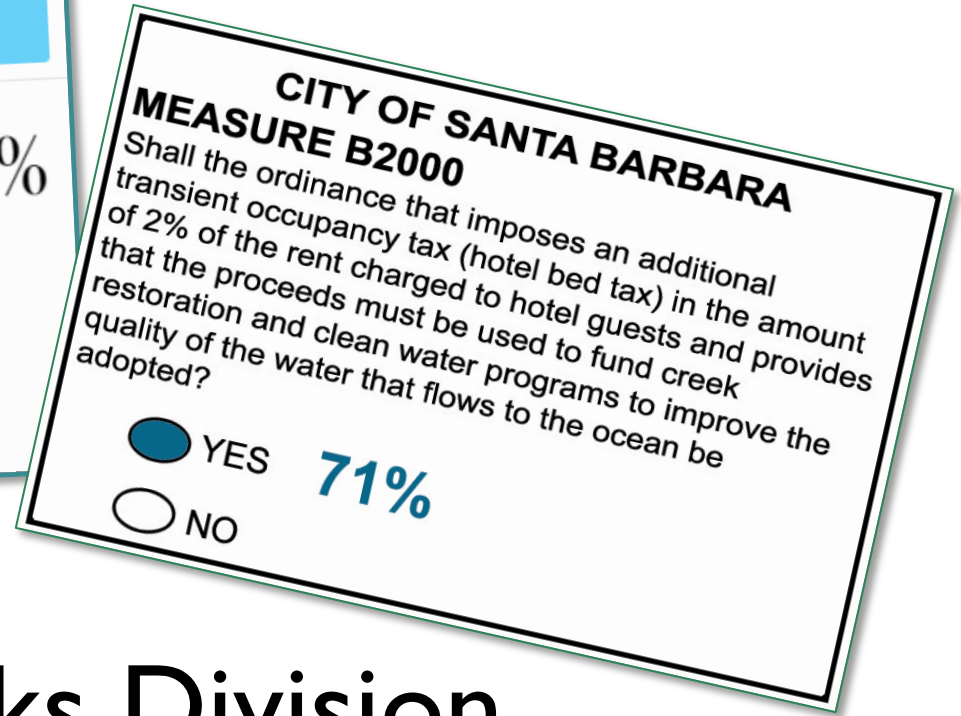


Reducing Human Sources of Bacteria to Storm Drains, Creeks, and Beaches

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Creeks Division

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City of SB Creeks Division

Measure B

Lodging tax rate from 10% to 12%, effective January 2001.

Mission

Improve creek and ocean water quality and restore natural creek systems

Creeks Advisory Committee

Representatives from the hotel/lodging industry, business community, and environmental field meet monthly to provide advisory role.

How can we reduce indicator bacteria at beaches, creeks, and storm drains?



Early Water Quality Improvement Projects

- ❌ Ultraviolet (UV) disinfection of storm drain discharge
 - Indicator bacteria at background levels 200 ft downstream
- ❌ Low-flow storm drain diversions to sanitary sewer
 - Conflict with restoration goals
- ❌ Bioswales
 - Insufficient contact time

Funding from Measure B and Clean Beaches Initiative (Props 40, 50, 84), managed by Clean Beaches Task Force

- **Why are there so many fecal indicator bacteria at this beach, creek, or storm drain?**
- **Are the fecal indicator bacteria from human or animal waste?**
- **What is the risk?**



Microbial Source Tracking

- Professor Patricia Holden, UCSB
- Molecular revolution
- Human waste *was not* detected at some project sites
- Human waste *was* detected in some storm drains
- Indicator bacteria did not correlate with human waste markers



