Step 3 for L3 and L2 stations.

Step 4: Tier 4 Performance Monitoring

4a) If Tier 4 performance monitoring results for HF183 and FIB are below action level/STVs, AOI is set to low priority.
- Abatement measures are successful, and investigation is completed.

4b) If paired FIB and HF183 are above action level/STVs, continue to Step 2.
- Repeat steps until source(s) are identified and abated.
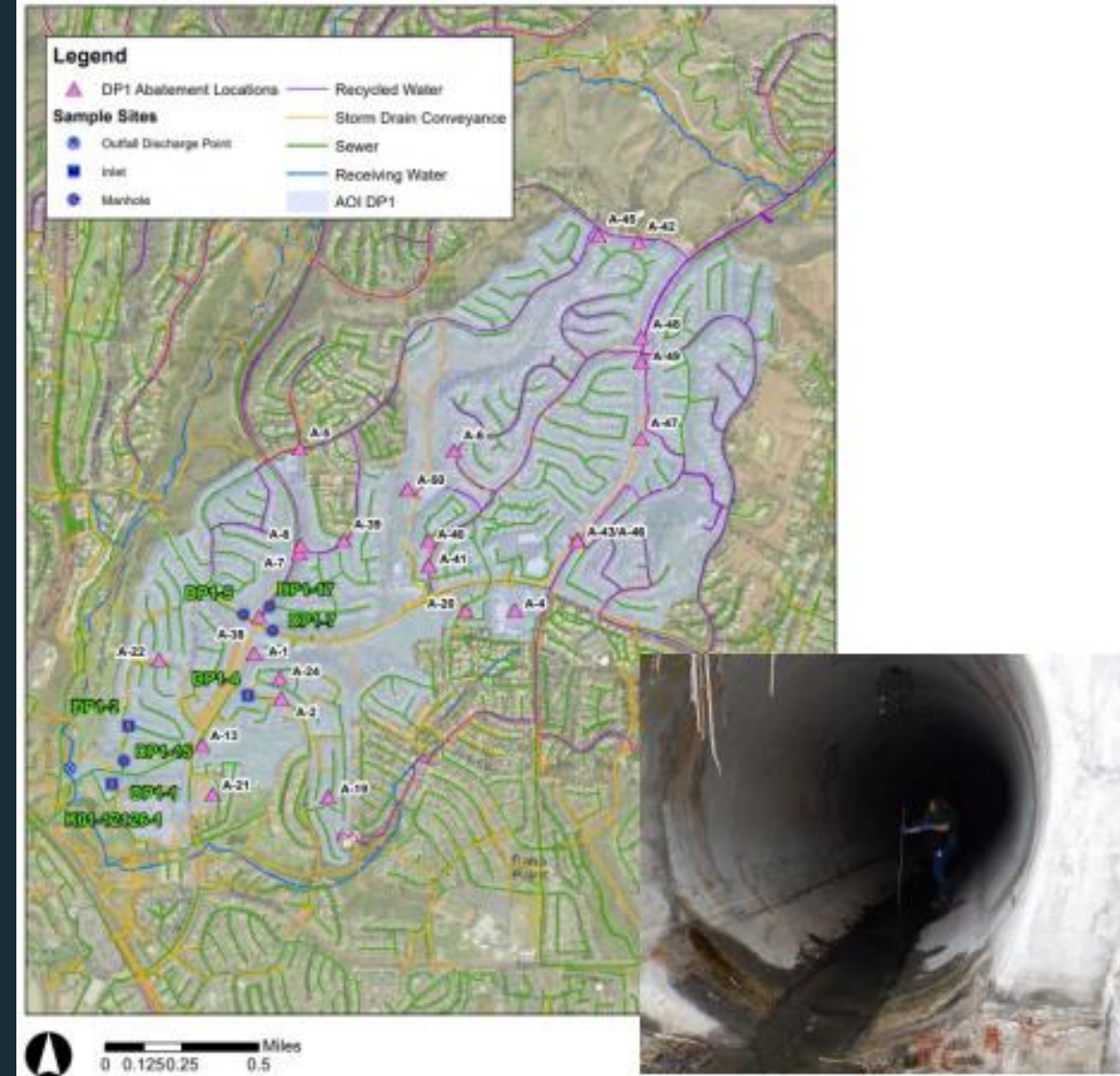
Decision Tree
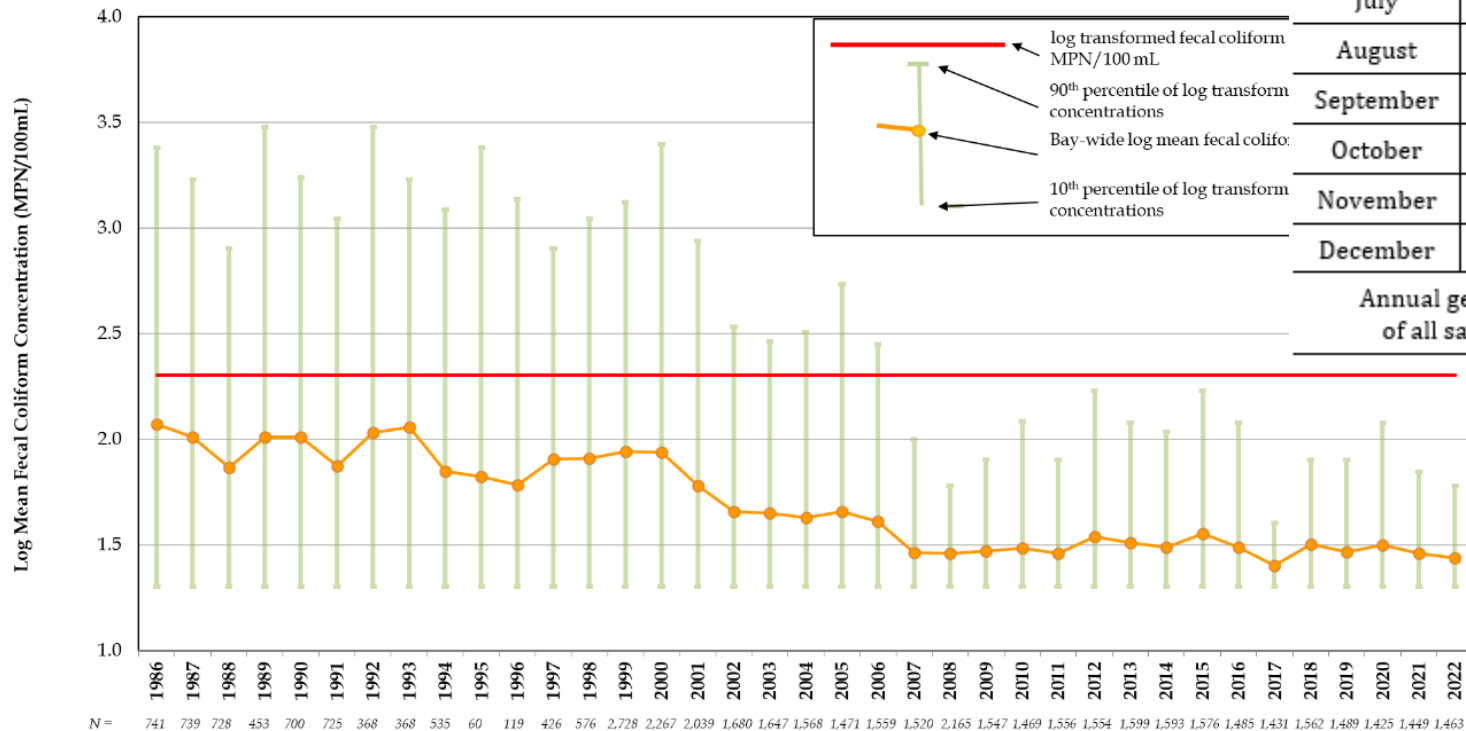
AOI Investigations

