# PWD 2019 Bacteria Monitoring

## DRBC Water Quality Advisory Committee, April 2020

Presented to an advisory committee of the DRBC on April 30, 2020.
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# OVERVIEW

1. Pre-2019 Monitoring
2. PWD 2019 Monitoring Locations & Methods
3. Results & Discussion Topics

# Pre-2019 Bacteria Monitoring

- **DRBC Boat Run (1967 – Present)**
- **PWD / EPA Boat Run 2011-2015**
- **Most Samples from Center Channel**

# Pre-2019 Bacteria Monitoring

- **WQAC presentation 7/18/2018 suggested primary contact recreation may be supported in zones 3 & upper zone 4**
- **PWD analysis suggested only secondary contact may be supported; assessment ultimately depends on spatial and temporal aggregation of data**
- **Insufficient data from shore recreation areas and during local wet weather events**
- **Right-censored data (*i.e.*, “>” greater than) can result in underestimate of water quality conditions**

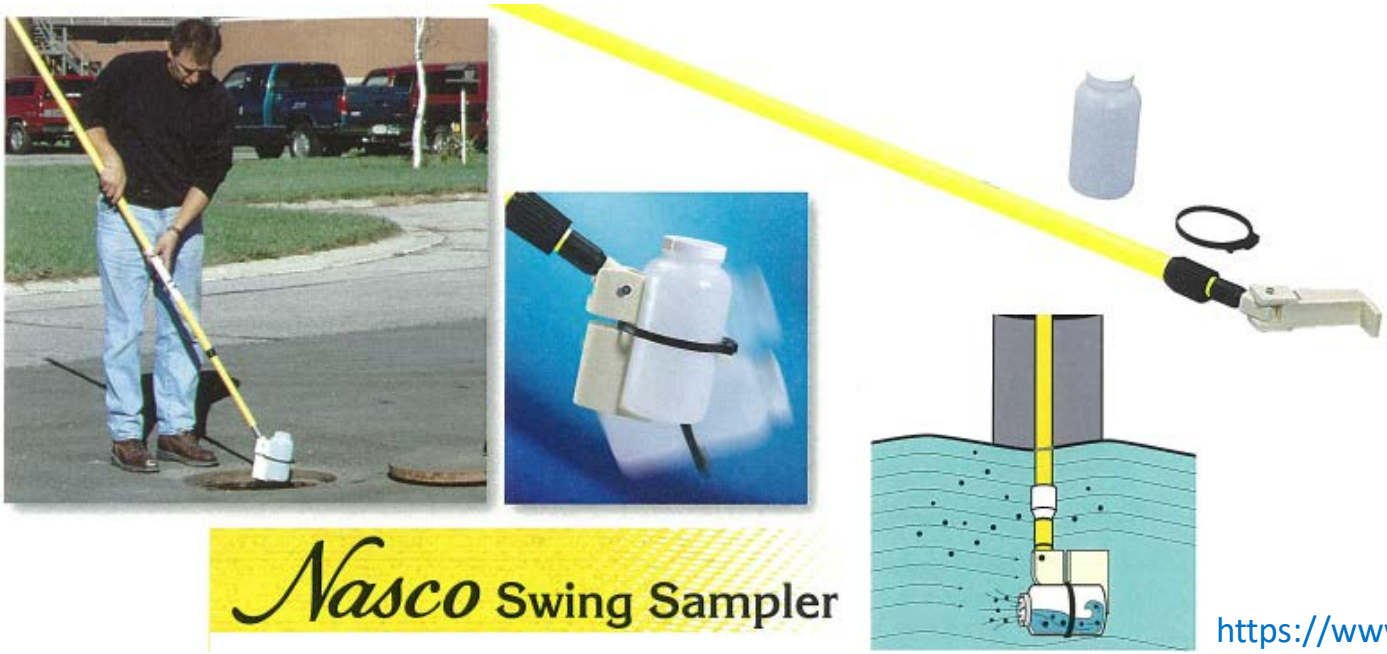
# PWD 2019 Bacteria Monitoring

- Monitoring Plan & Locations
- Analysis Methods

Mention of trade names or commercial products does not constitute PWD endorsement or recommendation for use