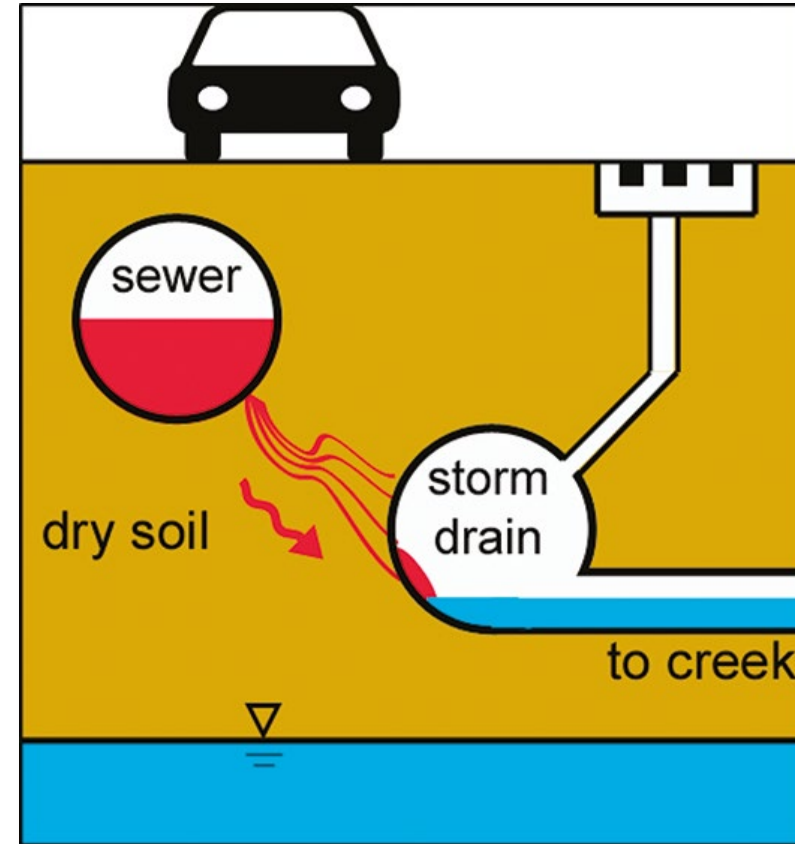
Pause

- Proposed to Creeks Advisory Committee to focus on human waste due to risk

Microbial Source Tracking



Macaulay, 1976, *Underground*.



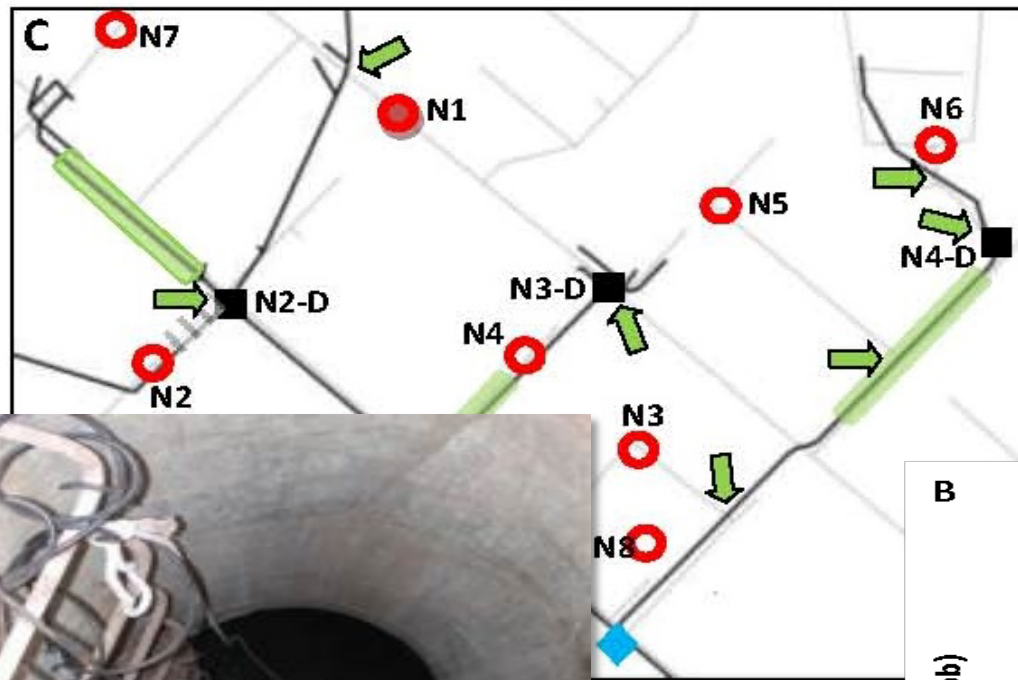
(Sercu et al. 2011, ES&T)

Laguna Watershed Study and Microbial Source Tracking Protocol Development Project (Funded by Clean Beaches Initiative), collaboration with UCSB and Geosyntec

