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

Commission Update
June 2023

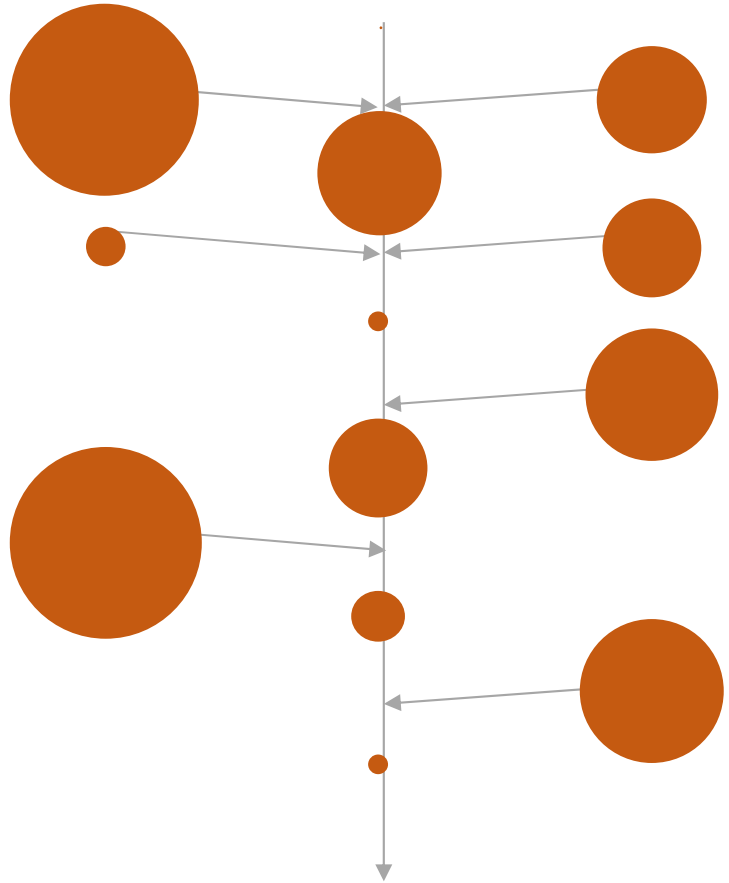
Background

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

- Wet weather discharges from the San Diego River contain human pathogens as well as human fecal markers (HF183)
  - 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

Relative HF183 Concentration in the San Diego River and Tributaries



Which Human Source?

- Public Sewer Exfiltration
- Onsite Wastewater Treatment Systems (Septics)
- Sanitary sewer overflows
- Sewer Laterals and Septics
- 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
  - HF183 will be the “currency”

- 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
  - Watershed wide, not site-specific

Which Human Source?

• Public Sewer Exfiltration	**Over halfway done**
• Onsite Wastewater Treatment Systems (Septics)	**Completed**
• Sanitary sewer overflows	**Completed**
• Sewer Laterals	**Initiating now**
• Homeless Populations	**Completed**
• Illicit Connections/Illegal Discharges	**Completed**

Two Approaches for Detecting and Measuring Public Sewer Exfiltration

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

- Direct measurements of volumetric loss to quantify exfiltration

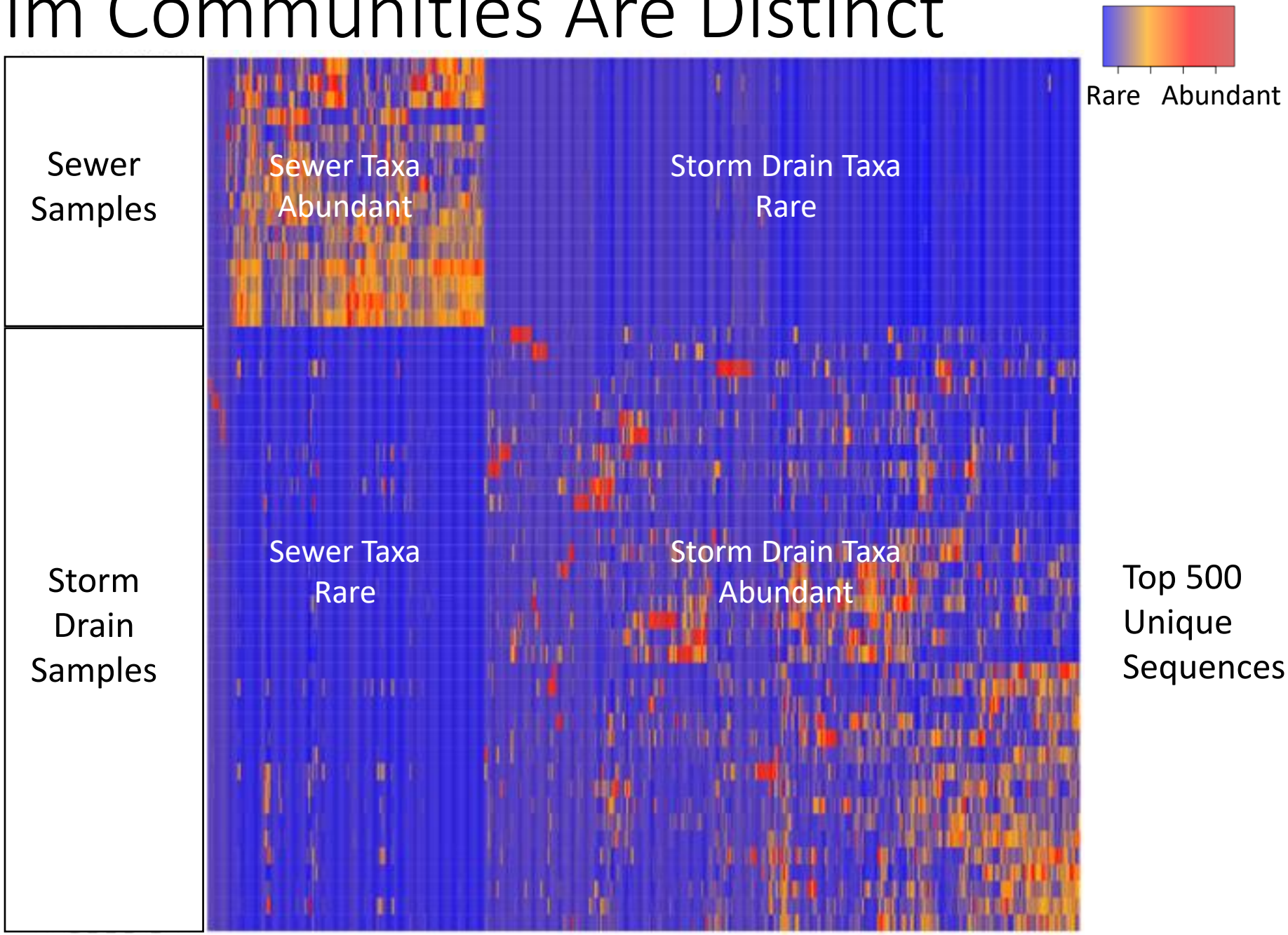
Using Biofilms as a Tracer for Sanitary Sewers

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

- We needed to make sure sewer and storm drain biofilms had unique community profiles
  - Ensure the biofilm tool is sensitive and persistent