Example AOI

Findings

- HF183 measured in areas receiving heavy recycled water use

- Extensive abatement efforts included recycled water inspections, repairs to irrigation system, notifications of runoff, review of CCTV

- Using multiple line of evidences and additional MST toolbox approach

- Further monitoring to help verify if recycled water is the source of HF183 measured in the AOI


Legend
DP1 Abatement Locations — Recycled Water
Sample Sites
Outfall Discharge Point — Storm Drain Conveyance
Inlet — Sewer
Manhole — Receiving Water
AOI DP1

Miles
0 0.125 0.25 0.5

Newport Bay
Time Schedule Order

The Issue

Month	Number of samples	Geomean (CFU/100mL) [1]	Percentage of samples greater than 400 CFU/100mL [2]	Both numeric targets met [3]
January	35	14	6%	Y
February	28	37	21%	N [4]
March	28	137	46%	N [5]
April	28	14	0%	Y
May	35	11	0%	Y
June	28	13	0%	Y
July	28	12	0%	Y
August	35	11	3%	Y
September	28	15	7%	Y
October	27	15	4%	Y
November	24	10	0%	Y
December	19	19	0%	Y
Annual geomean of all sample [6]		17.1		

Watershed Investigations

Pollution Prevention Plan
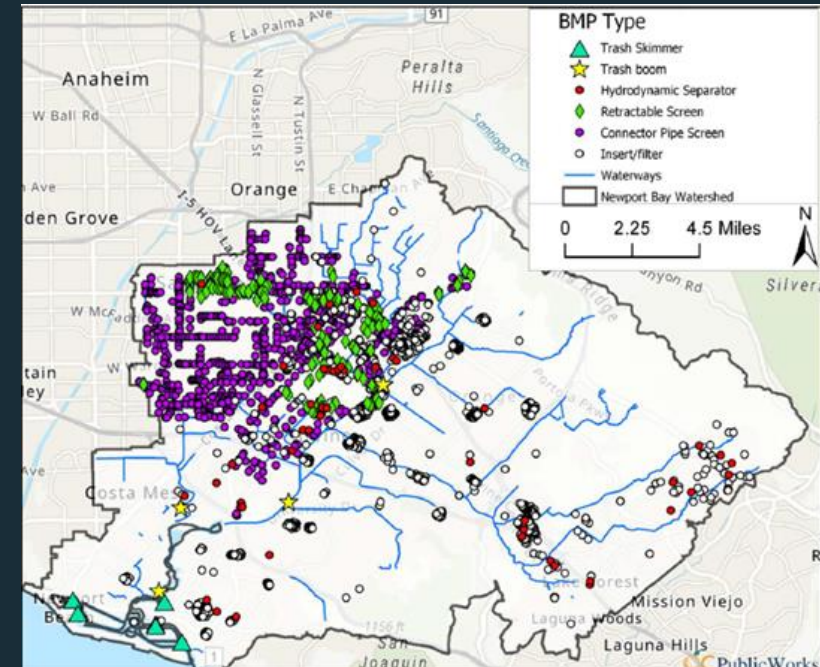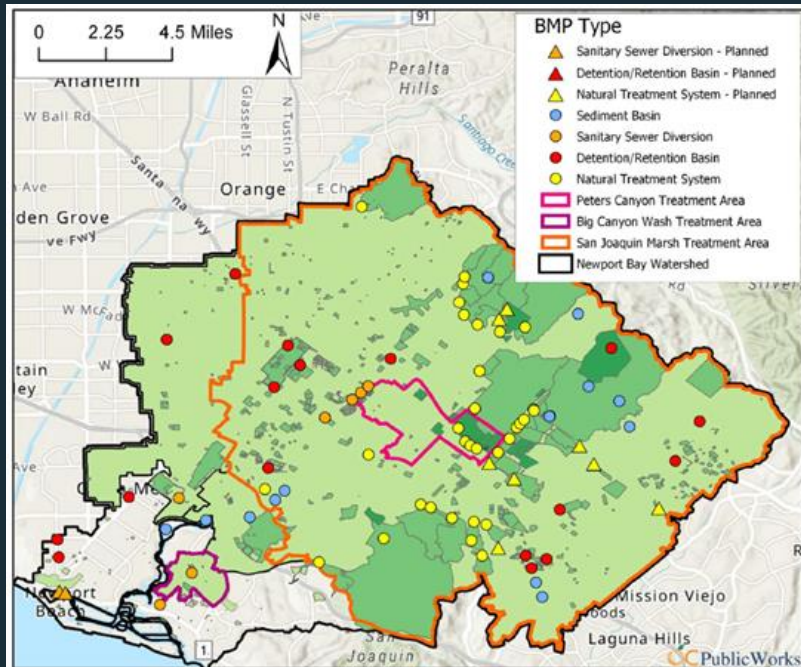
POLLUTION PREVENTION METHODS
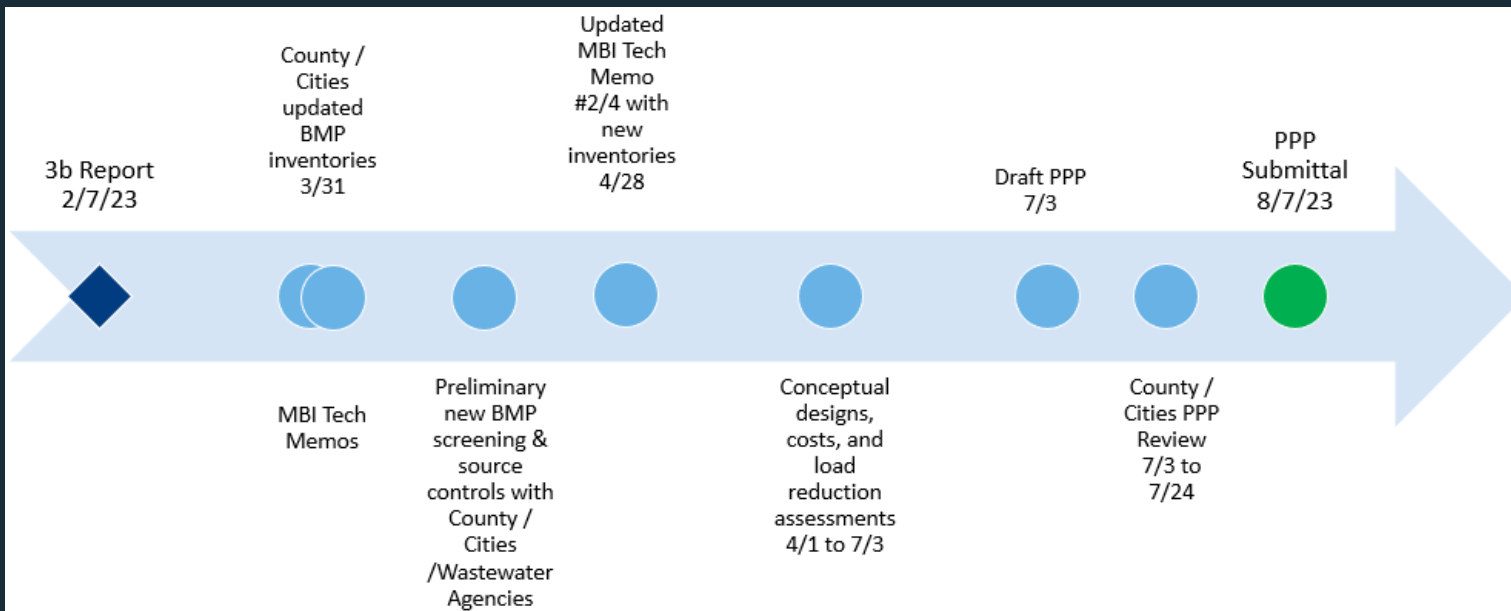