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consultants

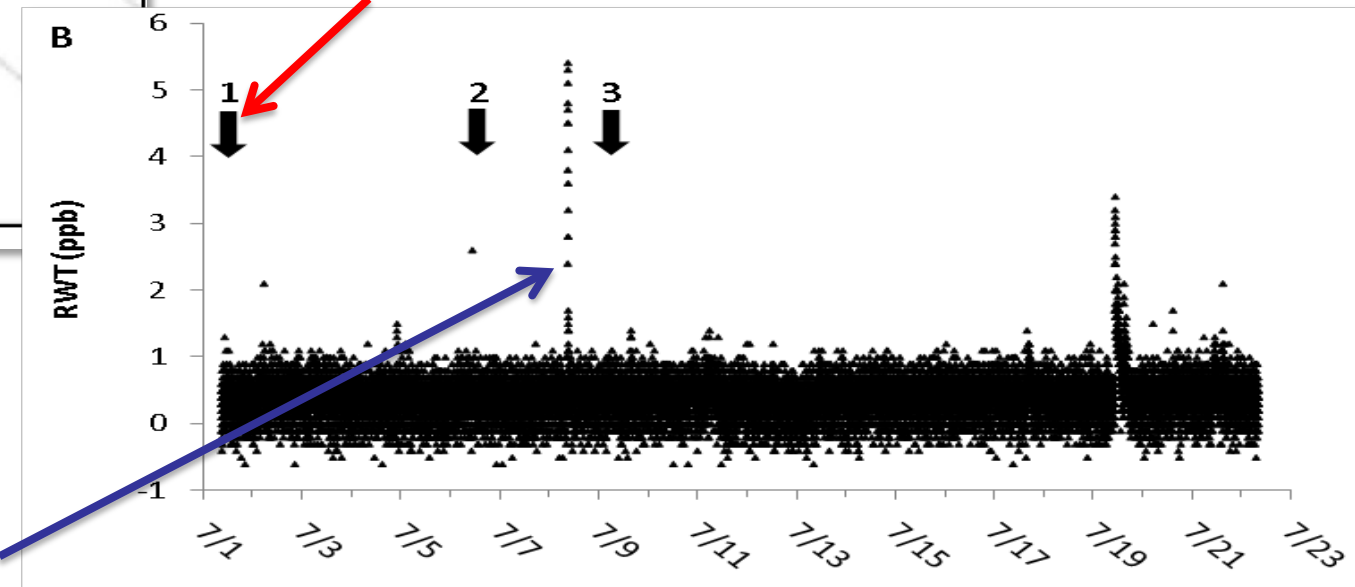
Dye Studies



Dye in Sanitary Sewer

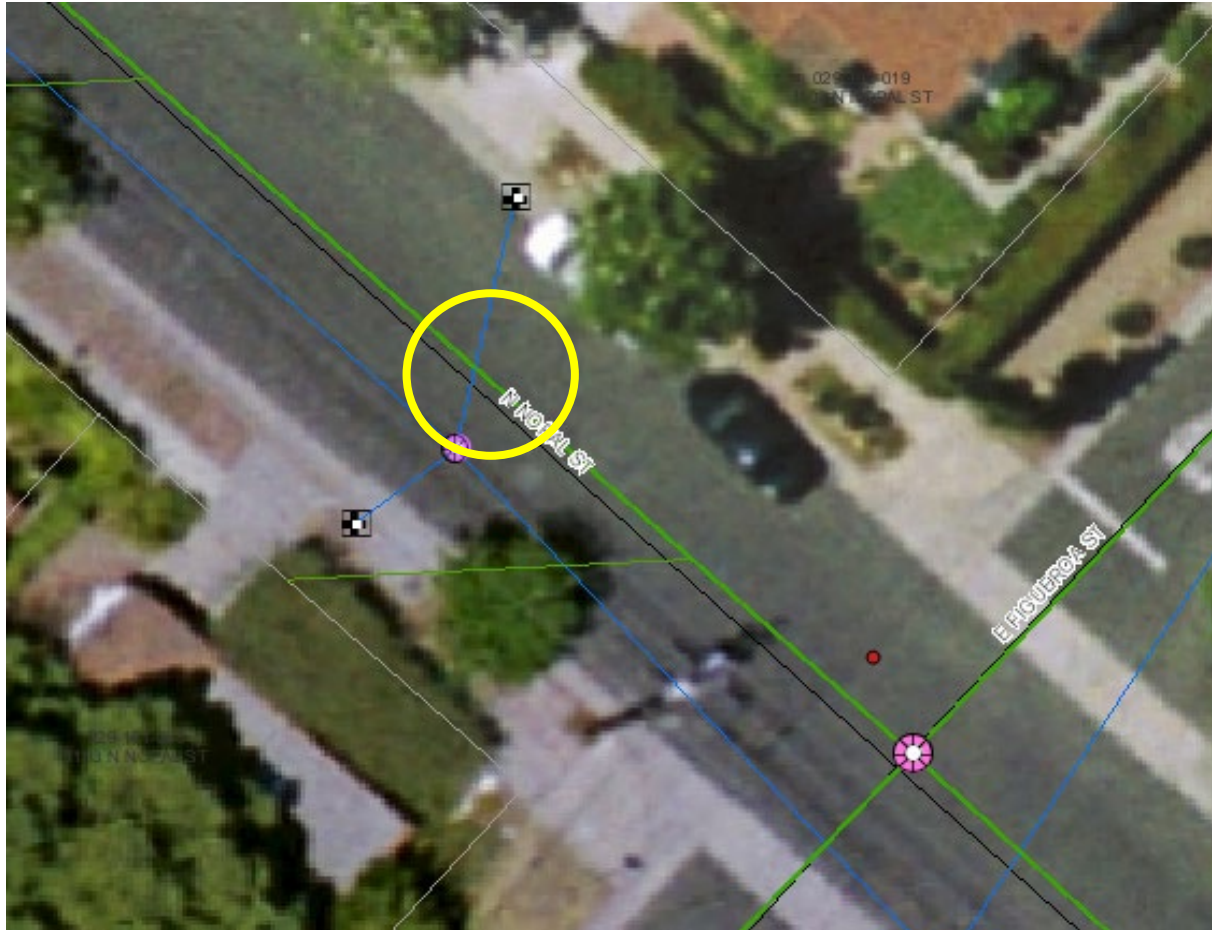


Probe in
Storm Drain



Sercu et al. 2011 ES&T

Video of Storm Drains



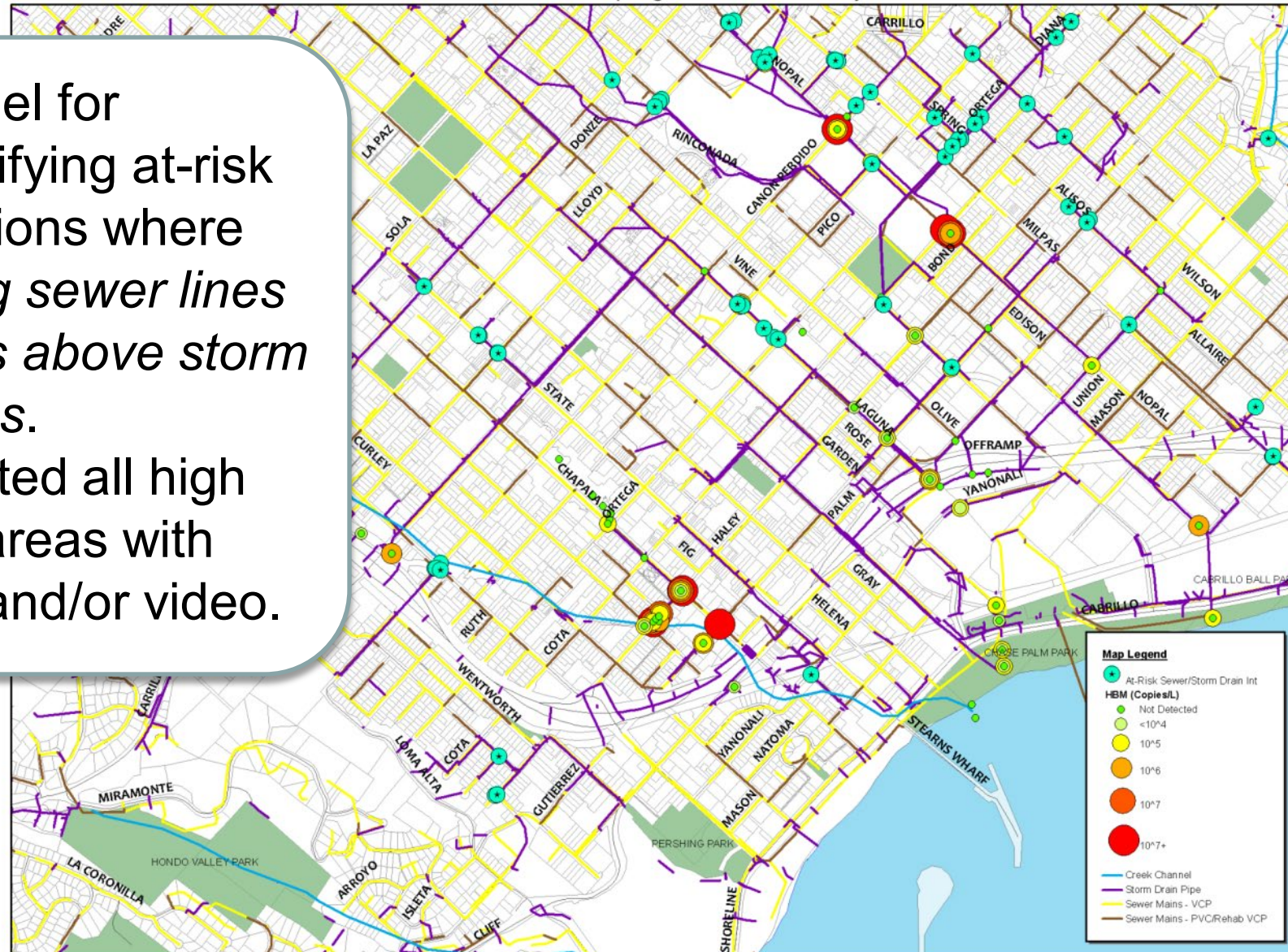
Wastewater Infiltration



GIS Tools

