San Diego Investigative Order (IO): Quantifying Human Fecal Loading to the San Diego River

December 12, 2019

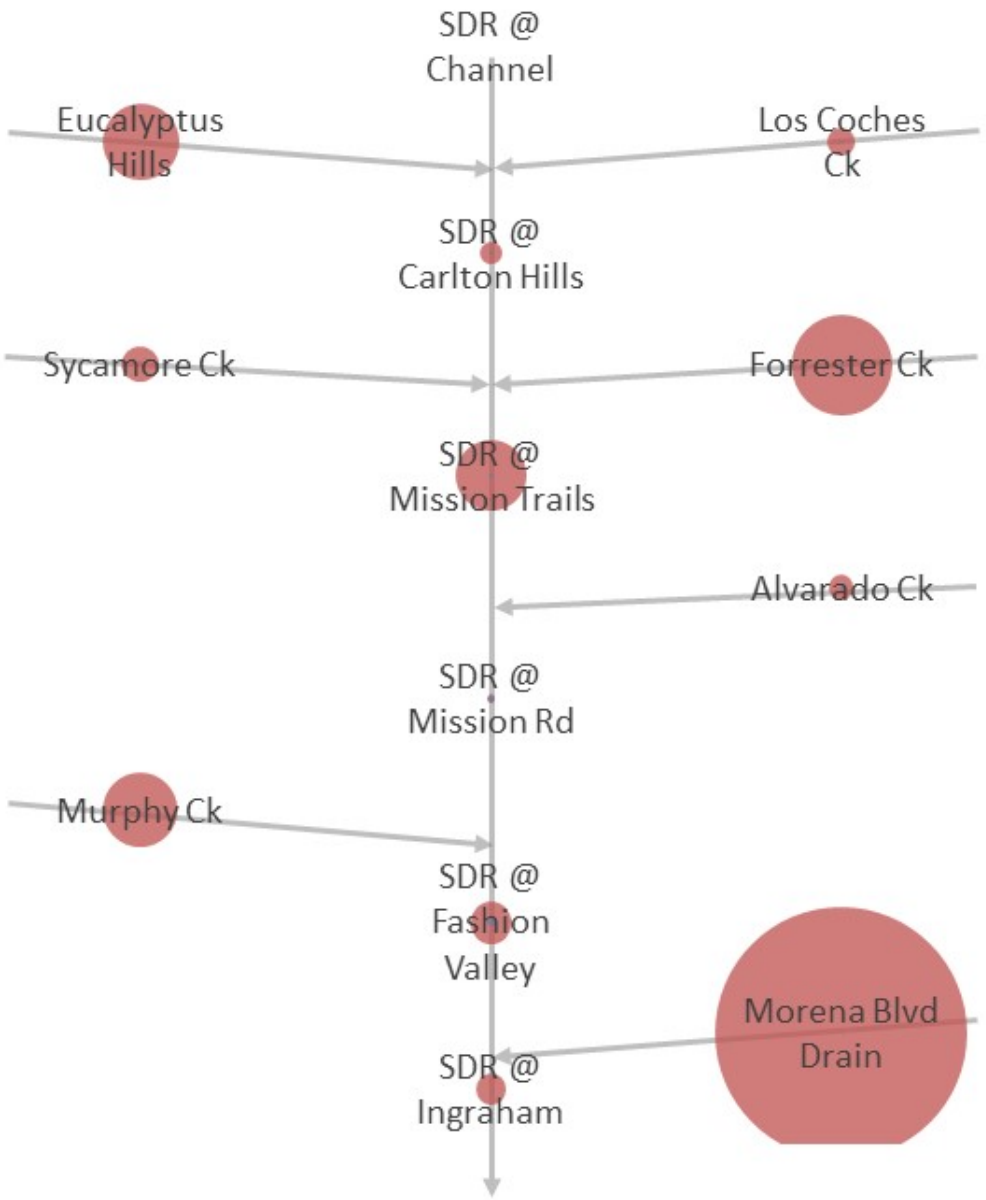
Background

- There is a wet weather bacteria TMDL in San Diego
  - Compliance deadlines begin in 2021