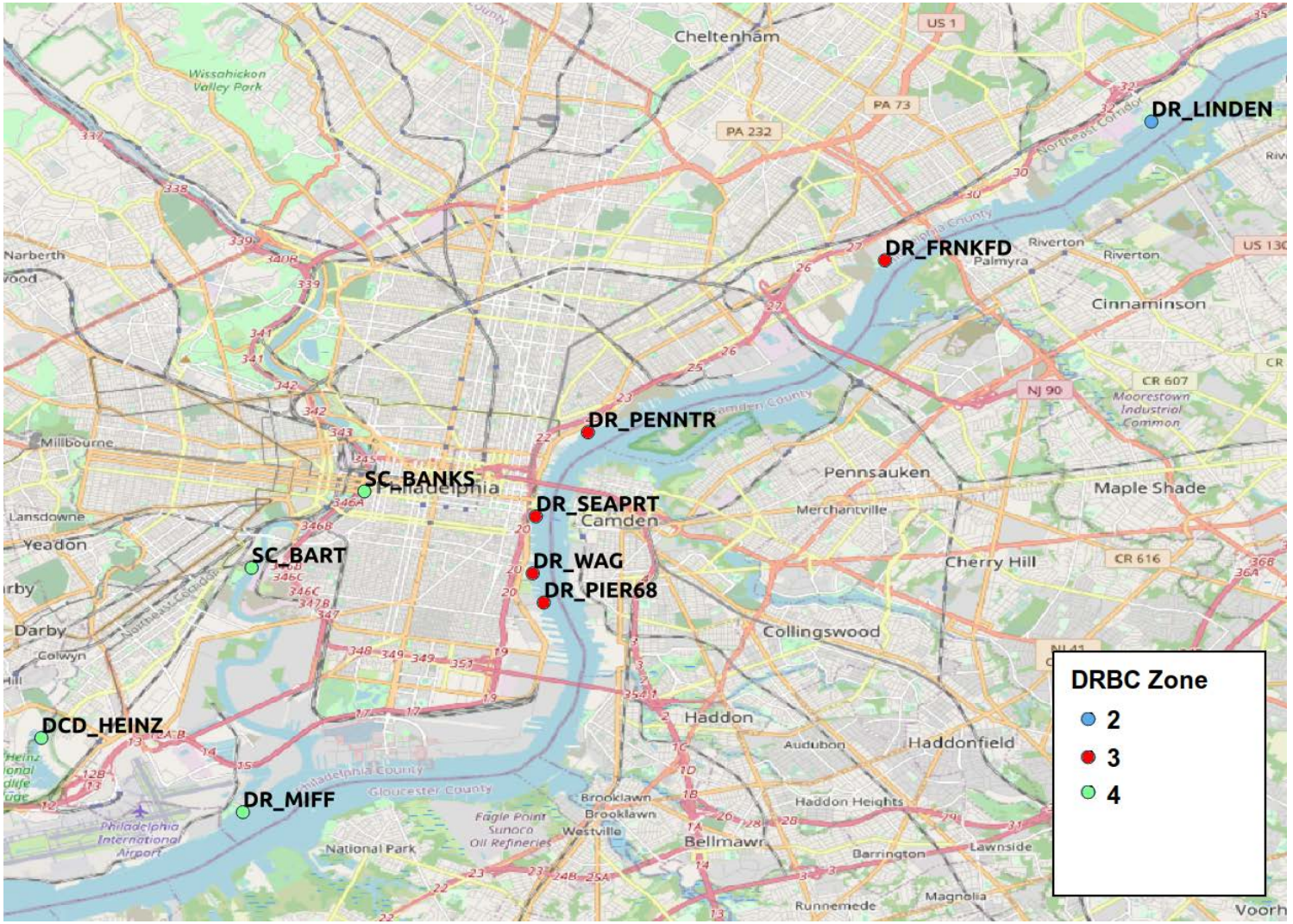
# PWD 2019 Bacteria Monitoring

- **Collect representative data from shore recreation areas under a variety of weather and water quality conditions**
- **Sample dates pre-selected ~2 mo. in advance**
- **Samples collected Mon-Thurs using sampling pole**