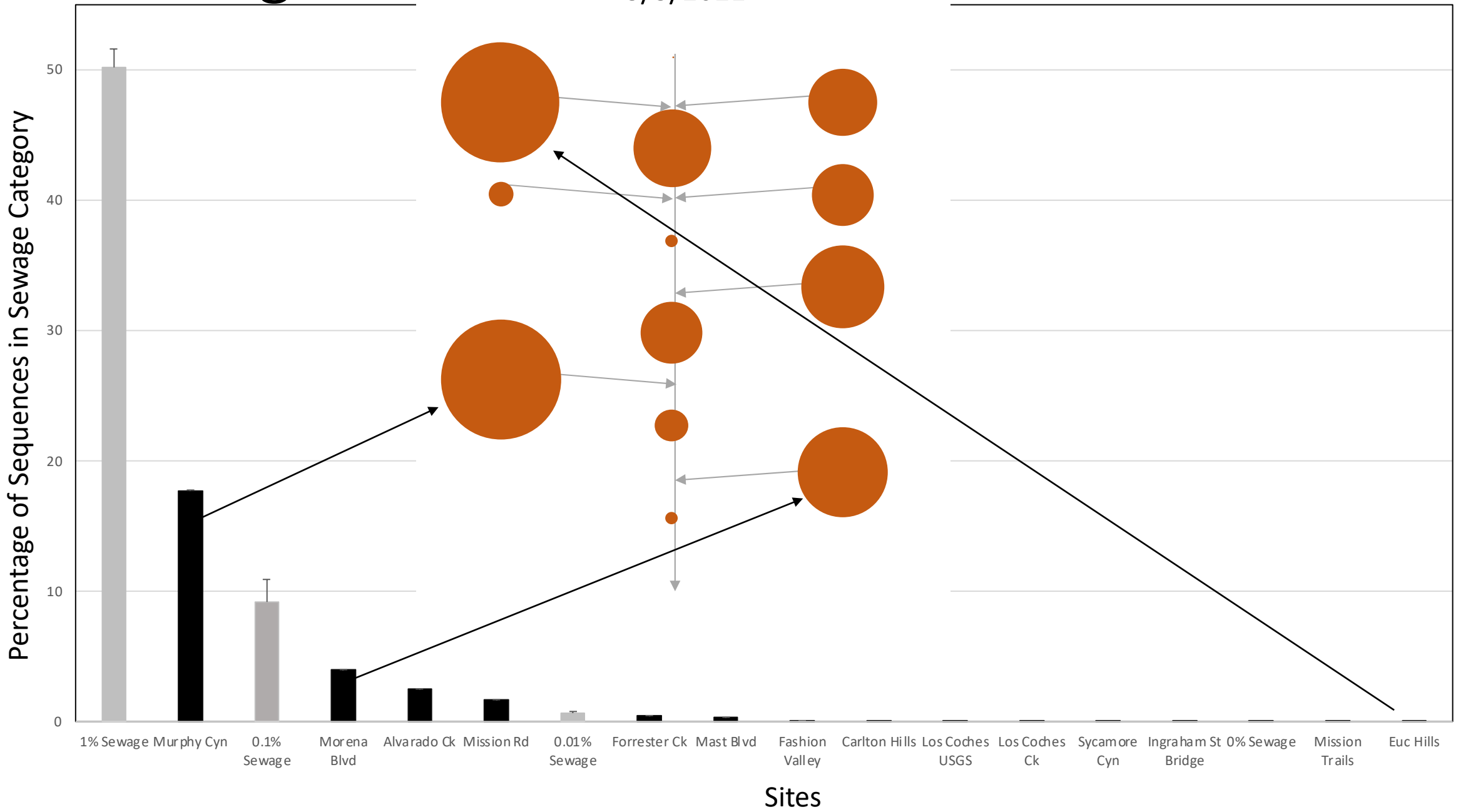
- If profiles are consistently different, then apply to stormwater samples in the San Diego River

Biofilm Communities Are Distinct



Strength of [illegible] nal - Storm 1

Storm 1
3/3/2021



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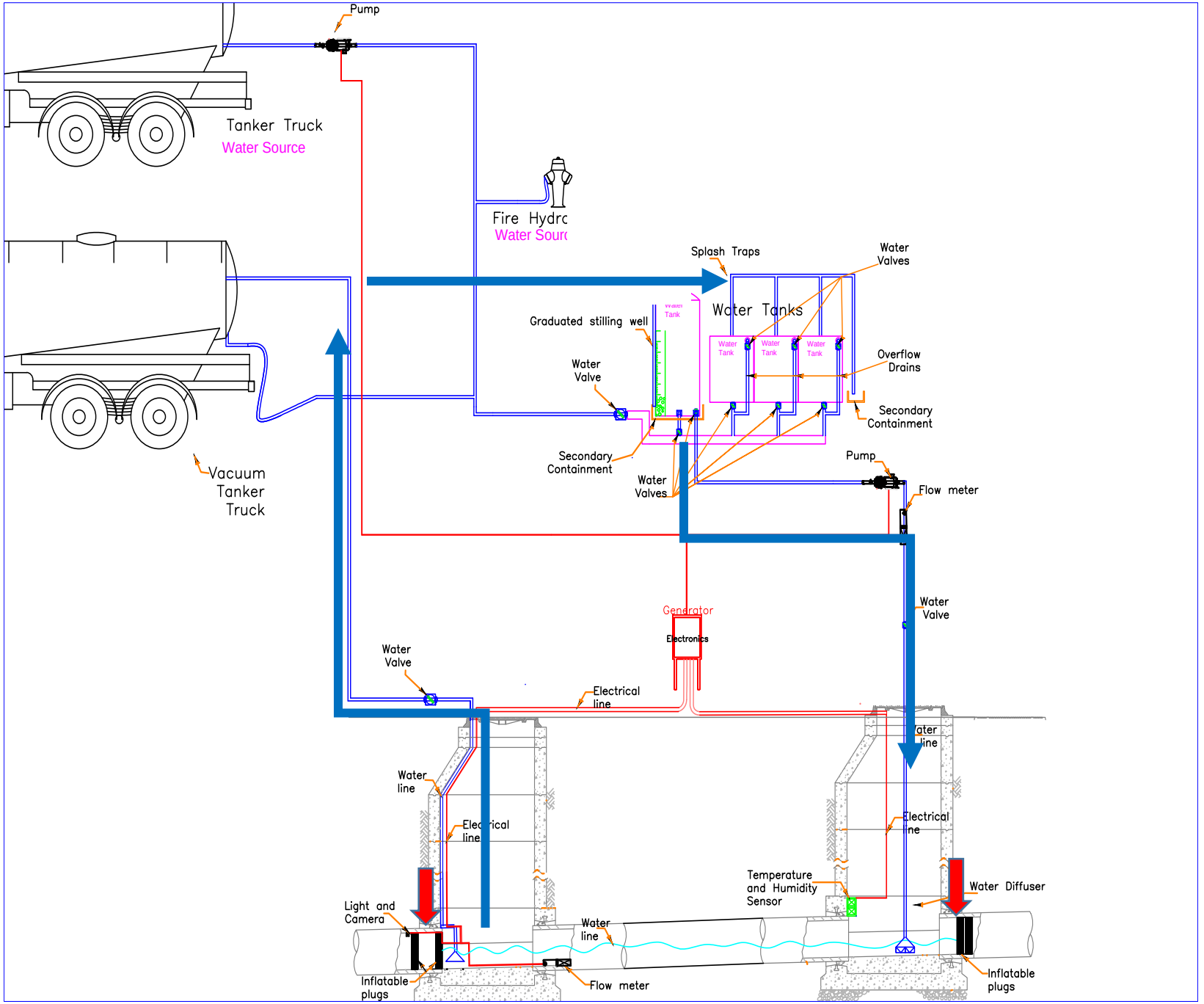
- Direct measurements of volumetric loss to quantify exfiltration

Direct Measurement of Exfiltration

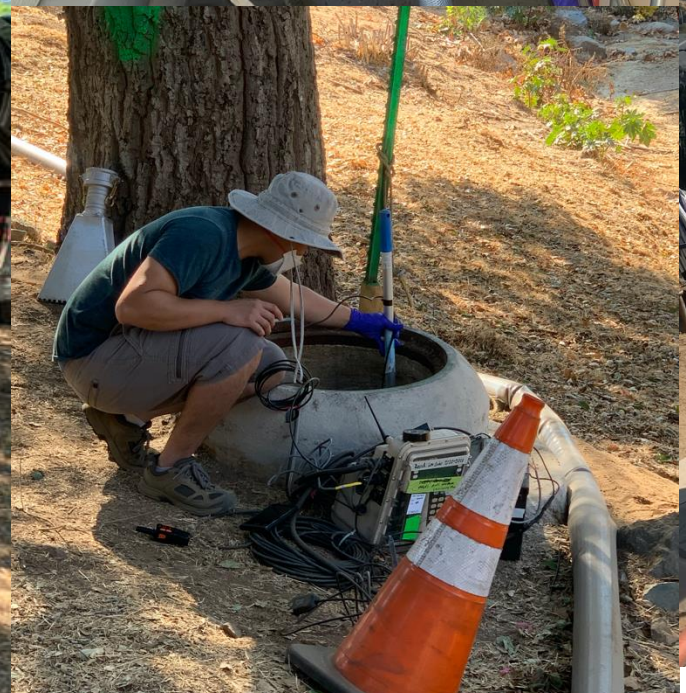
- Isolate a section of sanitary sewer pipe
  - Artificially create wet weather flows using pumps and flow sensors
  - Measure volumetric loss over time
- Designed and constructed a prototype sampling device
  - Can measure volume losses of ~1 L out of 4,000 L
- Factorial design will enable extrapolation to the rest of the watershed
  - Based on combinations of risk factors
- Volume loss is only part of the equation
  - Use fluorescent dyes as a tracer to quantify transport to receiving waters