3.	POLLUTION PREVENTION METHODS	
3.1	Overview of Pollution Prevention Approaches	
3.2	Basin Plan – Controllable vs Uncontrollable Sources	
3.3	Pollution Prevention Options and Current Implementation	
	3.3.1	Source Control BMPs
	3.3.1.1	Public Education/Engagement/Incentives
	3.3.1.2	Routine Monitoring
	3.3.1.3	Source Tracking
	3.3.1.4	Inspections
	3.3.1.5	Trash Maintenance
	3.3.1.6	Enforcement
	3.3.1.7	New Regulations
	3.3.2	Treatment BMPs
	3.3.2.1	Diversions
	3.3.2.2	IRWD Natural Treatment System (NTS) and Detention Basins
	3.3.2.3	Constructed Wetlands and other Biological Treatment BMPs
	3.3.2.4	Sediment Basins and Drop Structures
	3.3.2.5	Media Filters
	3.3.2.6	Trash and Debris-Related Physical BMPs
	3.3.3	Volume Reduction BMPs
	3.3.3.1	Infiltration Basins, Trenches, Galleries
	3.3.3.2	Permeable Landscape (Softscape)
	3.3.3.3	Permeable Landscape (Hardscape)
	3.3.3.4	Rainwater Harvesting
	3.3.3.5	Low Impact Development Measures
	3.3.4	Restoration of Assimilative Capacity
	3.3.4.1	Upper Newport Bay Ecosystem Restoration/Dredging
	3.3.4.2	Channel Sediment Removal
	3.3.4.3	Channel Improvements
	3.3.5	Summary of Currently Implemented Watershed Structural BMPs
3.4	Pollution Prevention BMP Adverse Impacts	

