



Santa Barbara Beaches MST Study - Case Study on MST at High Use Beaches



Brandon Steets, PE | 10.17.18

Presentation Outline

- Project Objectives
- Water Quality at Santa Barbara Beaches
- Hypothesis Testing
- Results and Interpretation
- Implications Statewide and Beyond...



Takeaway Messages

1. Rigorous hypothesis testing used to evaluate sources
2. All viable sources investigated
3. First time urban beaches in CA have been conclusively demonstrated to have no significant infrastructure or homeless impacts
4. Bather shedding can impact bacterial water quality

Project Objectives

- Perform microbial source tracking (MST) at three Clean Beaches Initiative (CBI) priority beaches in the Santa Barbara region:
 - Leadbetter Beach – Study Complete
 - East Beach – Study Complete
 - Goleta Beach – Study In Progress
- **The overall goal is to improve water quality and protect public health at Santa Barbara beaches**
- Funding for this study is from CA Proposition 84 through the CBI grant program



Water Quality at Santa Barbara Beaches

- Water quality in dry weather is generally very good at Santa Barbara Beaches
- Leadbetter and East Beach were CBI priority beaches in 2012
- 303(d) listed for bacteria
- Human markers detected as part of a previous study by UCSB

Santa Barbara County Grades												
	2017-2018						5-Year Avg. (2012-2017)					
	Summer Dry*		Winter Dry		Wet Weather		Summer Dry*		Winter Dry		Wet Weather	
	#	%	#	%	#	%	#	%	#	%	#	%
A	15	94%	6	46%	3	19%	15	94%	12	77%	8	51%
B	1	6%	2	15%	2	13%	1	6%	2	15%	3	19%
C	0	0%	2	15%	2	13%	0	0%	1	5%	2	10%
D	0	0%	0	0%	5	31%	0	0%	0	1%	1	4%
F	0	0%	3	23%	4	25%	0	0%	0	1%	3	16%
Total	16		13		16		16		16		11	

Beach	Summer Dry	Winter Dry	Wet Weather
Leadbetter Beach	B	A	F
East Beach	A+	A	D

From: Heal the Bay's 2017-2018 Beach Report Card

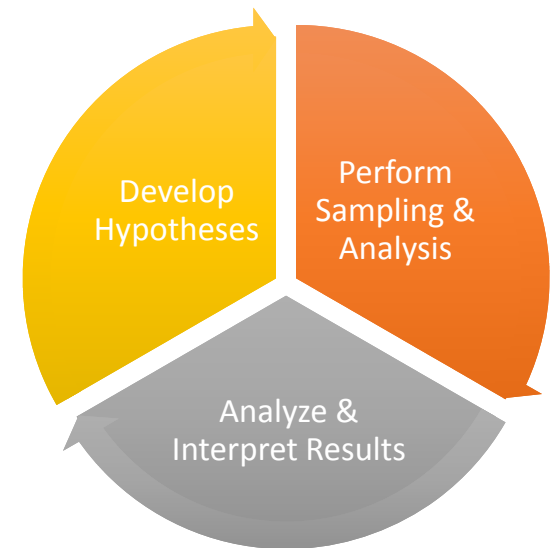
Project Stakeholders

- Stakeholder engagement throughout this project, including:
 - State and Regional Water Boards
 - City of Santa Barbara, Creeks Division and Waterfront Division
 - Santa Barbara County, Project Clean Water and Environmental Health Services
 - Santa Barbara City College
 - Santa Barbara Zoo
 - El Estero Wastewater Treatment Plant
 - Heal the Ocean and Channelkeeper



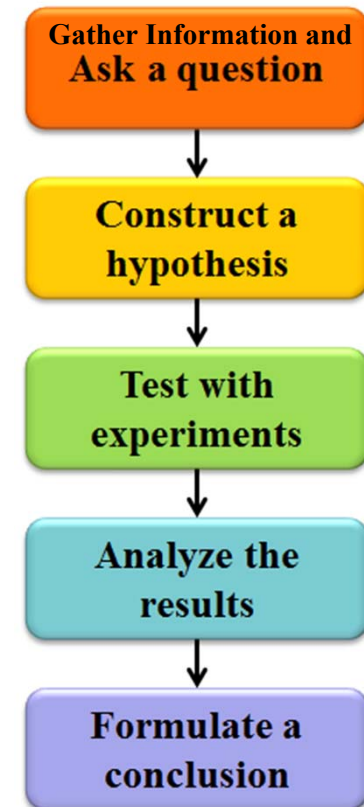
Project Timeline

YEAR	Actions / Deliverables
2015	<ul style="list-style-type: none"> - Stakeholder Engagement and Hypotheses Development - AB411 (April - October) Sampling and Analysis - Results Interpretation and Summary
2016	<ul style="list-style-type: none"> - Stakeholder Engagement and Hypotheses Development - AB411 (April - October) Sampling and Analysis - Results Interpretation and Summary
2017	<ul style="list-style-type: none"> - Stakeholder Engagement and Hypotheses Development - AB411 (April - October) Sampling and Analysis - Results Interpretation and Summary
2018	<ul style="list-style-type: none"> - Findings and Recommendations Report