At-Risk Sewer & Storm Drain Intersections - HBM Sampling Location Proximity & Results in Downtown Santa Barbara

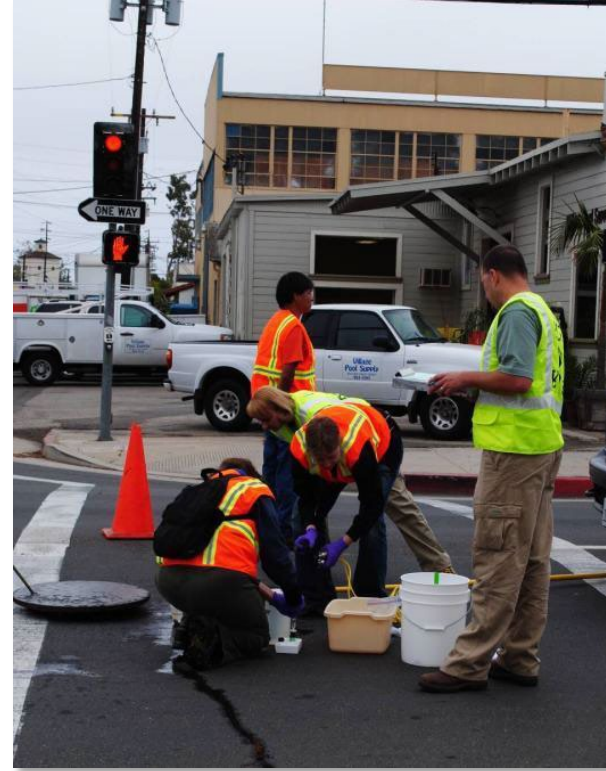
- Model for identifying at-risk locations where *aging sewer lines cross above storm drains*.
- Tested all high risk areas with dye and/or video.



Sewage Sniffing Dogs



Environmental Canine
Svc., LLC



UCSB

Tools for Tracking Human Fecal Pollution in Urban Storm Drains, Creeks, and Beaches



- Sources
- Tools
- Strategies

Dye entering Mission Creek (Santa Barbara, CA) after being flushed down toilets in nearby businesses. A private sewer lateral serving six businesses was found to be leaking into a storm drain.