- Wet weather discharges from the San Diego River contain human pathogens as well as fecal indicator bacteria (FIB)
  - The risk of surfer illness increased following wet weather compared to no exposure or dry weather exposure

- Cost of compliance is estimated in the $billions
  - Reducing human sources of fecal contamination is the most cost-effective solution to protect human health

Concentrations Human Marker (HF183) In SD River



Storm Date: 1/31-2/1/2016

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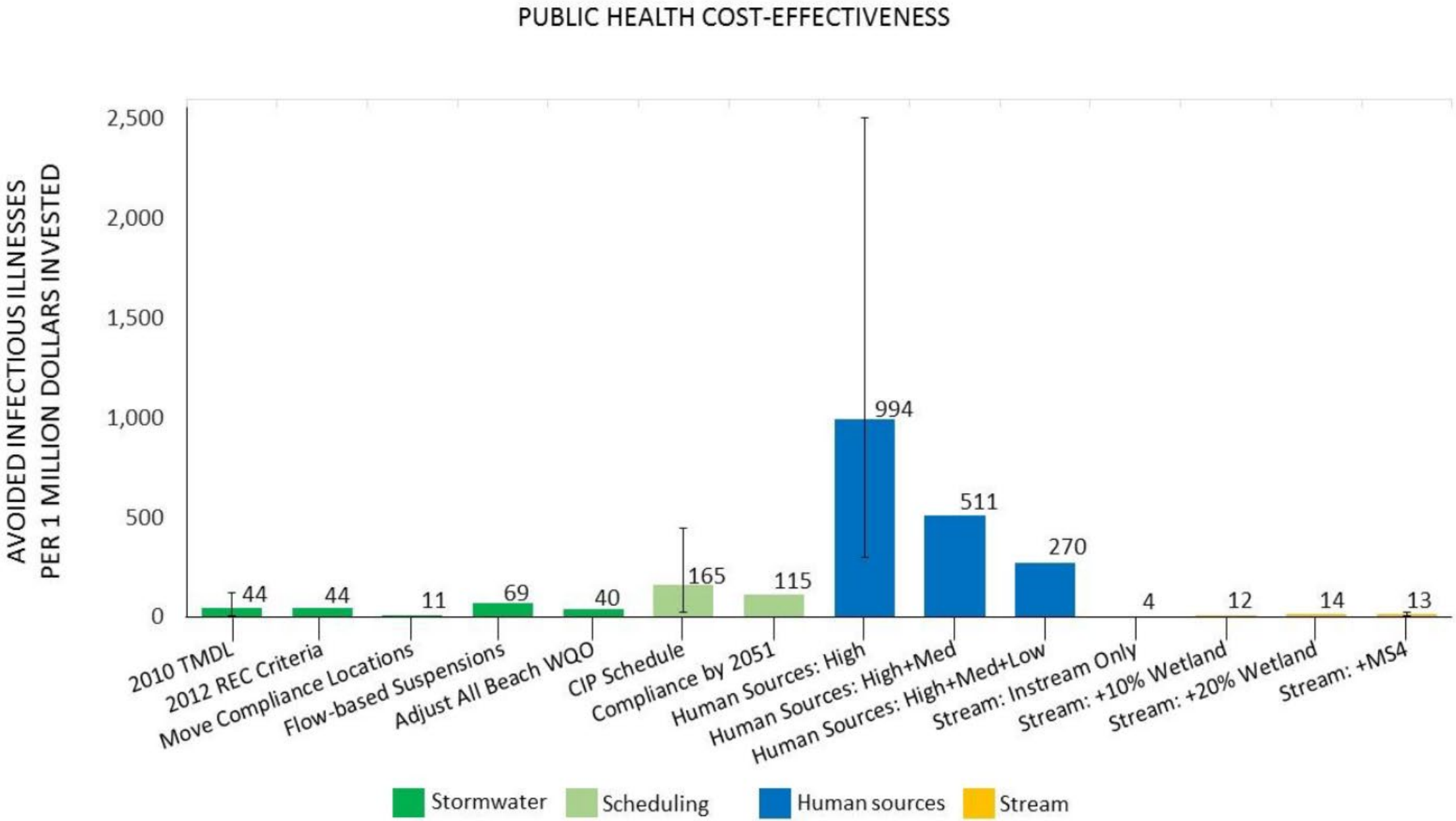


https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/issue3/Final_CBA.pdf

Which Human Source?