https://www.enasco.com

# PWD 2019 Bacteria Monitoring Locations



# PWD 2019 Bacteria Monitoring Locations

| Loc_ID | RM | Location Description | DRBC Zone |
|---|---|---|---|
| SC_BANKS | 6.9 | Schuylkill River at Schuylkill Banks | 4 |
| SC_BART | 4.95 | Schuylkill River at Bartram's Garden | 4 |
| DCD_HEINZ | 4.54 | Darby Creek at Heinz Wildlife Refuge Canoe Launch | 4 |
| DR_MIFF | 91.5 | Delaware River at Ft. Mifflin | 4 |
| DR_PIER68 | 98.1 | Delaware River at Pier 68 | 3 |
| DR_WAG | 98.6 | Delaware River at Washington Ave. Green | 3 |
| DR_SEAPRT | 99.5 | Delaware River at Independence Seaport Museum | 3 |
| DR_PENNTR | 101 | Delaware River at Penn Treaty Park | 3 |
| DR_FRNKFD | 106.5 | Delaware River at Frankford Boat Launch | 3 |
| DR_LINDEN | 110.7 | Delaware River at Linden Ave. Boat Launch | 2 |

# PWD 2019 Bacteria Analysis Methods

- **PWD Bureau of Laboratory Services Aquatic Biology Lab**
  - PADEP-accredited lab for microbial methods
  - 2019 processed 15,078 samples, 40,892 tests
  - Range 15,000-17,000 and 40,000-45,000
- **IDEXX Quanti-Tray/2000 Methods for Surface Water Samples**
  - Enterolert - *Enterococcus*
  - Colilert-18 - *E. coli* and fecal coliforms
- **Most Probable Number (MPN) lookup table based on 97 wells (49 large, 48 small)**
- **Samples run at 10X dilution when contamination is suspected**
  - 1X (no dilution) up to 2,400 MPN/100mL
  - 10X dilution up to 24,000 MPN/100mL