How it Works

- Install sewer diversion
  - Section without laterals
- Pump ~4,000L freshwater into upstream MH
- Retrieve at downstream MH using vacuum trucks
- Measure recovered volume
- Repeat up to six times
  - Preliminary run to prime voids



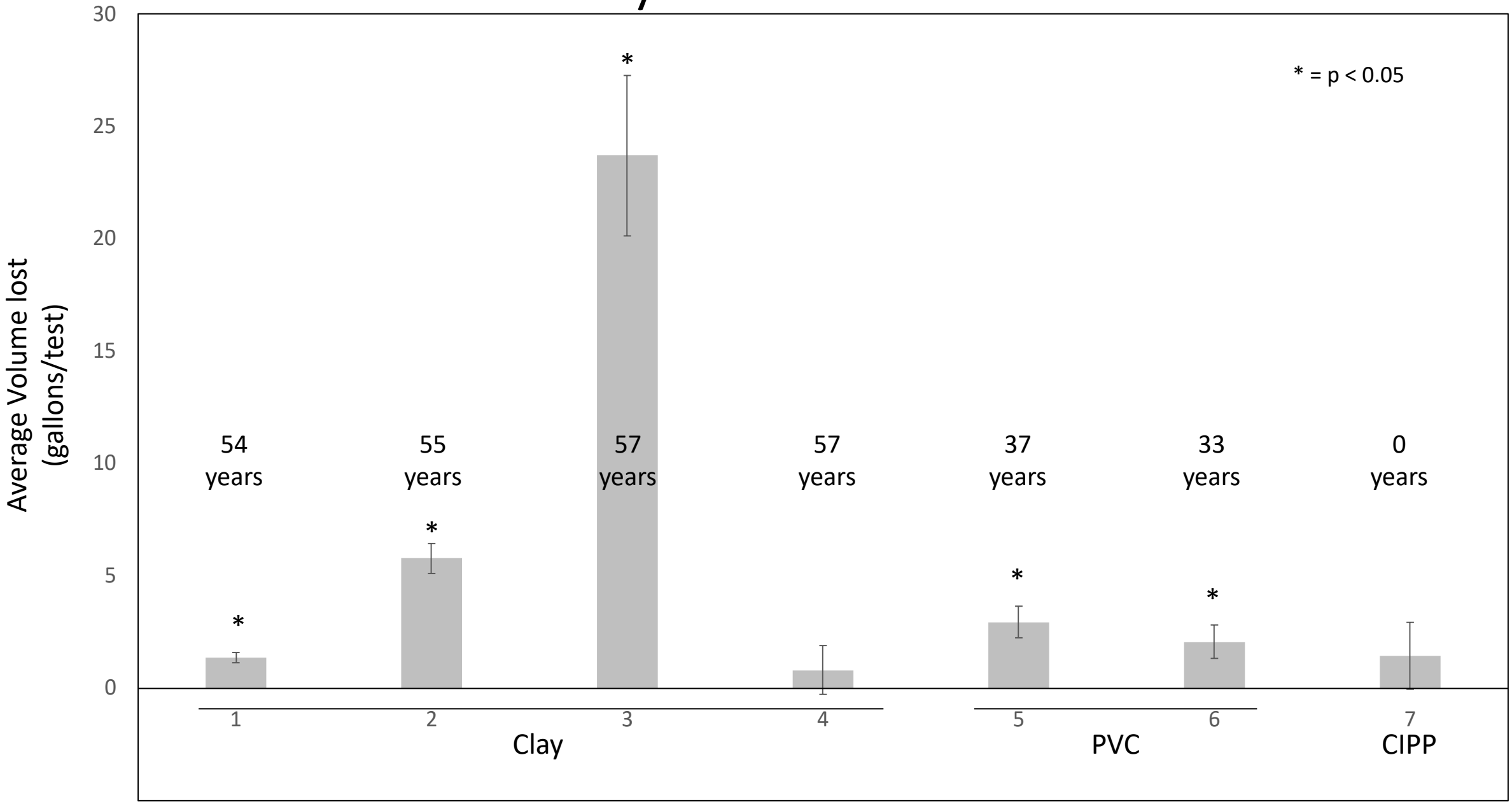

CleanHarbors
GAL. CAP. 3200
CA188448



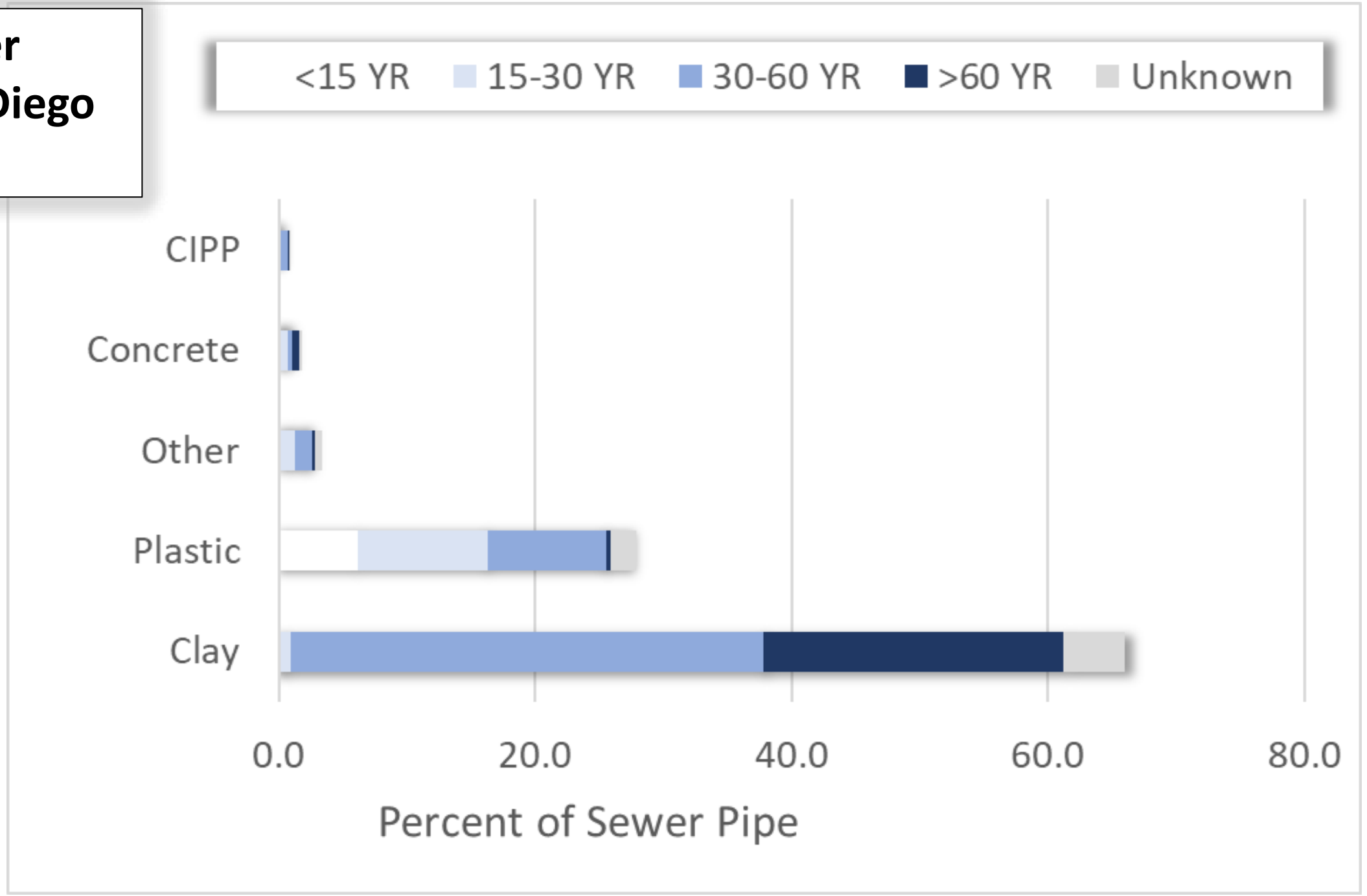
Exfiltration Risk Factors

- **Materials of construction (clay, concrete, plastic/PVC, Cured In Plan Pipe/CIPP)**
- **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