City of Santa Barbara, Creeks Division
In partnership with:
University of California, Santa Barbara

June 1, 2012

Microbial Source Tracking

High Hanging Fruit

- UCSB & Geosyntec, funded by Clean Beaches Initiative
- Two additional SB beaches, extensive hypothesis testing
- Frequent, low-level detections of human waste marker (HF183)
- Infrequent, low-level pathogen detection
- Many hypotheses ruled out
- Two were not ...

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Swimmers and treated wastewater effluent



Highlights

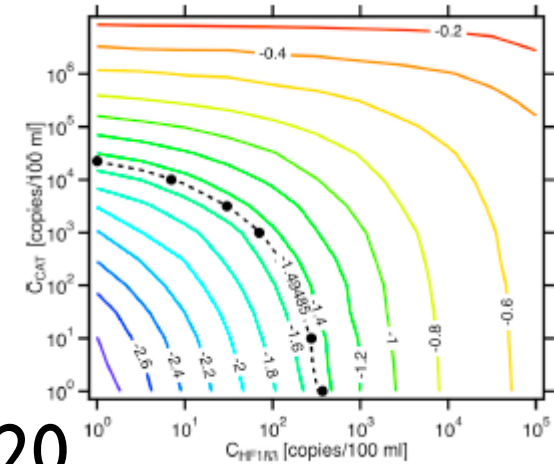
- Dogs and seabirds were sources of fecal indicator bacteria in surf zone water.
- HF183 human markers were low but chronic in surf zone water over three study years.
- Watersheds did not supply HF183 to surf zone water.
- Higher levels of HF183 occurred in afternoons than in mornings.
- WWTPs possibly contributed, but swimmers correlated to HF183 markers directly.

Additional support:

- Li et al. 2021, Front. Micro. (Goleta Beach)
- Toubiana et al. 2021, Front. Micro. (France)
- Li et al 2022, Wat. Res. (Bacterial community sequencing)
- Li et al 2022, J. Appl. Micro. (HF183 in skin and urine microbiomes)

Microbial Source Tracking – Current Work

- Annual surveillance (“New Sources”)
 - Including wet weather, chemical markers
 - Community sequencing
- Quantitative Microbial Risk Assessment
 - Pilot project in response to Boehm and Soller, 2020
 - Co-occurring gull and human waste marker (HF183)



How to reduce human waste?

- Focus on human waste
- Well-funded, nimble water quality program
- Remove feces directly
 - \$200,000 toward cleanup of creeks, beaches, and homeless encampments (5,544 piles of feces/yr)
 - \$20,000 for trash cans and porta-potties
- Locate sources, fix immediately
 - Science-driven, adaptive program
 - Conduct research internally
 - Partner with top academics and consultants
- Community support, transparent communication

What does it mean to be safe to swim?