# PWD 2019 Bacteria Monitoring Results

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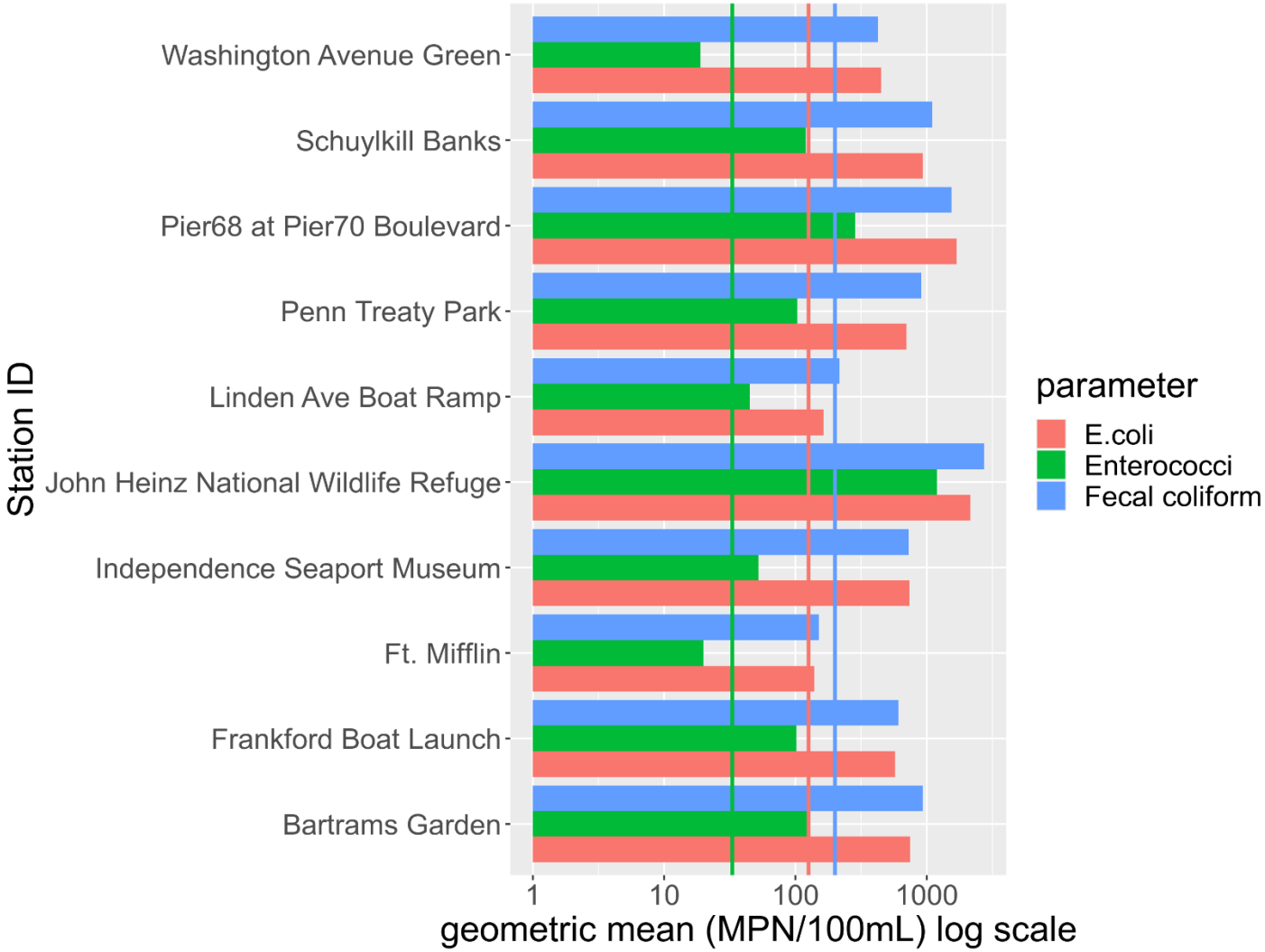
- **Geometric means calculated by site and by zone for 5 sample weeks during recreation season**
- **Results compared to water quality standards and reference values**
- ***E. coli*** **– USEPA 2012 RWQC (Recommendation # 1) 126CFU/100mL**
- ***Enterococcus*** **– DRBC Primary (33CFU/100mL) and Secondary (88CFU/100mL) Contact Recreation**
- **Fecal coliform – DRBC Primary (200 CFU/100mL) and Secondary (770 CFU/100mL) Contact Recreation**
- **Red – not meeting Secondary or Primary**
- **Blue – meeting Secondary; not meeting Primary**
- **Green – meeting Primary**