Exfiltration Preliminary Results



Lower San Diego River



Which Human Source?

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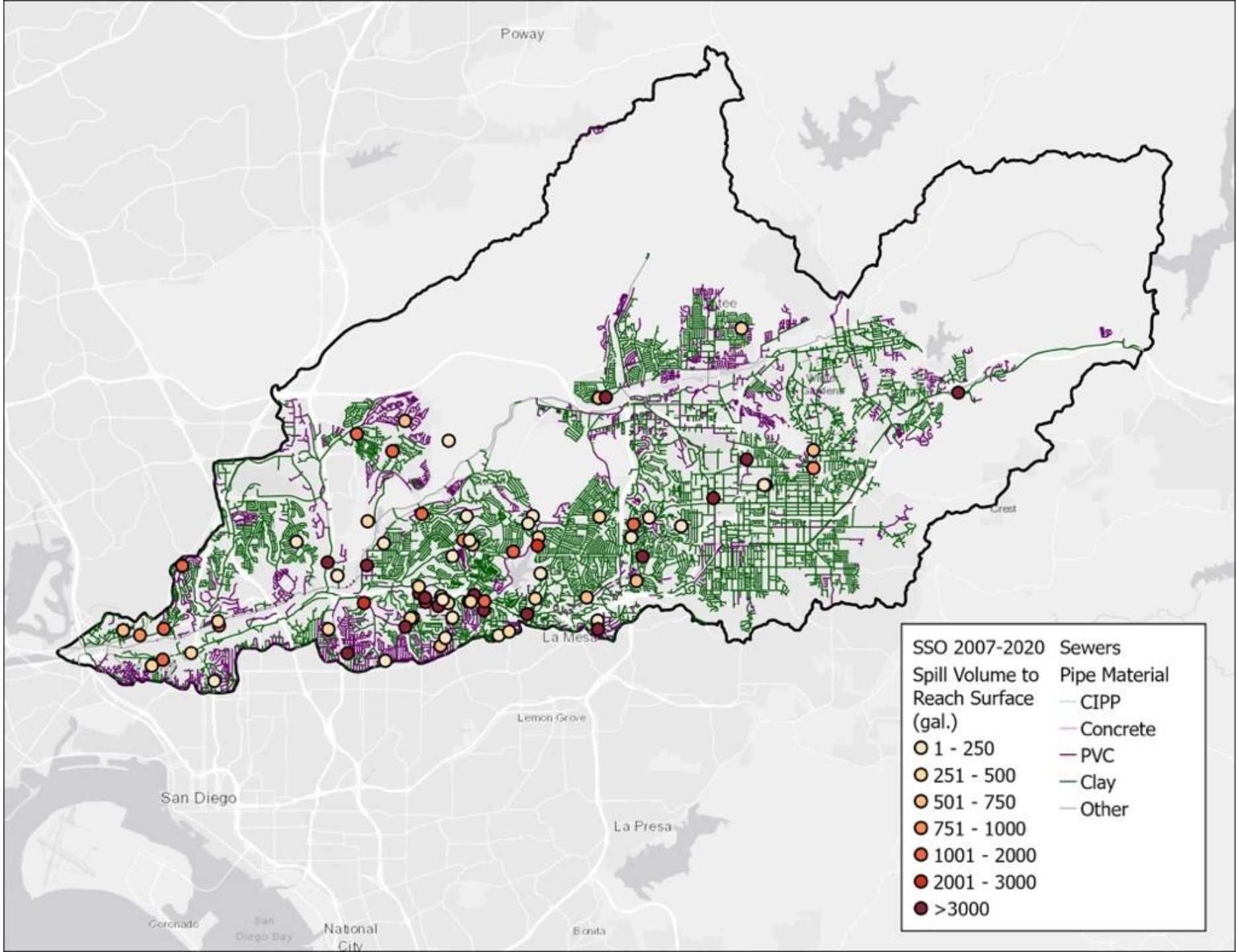
• Onsite Wastewater Treatment Systems (Septics)	**Completed**
• Sanitary sewer overflows	**Completed**
• Sewer Laterals	**Initiating now**
• Homeless Populations	**Completed**
• Illicit Connections/Illegal Discharges	**Completed**

Three Approaches for Estimating SSO Contributions

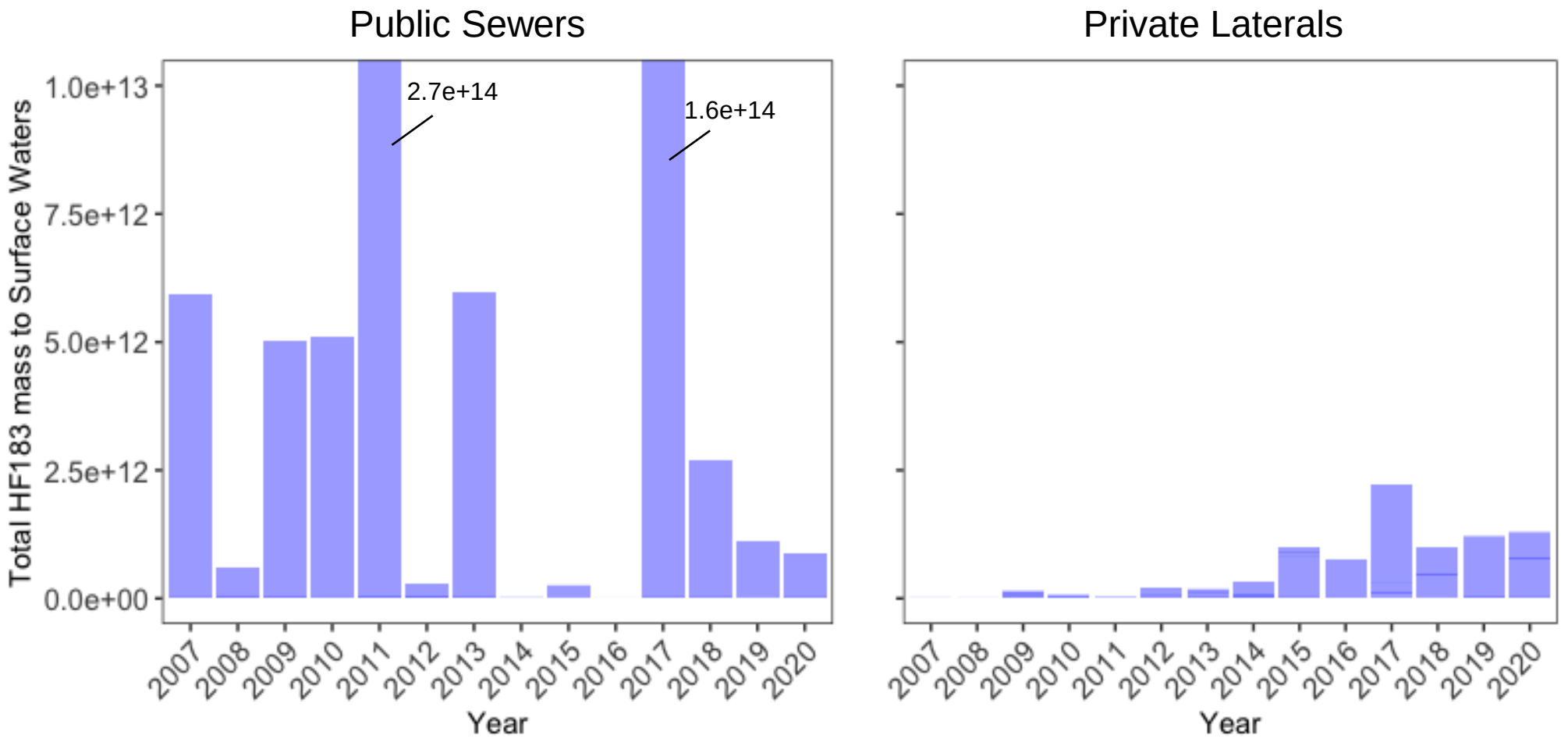
- Review State's SSO database for mass estimates from reported spills
- Review existing water level from the collection system operators for the potential of SSOs
- Deploy new water level sensors to fill any data gaps