Hypothesis Testing

- Identify potential sources through stakeholder consultation and review of historical data
- Define specific questions (hypotheses) that will be tested through sampling and analysis
- Develop a robust study design to test hypotheses
- Analyze data to conclusively accept or reject each hypothesis with statistical confidence
- Make conclusions, including identifying new hypotheses for further study



Source Hypotheses Tested in 2015

1. Beach Bathrooms
2. Creeks
3. Gulls and Dogs
4. Flowing MS4 Outfall (Leadbetter)
5. Bird Refuge (East Beach)



Honda Creek Culvert at Leadbetter Beach

Example Study – Beach Bathrooms

- Dye testing of bathrooms and sewer lines near beaches
- Groundwater and surface water sampling
- Rhodamine dye detectable to 1ppb
- **No infrastructure sources identified**



Outcome of 2015 Studies

- Dogs and Birds were sources of FIB to the surf zone in dry weather
 - The upstream watershed was not a source of bacteria to the surf zone in dry weather (both creeks bermed throughout the dry season)
 - Sewer infrastructure was not a source of bacteria to the surf zone
 - Human markers were consistently detected at low levels in the surf zone during dry weather
- **What is the source of these low level human markers?**

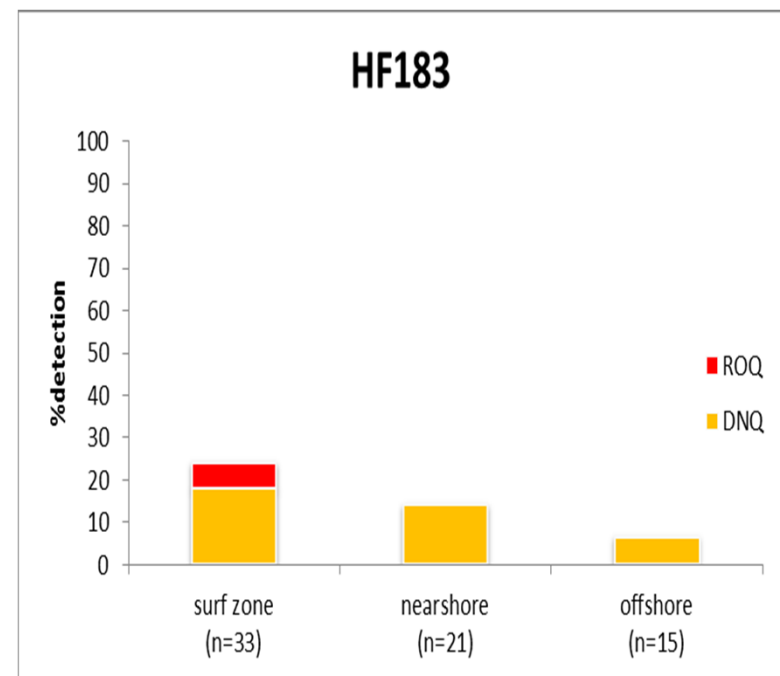
Source Hypotheses Tested in 2016

1. Repeatability of Patterns
2. Background/Natural Sources
3. Flowing MS4 Outfall
4. Sewers and Septic Systems
5. Scour Ponds
6. Creek Sediments
7. Intertidal Sands
8. Marine Sediments
9. WWTP Effluent
10. Boats (Harbor and Offshore)



Example Study – Offshore Sources

- Samples collected from surf zone, nearshore (near moored boats), and offshore (near WWTP outfall)
- Analysis for FIB, Source Markers, and Pathogens
- Detection of Human, Dog, and Gull markers highest at the beach
- Results suggest source of bacteria directly to the beach and not from offshore boats or WWTP