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PPP Actions

SSO

Jon Chandler, 33, rode out this week's El Nino storms inside his tent pitched on higher ground along the Santa Ana River Trail in Orange. Flood waters released from dam gates could force him to move to. January 7, 2015.

(Erika Aguilar/KPCC)

On Monday morning, the city began informing homeless that they must vacate the three-mile-long tent city.

Diversions & BMPs

Laterals

TSO and New TMDL

Strategies
Bacteria TMDLs

Tiered Approach

Weight of Evidence

Microbial Source Tracking

Intensive sampling using standard measurements; Infrared thermography

Sanitary Survey

Identification of impaired areas based on long-term monitoring
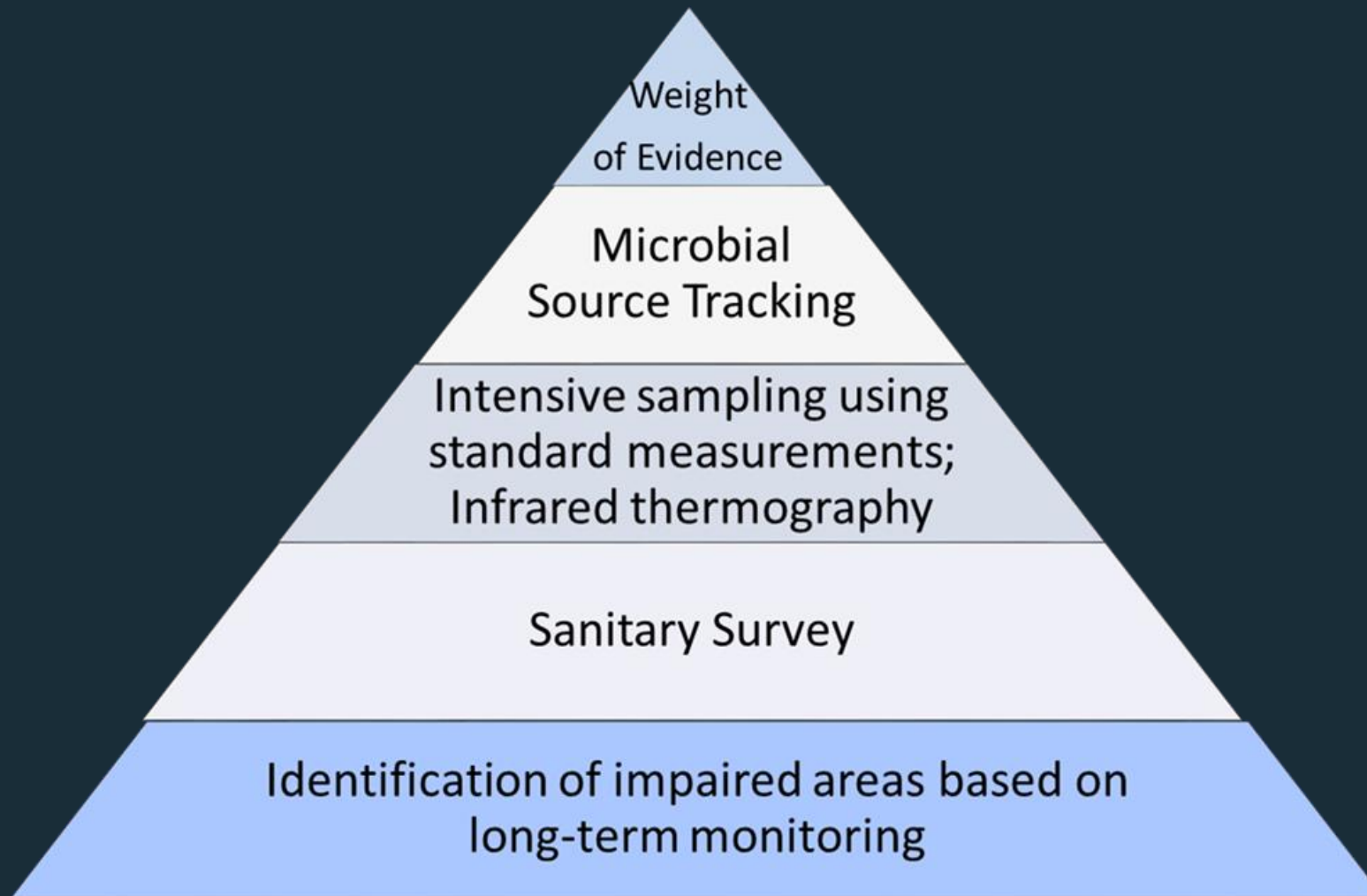
Bacterial Source Tracking Methods