Summary from State's SSO Database

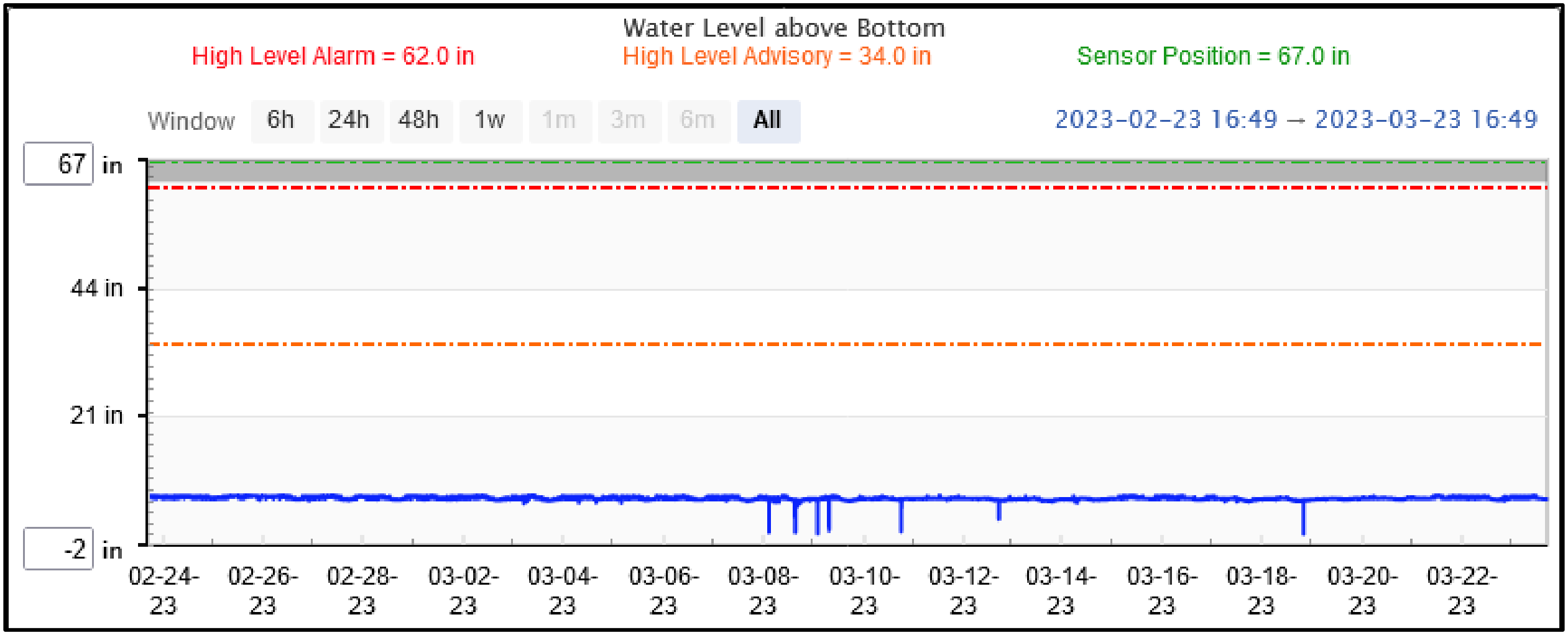
- Averaging roughly 42 sanitary sewer overflow events per year in the lower watershed for the last 14 years
- Mass of HF183 from public sewer SSOs has been decreasing over time, punctuated by sporadic large spills
- Mass of HF183 from private sewer SSOs has been increasing over time, approaching annual volume of public sewers
- General tendency for SSOs to occur in older, clay pipes


Poway
La Mesa
Lemon Grove
San Diego
La Presa
Coronado
National City
Bonita
SSO 2007-2020
Spill Volume to Reach Surface (gal.)
1 - 250
251 - 500
501 - 750
751 - 1000
1001 - 2000
2001 - 3000
>3000
Sewers
Pipe Material
CIPP
Concrete
PVC
Clay
Other

Total mass of HF183 reaching surface waters



Independent Water Level Sensor Results



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Questions About the Impact of Homelessness on Water Quality

- How many people experiencing homelessness are unsheltered and living along the river corridor?
- What are the sanitation habits of the unsheltered people experiencing homelessness?
- What is the human fecal pollution loading from the unsheltered population?

Answers About the Impact of Homelessness on Water Quality

- How many people experiencing homelessness are unsheltered and living along the river corridor?

  Roughly 100 - 350

- What are the sanitation habits of the unsheltered people experiencing homelessness?

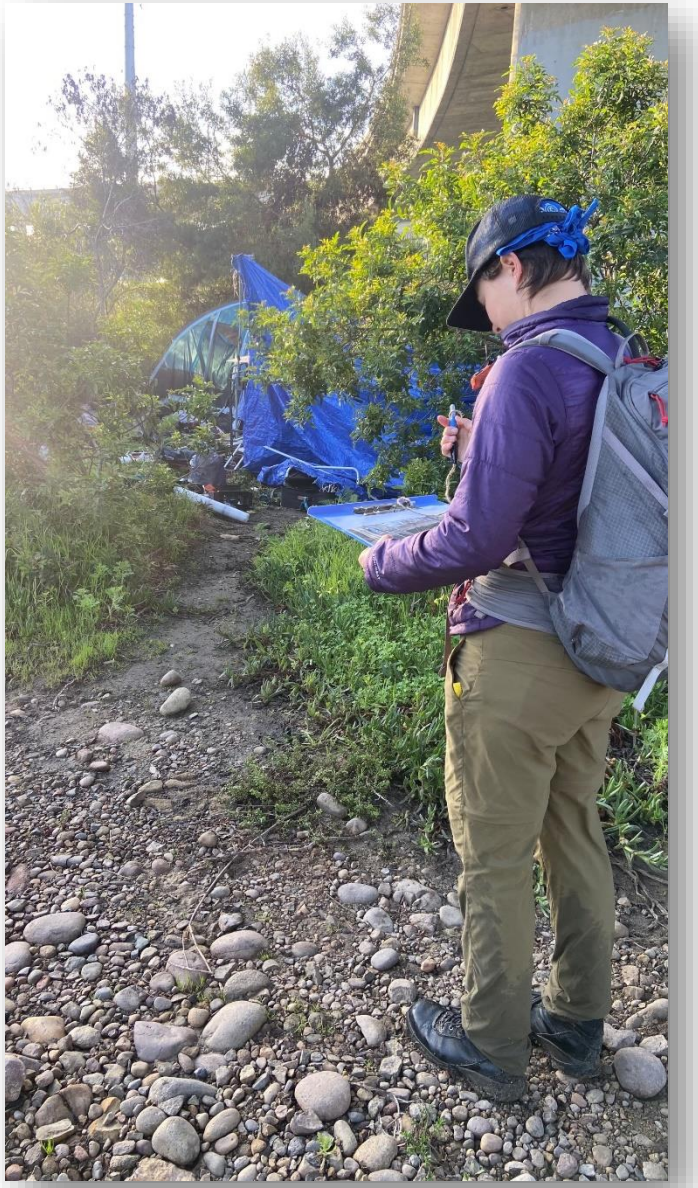
  Most defecate outdoors but the majority report containing their feces