- Public Sewer
  - Sanitary sewer overflows
  - Exfiltration
- Private Laterals
- Onsite Wastewater Treatment Systems (OWTS)
- Homeless Populations
- Illicit Connections/Illegal Discharges

Goals of the IO Conceptual Workplan

- Quantify loading of human fecal contamination from different sources to the San Diego River
  - Focus on wet weather

- Use the loading estimates to compare relative contributions among the sources of human fecal inputs
  - Which is the greatest potential source?

- Identify the factors that might lead to the greatest risk of loading
  - Where and when does the greatest loading occur?

Two Approaches for Detecting and Measuring Public Sewer Exfiltration

- Utilize DNA signature of bacterial biofilm found in sewer pipes to detect exfiltration of SSOs in receiving waters

- Direct measurements of volumetric loss to quantify exfiltration

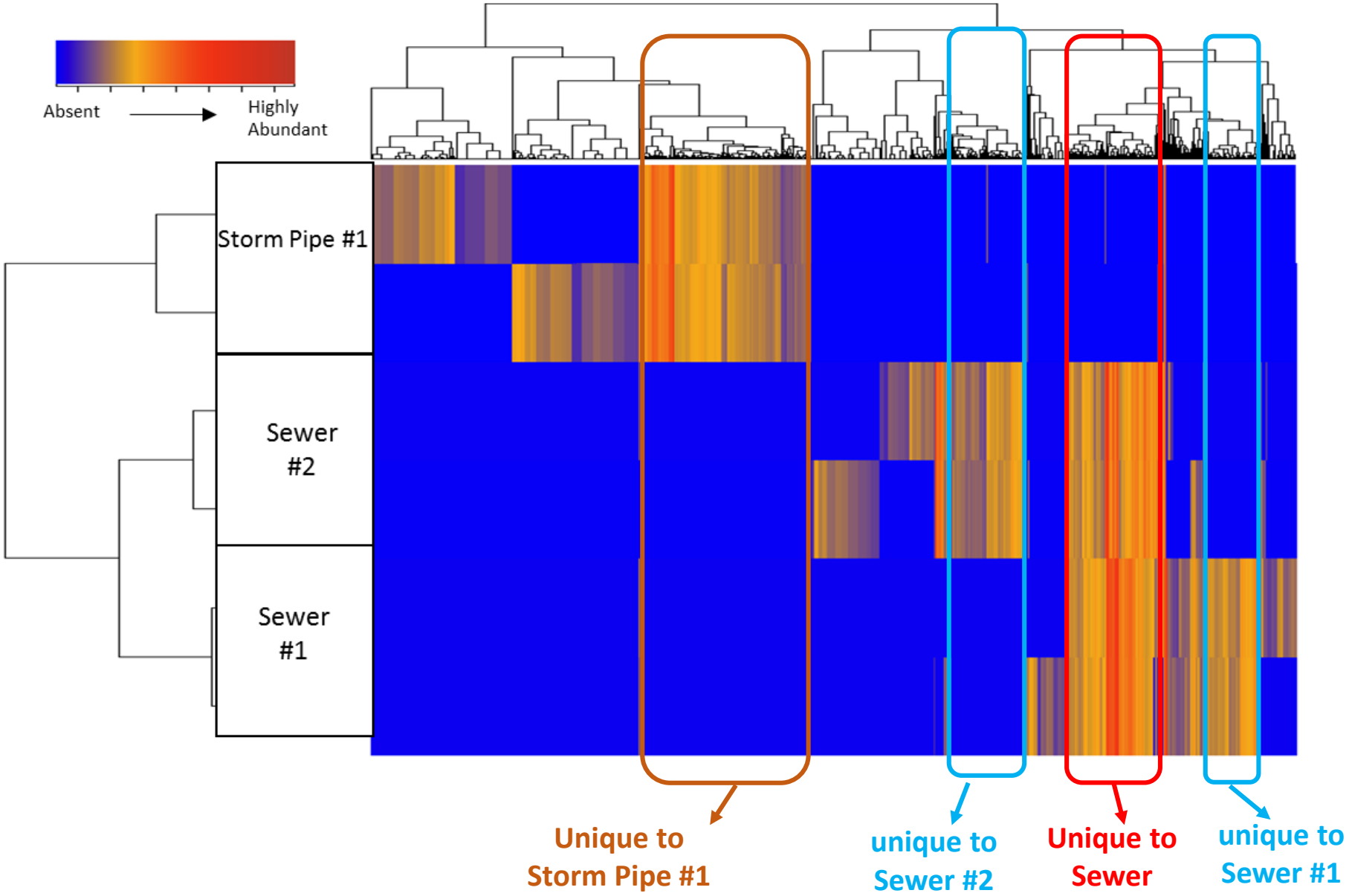
Using Biofilms as a Tracer for Sanitary Sewers