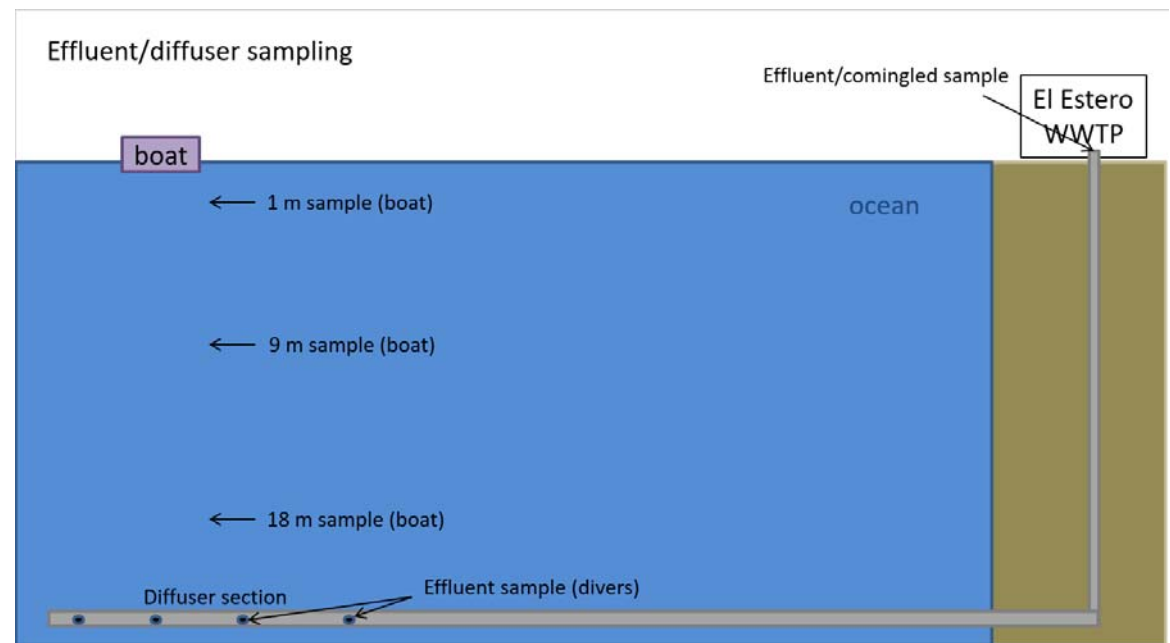


Outcome of 2016 Studies

- **Persistent low levels of human marker in the surf zone again detected in dry weather**
- Background/Natural sources ruled out (reference beach)
- Infrastructure sources ruled out
- Creeks and scour ponds ruled out
- Intertidal sand and offshore sediments ruled out
- Further study needed to rule out offshore sources
- **Combined results suggest a source of human markers directly at the beach**

Source Hypothesis Testing in 2017

1. Bather Shedding
2. WWTP Effluent
3. Water Defecation
4. Supratidal Sands
5. Stearns Wharf



Example Study – Bather Shedding

- Samples collected on busy weekends and before and after swimming race events
- Analyzed for Human Marker, FIB, and Human Adenovirus
- Human marker significantly correlated with swimmer counts
- Results suggest swimmers are a direct source to the surf zone



Outcome of 2017 Studies

- Supratidal sands and WWTP effluent were ruled out
 - Human marker detections were not related to water defecation during low recreational use periods (i.e., during the night)
 - Human marker concentrations increased after recreational use and were correlated with the number of swimmers observed
- **Results suggest bather shedding is a source of human markers to the surf zone at Leadbetter and East Beach**

Hypothesis Testing Matrix

Hypothesis	Dye Testing	Surf Zone Sampling	Offshore Sampling	Watershed Sampling	Sand/Sediment Sampling	Groundwater Sampling
Creeks		✓		✓		
Scour Ponds	✓	✓		✓		✓
MS4 Outfalls		✓		✓		✓
Sewers/Septic	✓	✓		✓		✓
Background		✓		✓	✓	
Creek Sediments		✓		✓	✓	
Marine Sediments		✓	✓		✓	
Intertidal/Supratidal		✓			✓	
Stearns Wharf	✓					
Moored Boats		✓	✓			
WWTP Effluent		✓	✓			
Water Defecation		✓				
Bather Shedding		✓			✓	

Study Findings

- Shorebirds were a significant source of surf zone FIB in dry weather, based on the correlation of host-associated DNA marker and FIB
- Consistent low level human markers were present in the surf zone, based on consistent, low level detection of human markers and, less frequently, pathogens
- Creek outlets were also human fecal impacted (possibly from open defecation and/or compromised sanitary infrastructure) but were non-transmissible to the surf zone based on beach dye studies and groundwater sampling
- Beach-area sanitary infrastructure (sewers, bathrooms, and a septic system) were not fecal sources to the surf zone

Study Findings

- Water defecation was not a source; although human fecal deposits were observed on the beaches, supratidal and intertidal sands were devoid of human markers
- An offshore municipal wastewater outfall was not a source based on modeling showing the plume to be deep and distant from shore
- Off- to onshore synchronized sampling suggested human-associated DNA markers originated in the surf zone
- Bathers were the primary source of human markers to the surf zone based on marker correlations with swimmer counts at the time of sampling and higher marker levels in afternoons when swimming occurrence peaked

Implications Statewide and Beyond...

- This study:
 - Identifies human marker levels at urban beaches when all non-bather sources have been addressed
 - Demonstrates the efficacy of comprehensive and systematic source testing, rigorous study design, and state of the science analytical tools in a complex urban coastal environment



Project Significance

1. (To our knowledge) First time urban beaches in CA have been conclusively demonstrated to have no significant infrastructure or homeless impacts to surf zone water quality
2. Bather shedding from normal recreational use can cause low level human marker detections in the surf zone at high use beaches



Thank You!

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