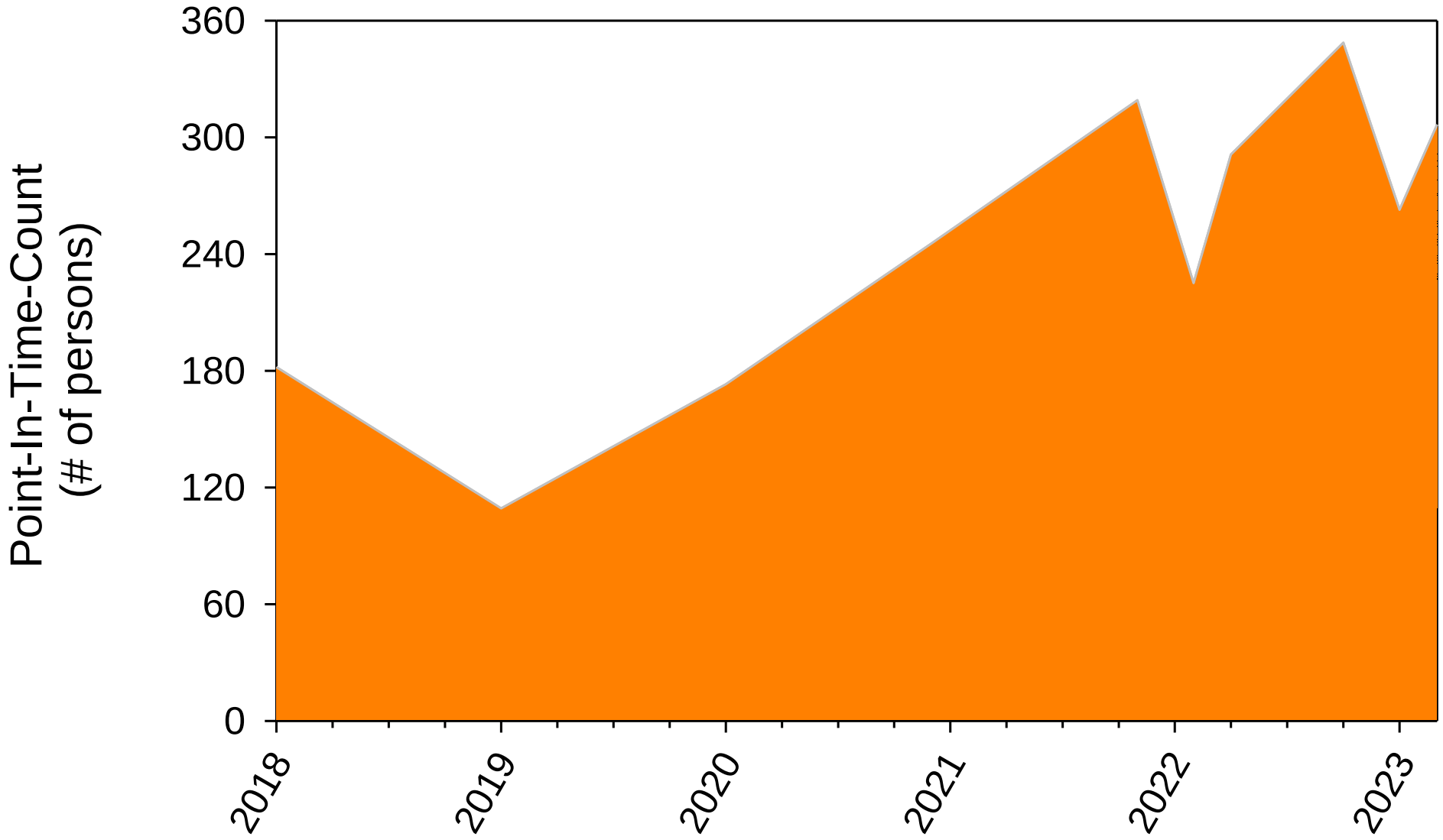
- What is the human fecal pollution loading from the unsheltered population?

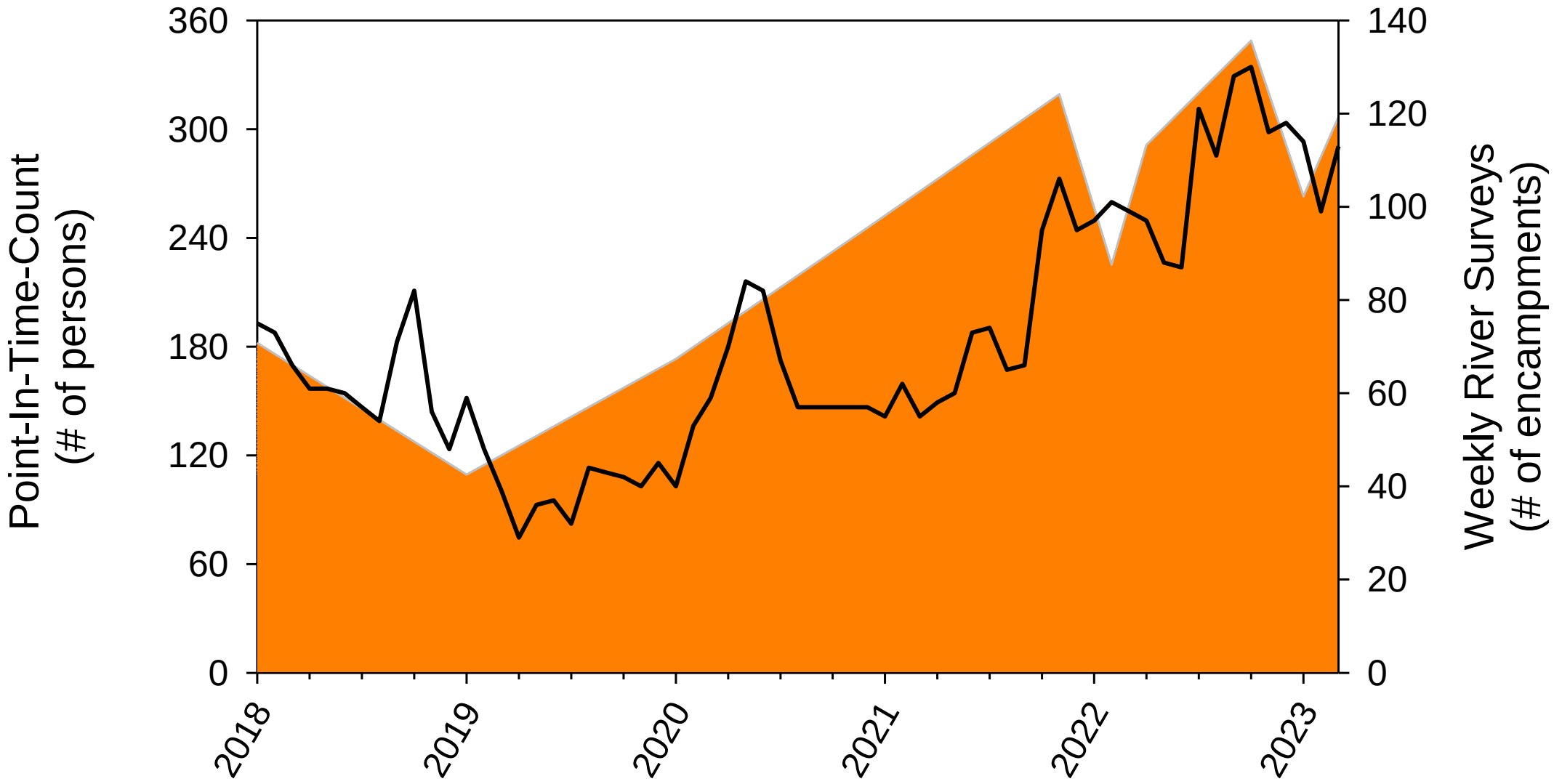
  A small fraction of what is measured at the end of the watershed