Method	Advantages	Disadvantages
FIB ratios	Easy uses traditional methods	Too many factors can influence
Multiple Antibiotic Resistance	Identification of Anthropogenic Sources	Antibiotic resistance can be transferred
Ribotyping	Good at Identifying Sources	Highly Geographically Specific
Pulsed Field gel Electrophoresis	Can Quantify Sources	Highly Geographically Specific
Traditional PCR	Low Level Detection	Only Presence / Absence Detects Dead Bacteria
Box-PCR	Can Identify Variations and Sources	Geographically Specific Limited Information
qPCR	Quantification of Target Presence	Relative results of assays not directly comparable
Viral Analysis	Identification of Anthropogenic Sources	low Resolution in Sources Fragile targets
Lab on a Chip	Rapid in Field Results	Very New Proprietary Technology
Chemical Methods	Quantifies Chemicals Associated with Humans	Not Directly Related to Bacteria

Quantitative Polymerase Chain Reaction (qPCR)
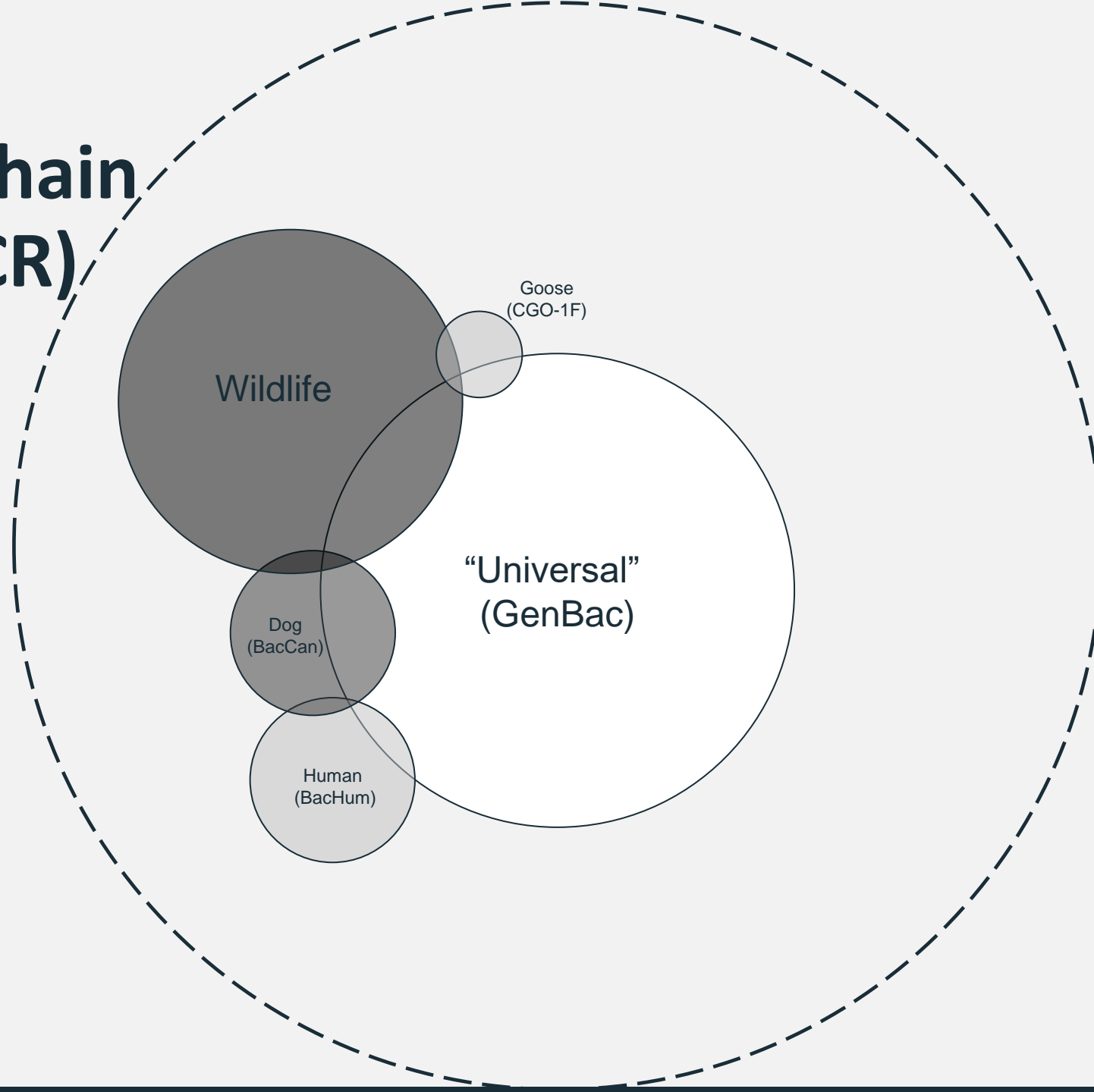
Goose (CGO-1F)