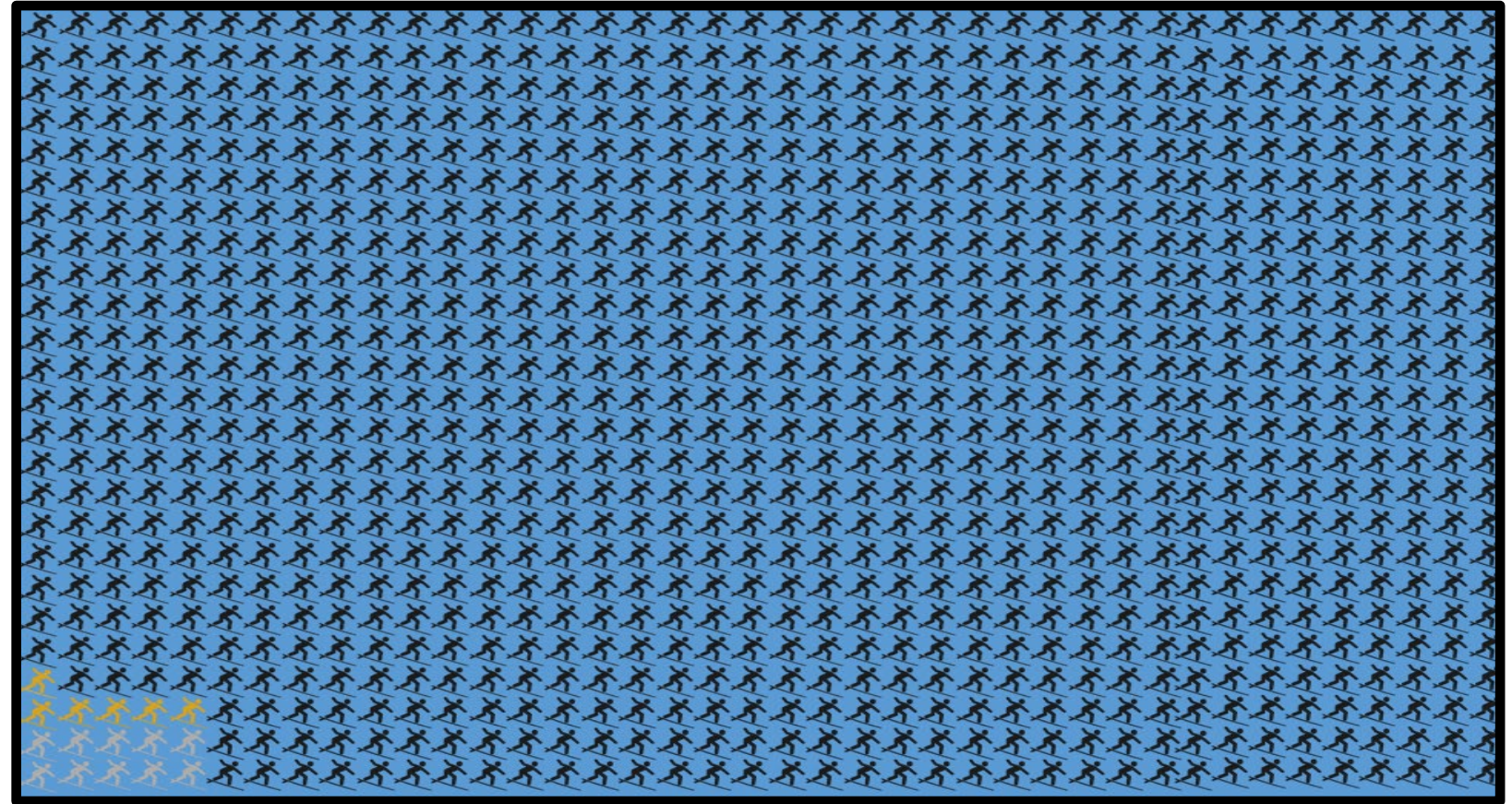
Healthy surfer



Illness, not from surfing



Excess illness from surfing



1,000 Surf Sessions

Public Health vs. Individual Risk

Exposure Scenario	Excess Annual Illnesses
Surfs twice per month, more often in wet weather	Nearly the same as background.
Surfs twice weekly	0.5 GI bug, 1 earache/ear pain, 1 sinus pain/infection.

What about other risks?

Odds Ratios (all published before Covid)

1.6 -2.0 – Common for ocean swimming studies

1.5 – Influenza after attending child's checkup

3.5 – *Campylobacter* for baby in shopping cart near raw meat

3.5 – GI illness in child attending preschool

10 – Virus when living with sick family member

20 – Cold due to air travel

What are we giving up while we continue weekly FIB indicator bacteria tests and postings?

A group of four children, two girls and two boys, are standing on a sandy beach, holding a red rope that stretches across the frame. They are facing away from the camera, looking out at the ocean. The children are wearing swimwear: a red one-piece swimsuit, a blue and green patterned one-piece swimsuit, blue patterned shorts, and a red one-piece swimsuit. The background shows the ocean and a clear sky.

	BEACH/COUNTY	GRADE
1.	Cowell Beach at the Wharf Santa Cruz County	F
2.	Avalon Harbor Beach, Catalina Island Los Angeles County	F
3.	Cabrillo Beach, harborside at restrooms Los Angeles County	F
4.	Topanga State Beach Los Angeles County	F
5.	Poche Beach Orange County	F
6.	North Beach Doheny Orange County	F
7.	Arroyo Burro Beach Santa Barbara County	F
8.	Baker Beach at Lobos Creek San Francisco County	F
9.	Colorado Lagoon, Long Beach Los Angeles County	F
10.	Capitola Beach Santa Cruz County	F

Unbridled Joy



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Will Rogers State Beach
Rustic Canyon Creek Estuary



Will Rogers State Beach
Santa Monica Canyon low-flow diversion
Swimming banned

Environmental Justice: Creating Undue Fear of Free Recreation, Connection, Exercise



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