Census and Survey of People Experiencing Homelessness

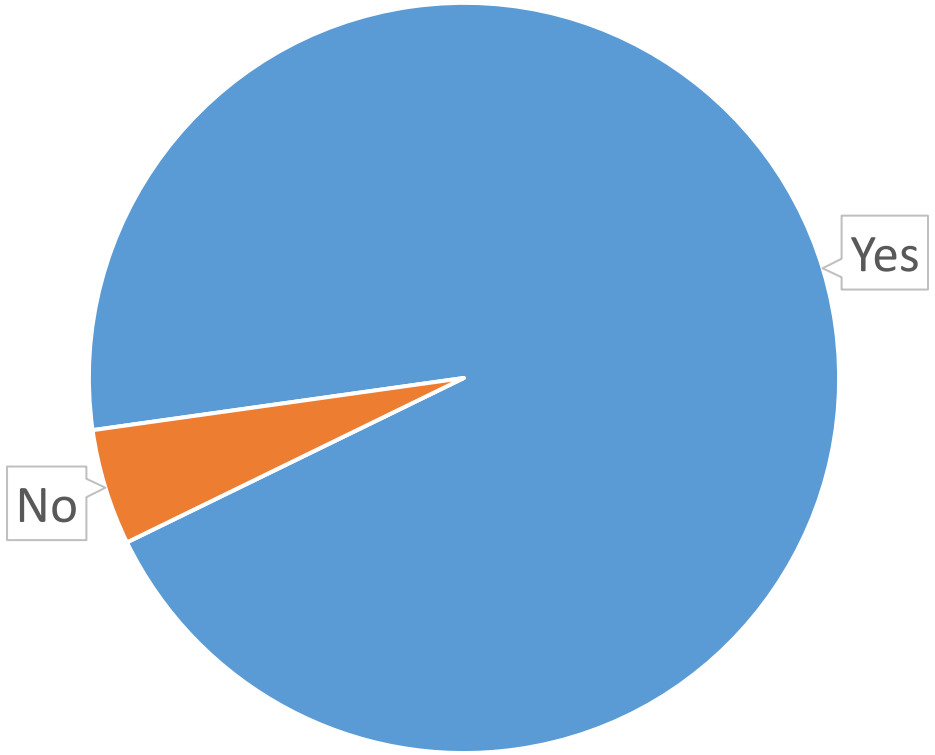
- Focused on the riverbed
- Eight “Point-in-Time” census over a five-year period, focused on winter
  - Matched with weekly walking surveys counting encampments
- 10-question survey about sanitation habits
  - Collected during the winter



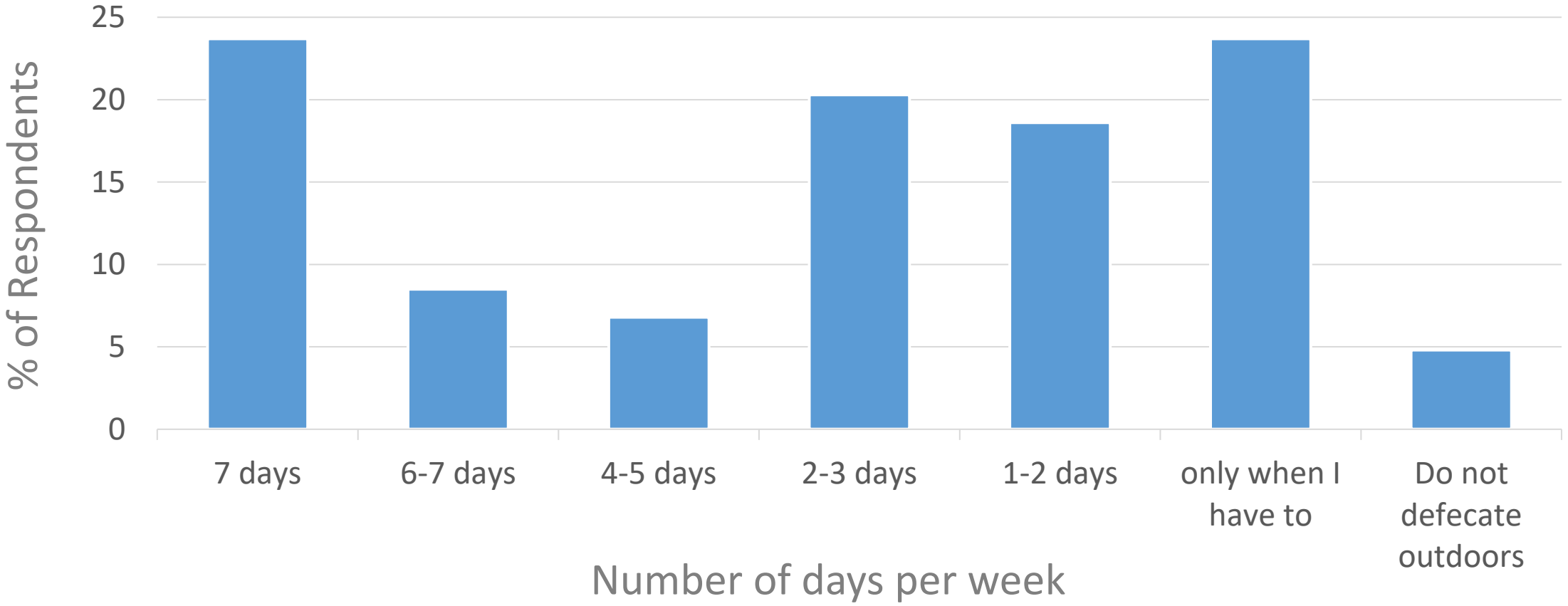

Point-In-Time-Count
(# of persons)
360
300
240
180
120
60
0
2018
2019
2020
2021
2022
2023


Point-In-Time-Count
(# of persons)
360
300
240
180
120
60
0
Weekly River Surveys
(# of encampments)
140
120
100
80
60
40
20
0
2018
2019
2020
2021
2022
2023

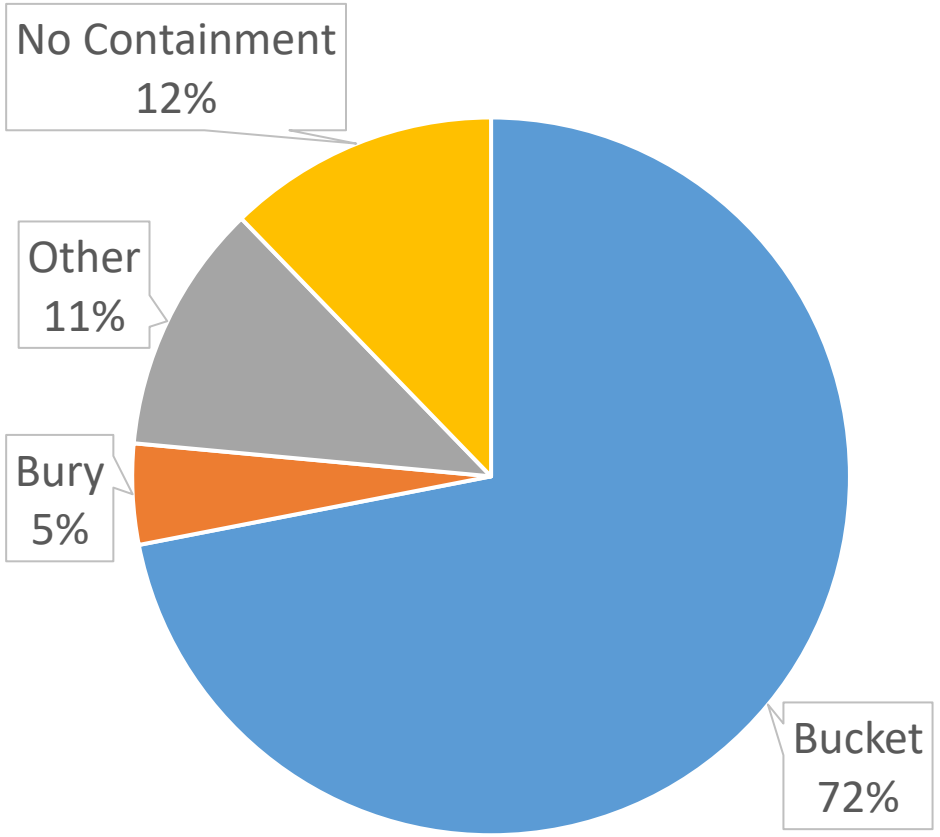
Do you or someone you know defecate outdoors? (N=63)