Wildlife

"Universal" (GenBac)

Dog (BacCan)

Human (BacHum)

Propidium monoazide (PMA)

Use of Viability-Based Methods for Improved Detection of Recent Fecal Contamination in a Microbial Source Tracking Study Near Tijuana, Mexico

Vanessa Thulsiraj · Amity G. Zimmer-Faust · Jennifer A. Jay

Abstract Current microbial source tracking methods heavily rely on the use of quantitative PCR (qPCR) assays to differentiate human and non-human sources of fecal contamination. However, traditional qPCR measures DNA from viable, viable but not culturable (VBNC), and dead cells, which may confound the use of this technique for detecting recent fecal contamination from waters receiving treated sewage effluent. In this study, fecal indicator bacteria (FIB), six host-associated markers, and two viability-based methods for rapid detection and assessment of fecal contamination were used in a microbial source tracking study to identify sources impairing water quality and sediments within the San Antonio de los Buenos watershed in Tijuana, Mexico. Horse- and gull-associated markers were detected in 4 and 8% of samples tested, respectively. The human- and dog-associated markers were positive in 74 and 63% of watershed samples and 92 and 75% of storm drain samples, respectively. Propidium monoazide (PMA) successfully inhibited amplification of DNA from dead cells in environmental creek waters that receive large volumes of treated wastewater effluent. Accordingly, PMA-qPCR measurements were more comparable to measurements made by culture-based methods (IDEXX). The covalently linked immunomagnetic separation/adenosine triphosphate (Cov-IMS/ATP) method showed a strong linear relationship to culture methods when compared to measurements made by the qPCR Entero1a assay. Both the PMA-qPCR and the Cov-IMS/ATP methods show