- Sewer pipes are a unique environment which promotes growth of a specific bacterial biofilm community

- Biofilm continuously sloughs off and has been used as a tracer for CSO's and SSO's in the mid-west
  - Takes advantage of advances in DNA sequencing

- SCCWRP is adapting biofilm detection for use in identifying sewer exfiltration

Preliminary Results: Microbial Community Analysis



Direct Measurement of Exfiltration

- Isolate a section of sanitary sewer pipe
  - Artificially create wet weather flows using pumps and flow sensors
  - Measure volumetric loss over time
- Designing and constructing prototype sampling device now
  - Start with bench top system for proof of concept
  - Already identified a site for field testing
- Factorial design will enable extrapolation to the rest of the watershed
  - Based on combinations of risk factors
- Volume loss is only part of the equation
  - Adding tracers to quantify transport to receiving waters

Exfiltration Risk Factors

- **Materials of construction (clay, concrete, PVC, CIP lining)**
- **Age (<10, 10-25, >25 years)**
- Condition scores (no action, maintenance required, repair/replace)
- High frequency cleaning list
- Groundwater height
- Soil type
- Land use
- Flow rate
- Depth of pipe relative to storm drain
- Proximity to surface water

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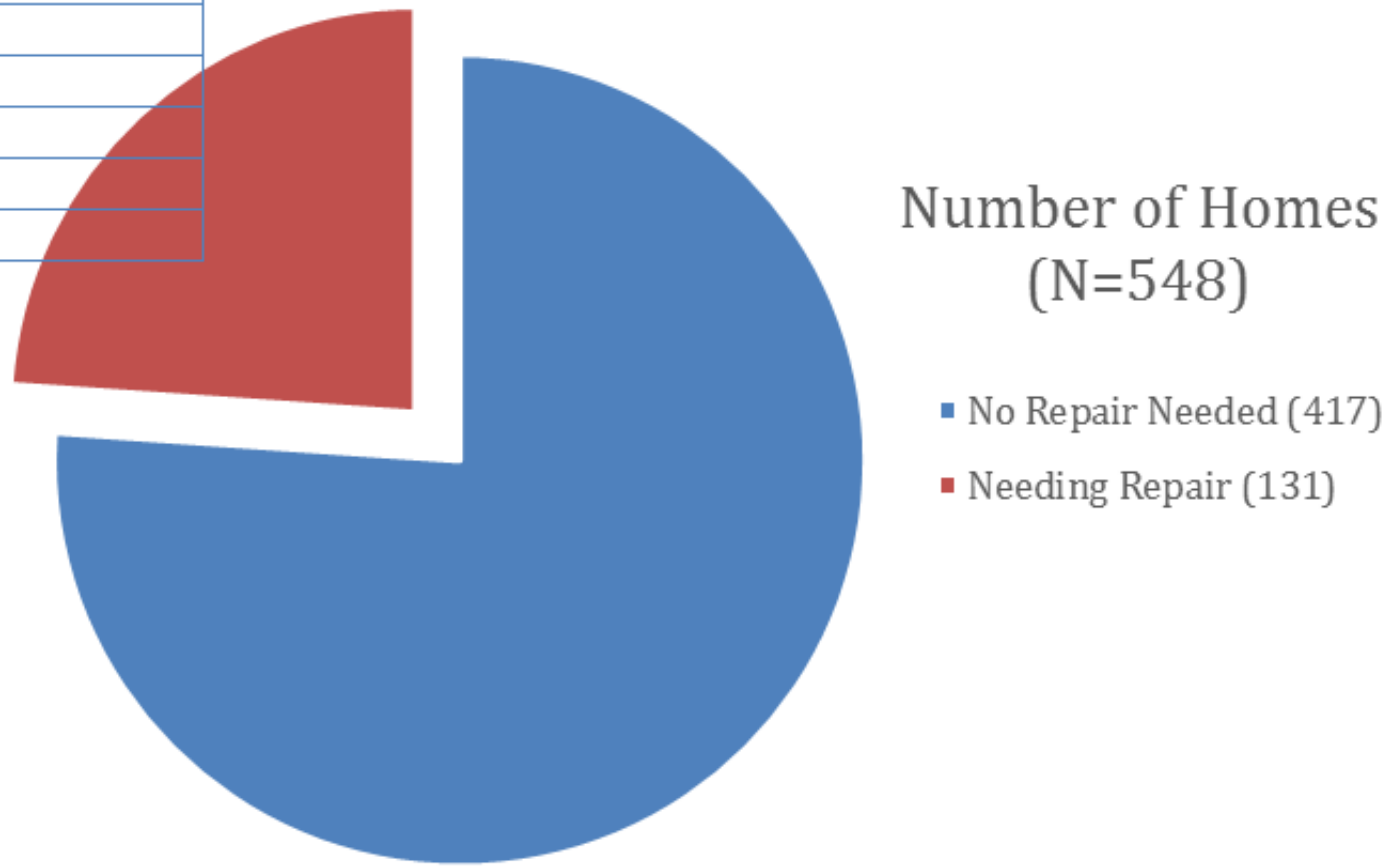
City of El Cajon Lateral Inspection Program (2009-2018)

Type of Repair	% of Laterals That Needed Repair
Root intrusion	32
Build Up	22
Broken Pipe	22
Offset	12
Sag	2
Corrosion	4
Outdated Plumbing	2



Approach for Lateral Contributions

- First step is to assess potential for leakage rates
  - Incentivize homeowners to conduct inspections
- Laterals will use similar direct exfiltration measurement strategy as used for public sanitary sewer
- Stratified random design will be used for extrapolating to watershed
  - Based on risk factors such as age