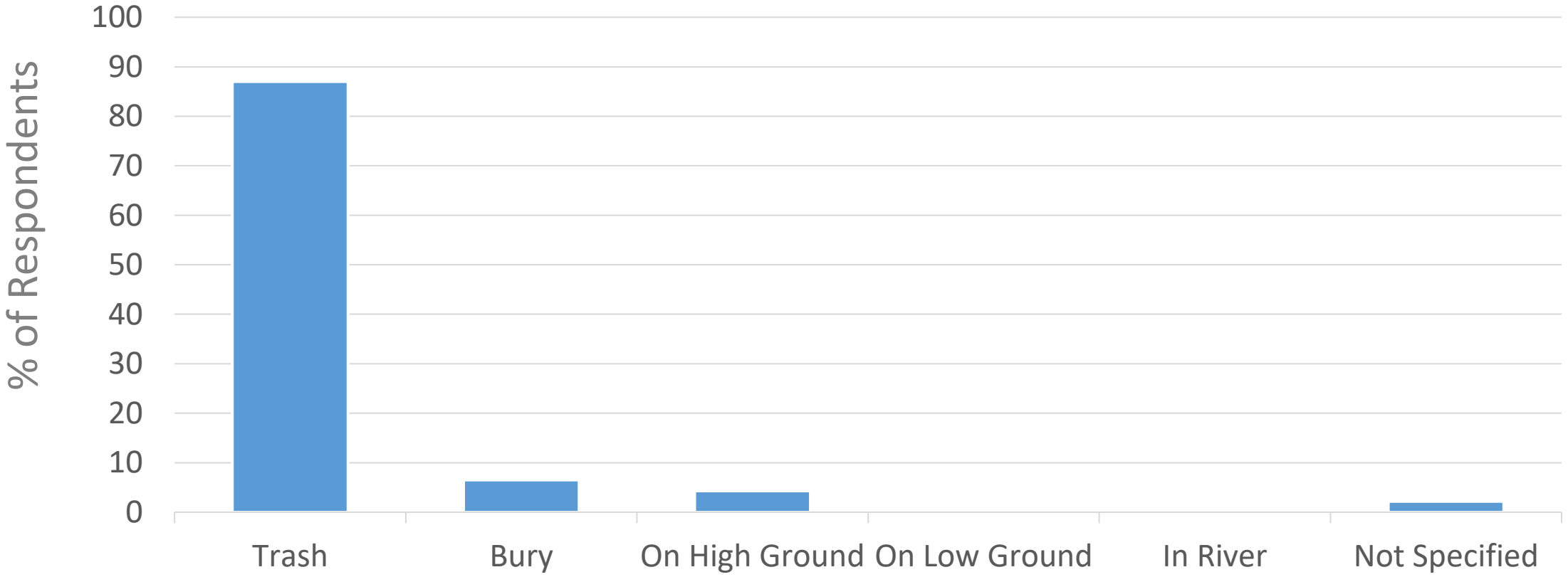
What is your frequency of outdoor defecation? (N=63)



Do you contain your outdoor defecation? (N=63)



Where do you dispose your container of feces? (N=49)



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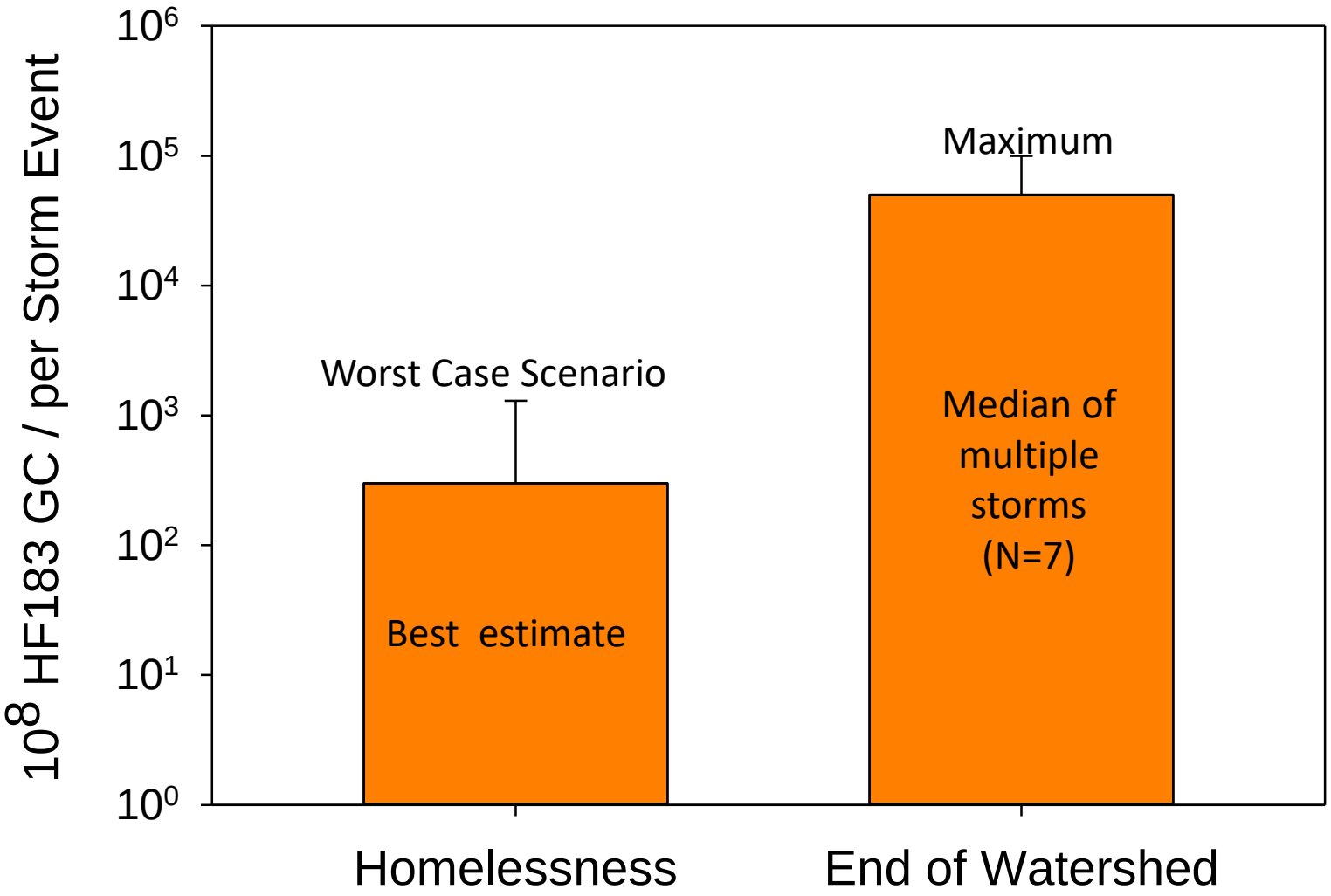
Calculating Mass of Human Fecal Loading

- Estimate HF183 on a storm-by-storm basis
- Factor number of people, frequency of defecation, containment, microbial decay
  - Mass of poop per person and HF183 per gram of poop from literature
  - Sensitivity analysis to see which factor is the most important
- Compare to the end of the watershed measurements

Mass Loading from Homeless is <1% of Remaining Watershed



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What’s Left To Do?

- Finish Exfiltration sampling and estimate HF183 loading
- Complete the private lateral assessment
- Keep up on our documentation
- Synthesis of sources
- Technical Review Committee