Epidemiological Studies
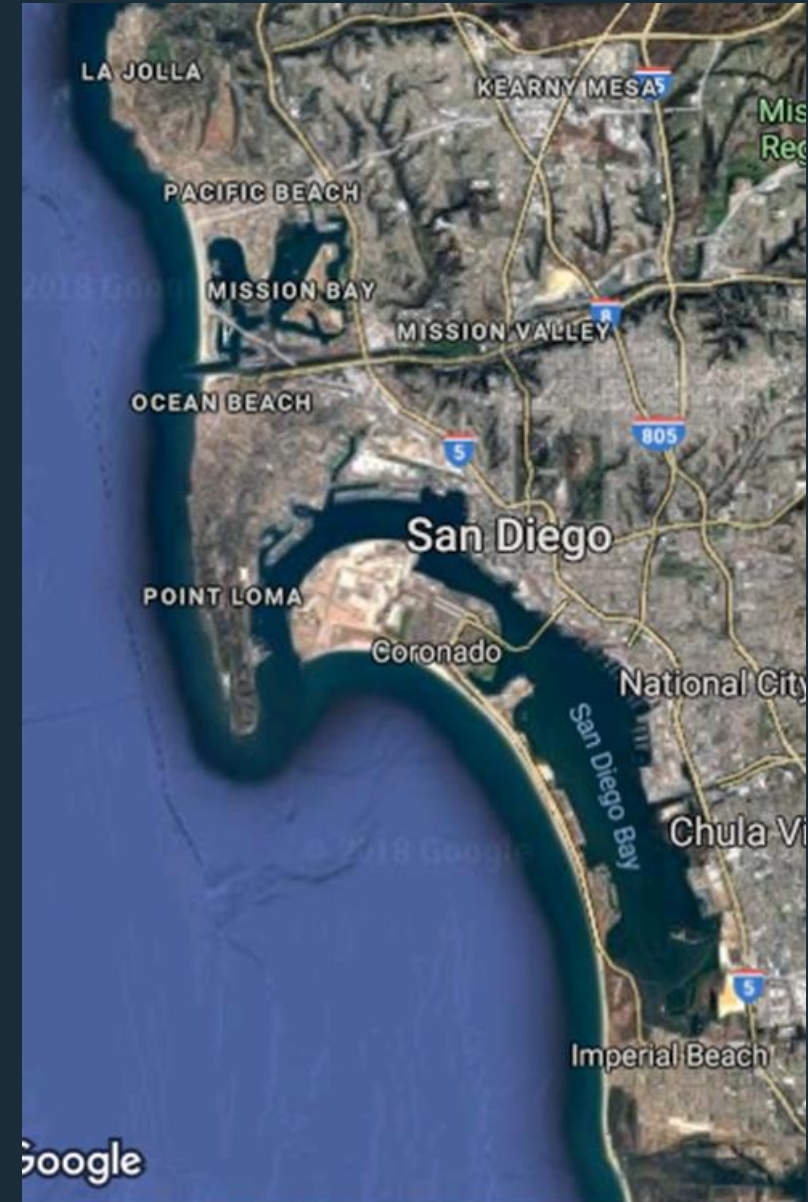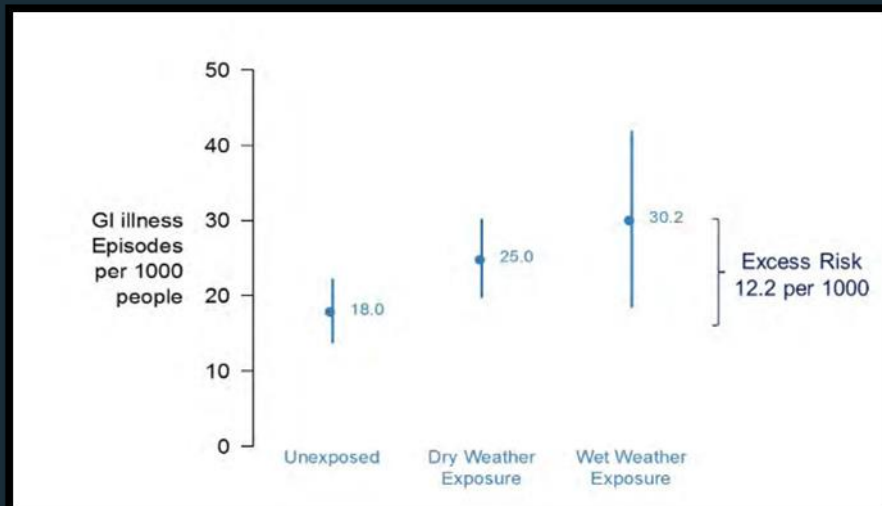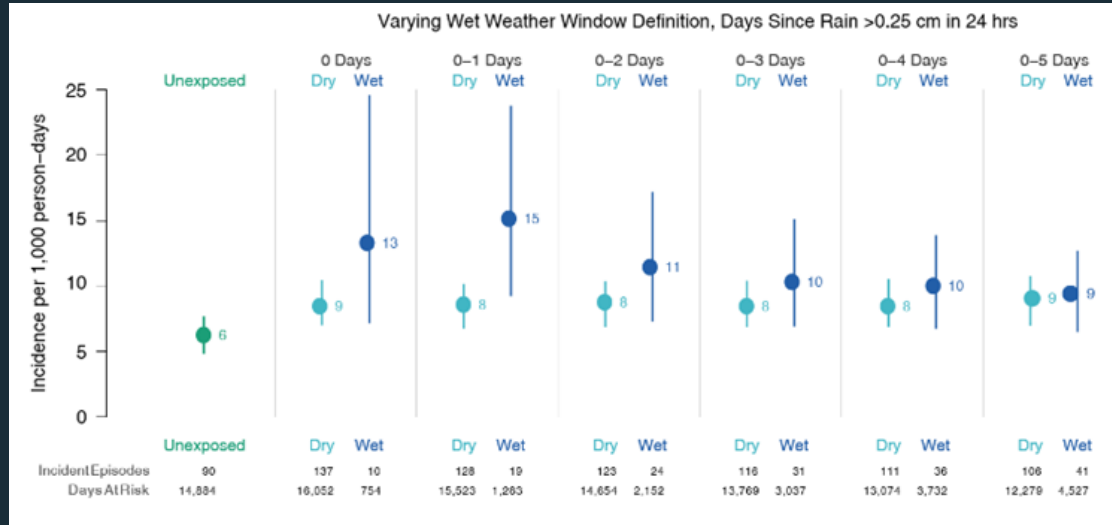
Quantitative Microbial Risk Assessment