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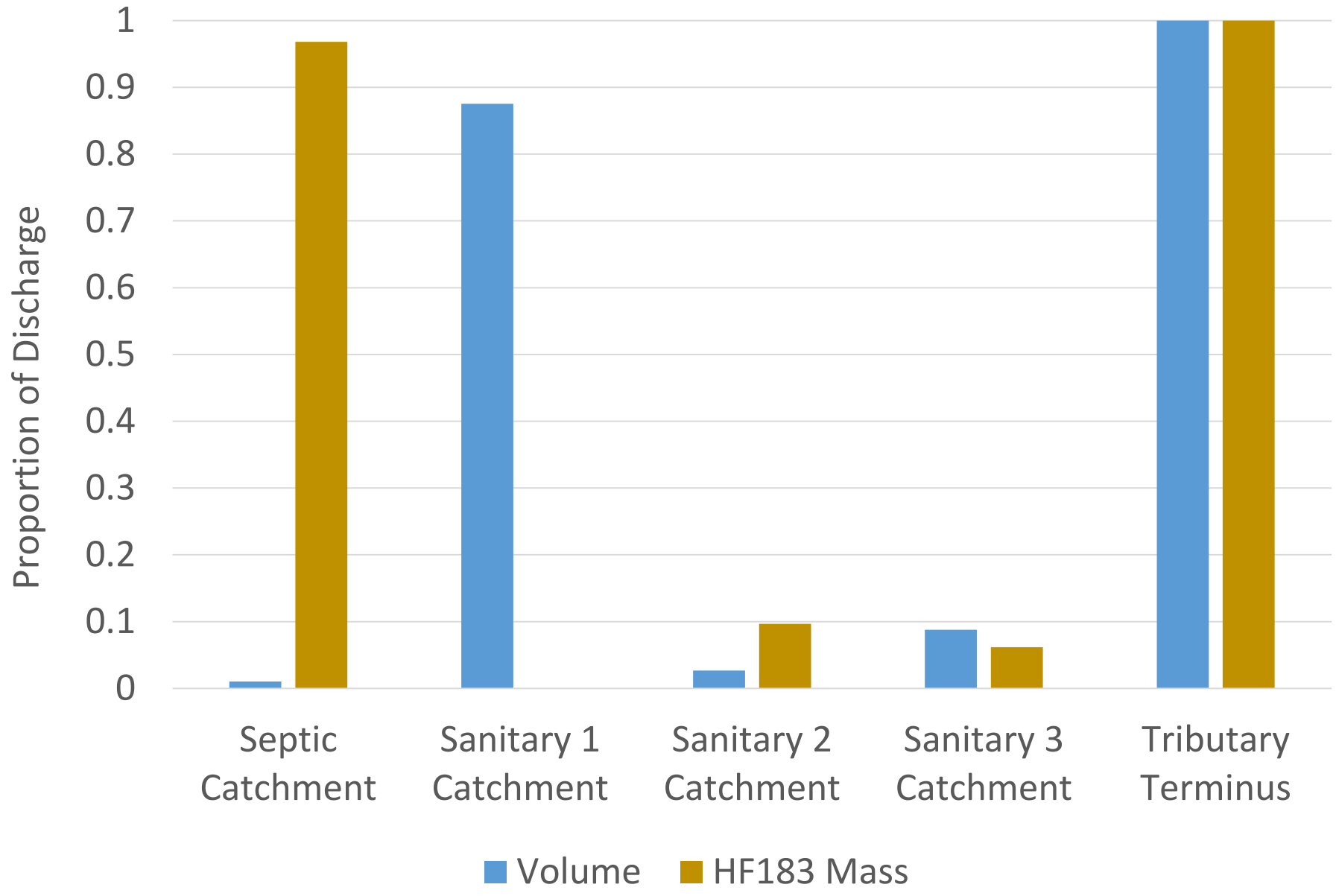
Volume and HF183 Human Marker Loading by Catchment Source



Approach for Onsite Wastewater Treatment Systems

- Identify catchments with OWTS as only source
  - Prioritize areas with a higher density of OWTS
- Sample catchments during wet weather to measure human fecal contribution
  - Estimate average and variability of human fecal loading per OWTS per storm
- Extrapolate human fecal loading per OWTS to watershed to estimate contribution

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Approach for Estimating Contributions from Homelessness

- Census and survey of homelessness
  - How many potential contributors? Where? When?
  - What are their sanitary habits (direct vs indirect deposit)?

- Confirming homelessness contribution estimates
  - Upstream-downstream sampling design

- Washoff experiments for boosting empirical confidence
  - Contribution from streambank latrines during wet weather