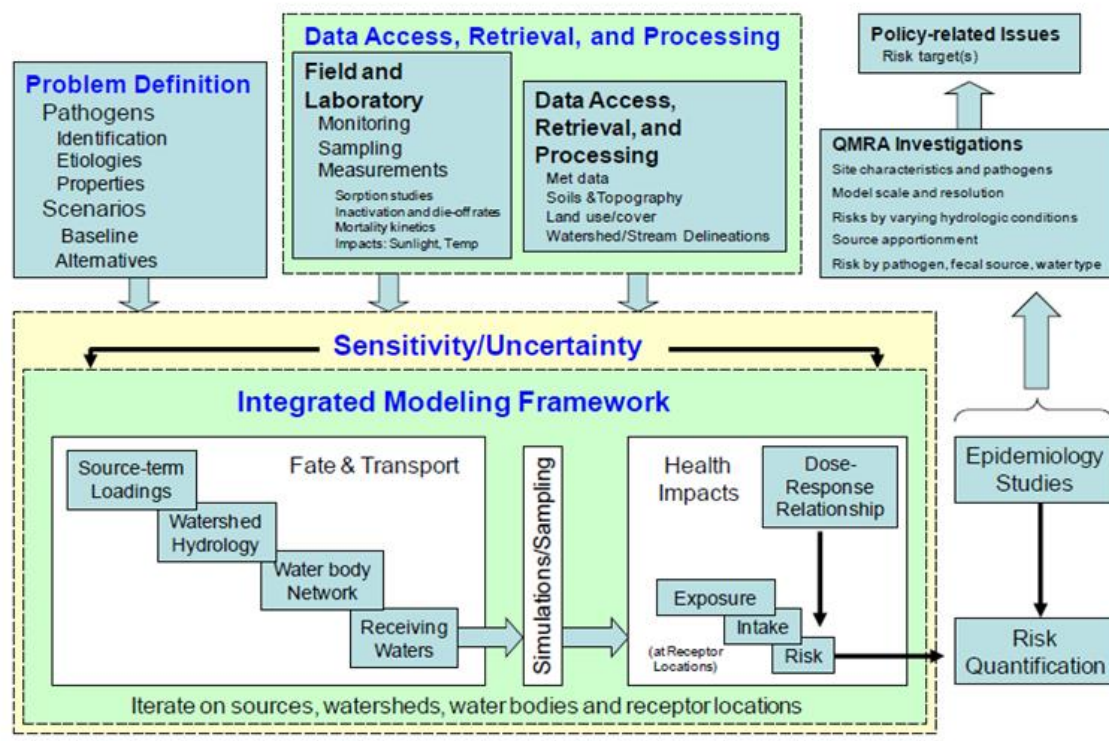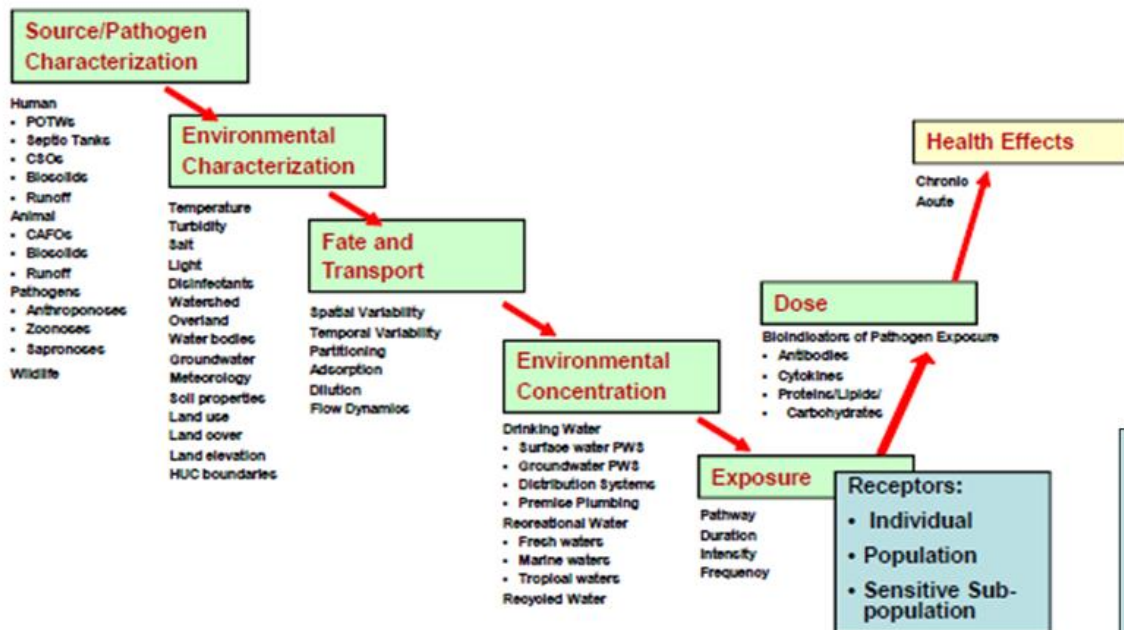
Application:
North Central Texas Council of Governments

thank you

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