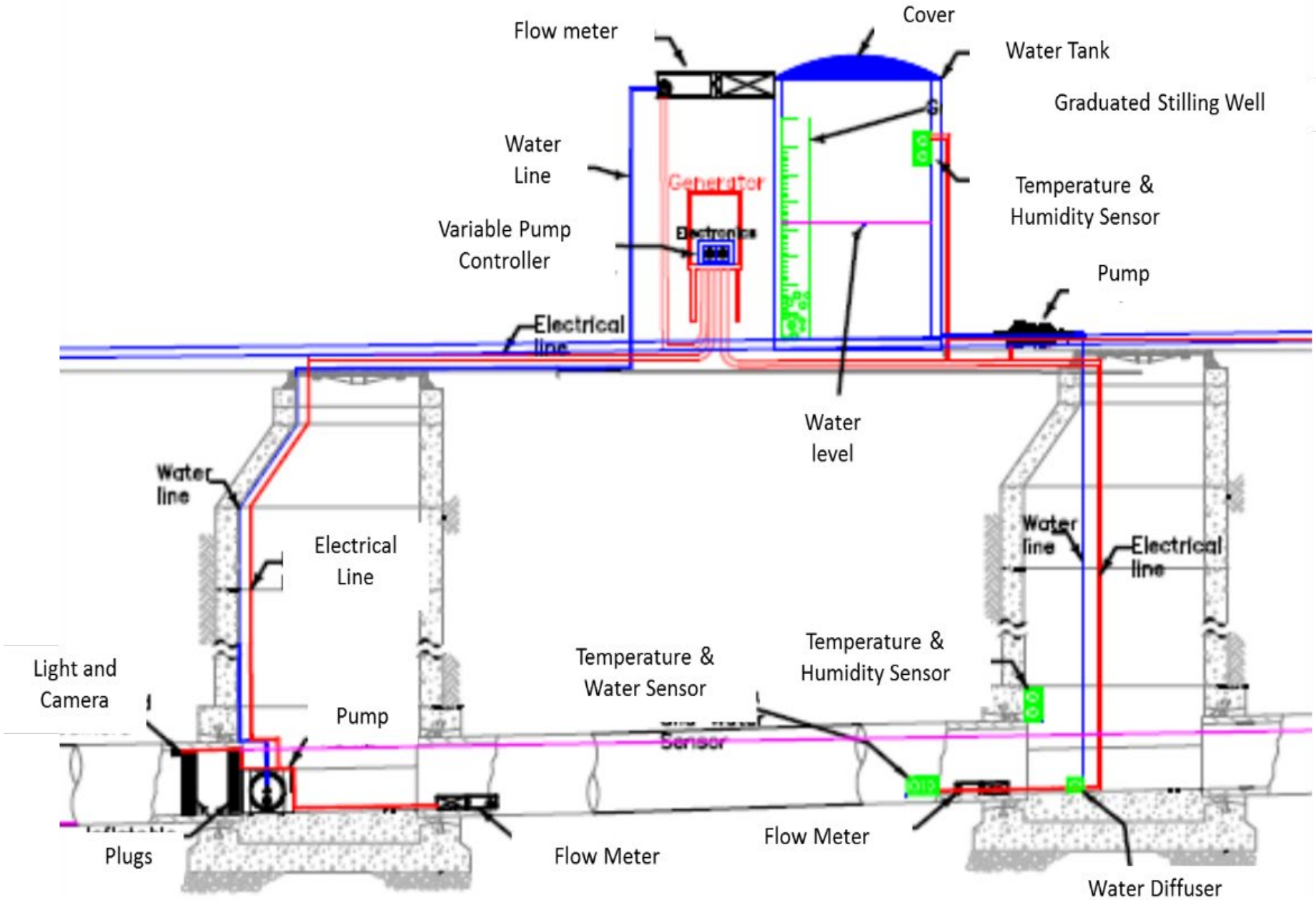
Current Status

- Final Draft Workplan due to RWQCB on Dec 12, 2019

- Assembled a Steering Committee
  - City, County, RWQCB
  - Other named parties
  - Coastkeeper and River Park Foundation

- Assembled an external Technical Review Committee of national experts
  - We encourage independent technical oversight

- RWQCB response expected within 90 days


Flow meter
Cover
Water Tank
Graduated Stilling Well
Water
Line
Generator
Temperature &
Humidity Sensor
Variable Pump
Controller
Electronics
Pump
Electrical
line
Water
level
Water
line
Electrical
Line
Water
line
Electrical
line
Light and
Camera
Temperature &
Water Sensor
Temperature &
Humidity Sensor
Pump
Sensor
Plugs
Flow Meter
Flow Meter
Water Diffuser