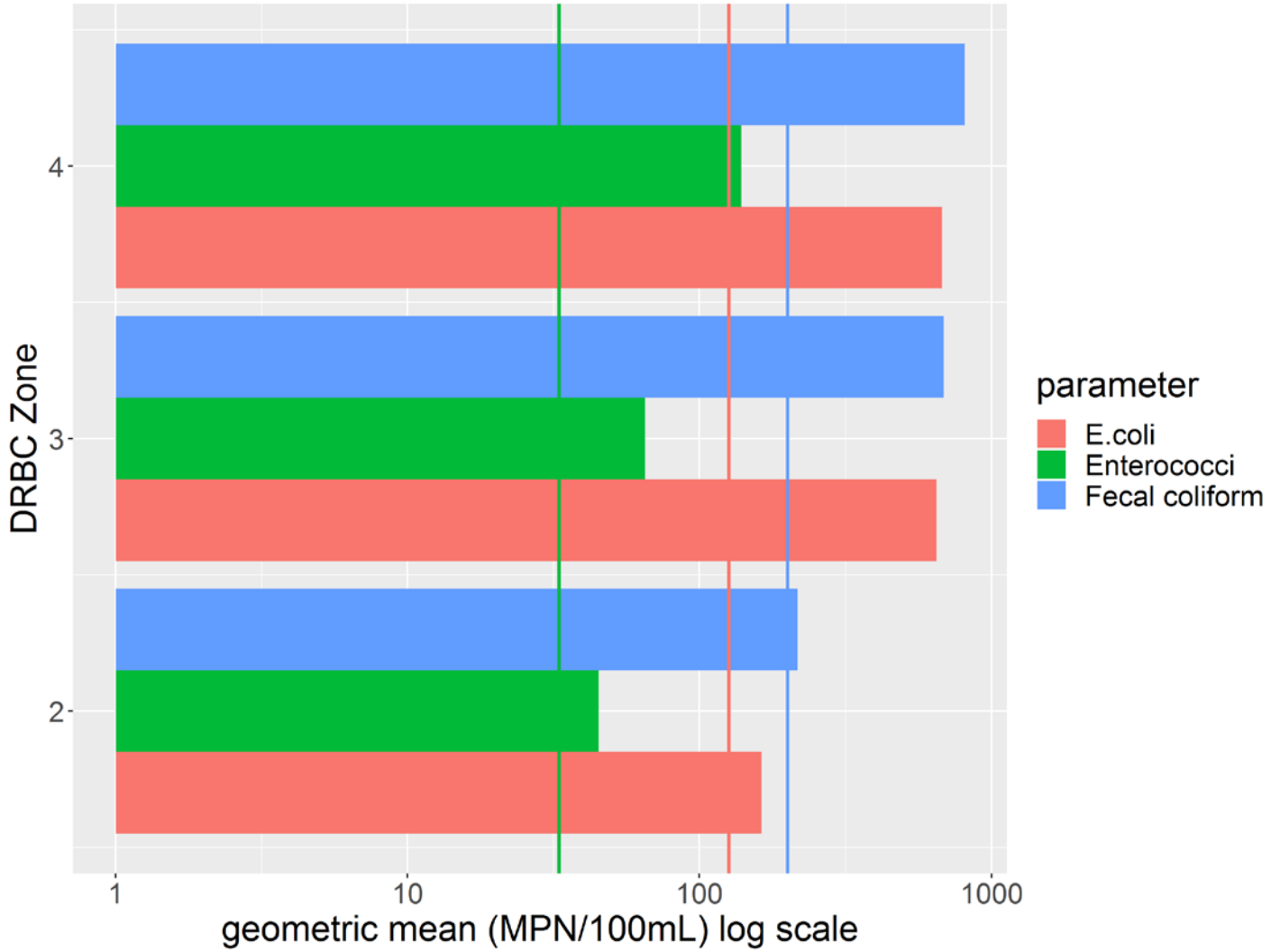
# PWD 2019 Bacteria Results Summary

| Location Description | n | *E. coli* | *Entero-coccus* | Fecal coliform |
|---|---|---|---|---|
| Schuylkill River at Schuylkill Banks | 20 | 935 | 120 | 1105 |
| Schuylkill River at Bartram's Garden | 20 | 744 | 130 | 932 |
| Darby Creek at Heinz Wildlife Refuge Canoe Launch | 20 | 2154 | 1198 | 2726 |
| Delaware River at Ft. Mifflin | 20 | 140 | 20 | 151 |
| Delaware River at Pier 68 | 4 | 1684 | 284 | 1543 |
| Delaware River at Washington Ave. Green | 16 | 452 | 19 | 423 |
| Delaware River at Independence Seaport Museum | 20 | 742 | 52 | 731 |
| Delaware River at Penn Treaty Park | 20 | 704 | 103 | 907 |
| Delaware River at Frankford Boat Launch | 20 | 574 | 102 | 610 |
| Delaware River at Linden Ave. Boat Launch | 20 | 163 | 45 | 216 |

# PWD 2019 Bacteria Results by Station



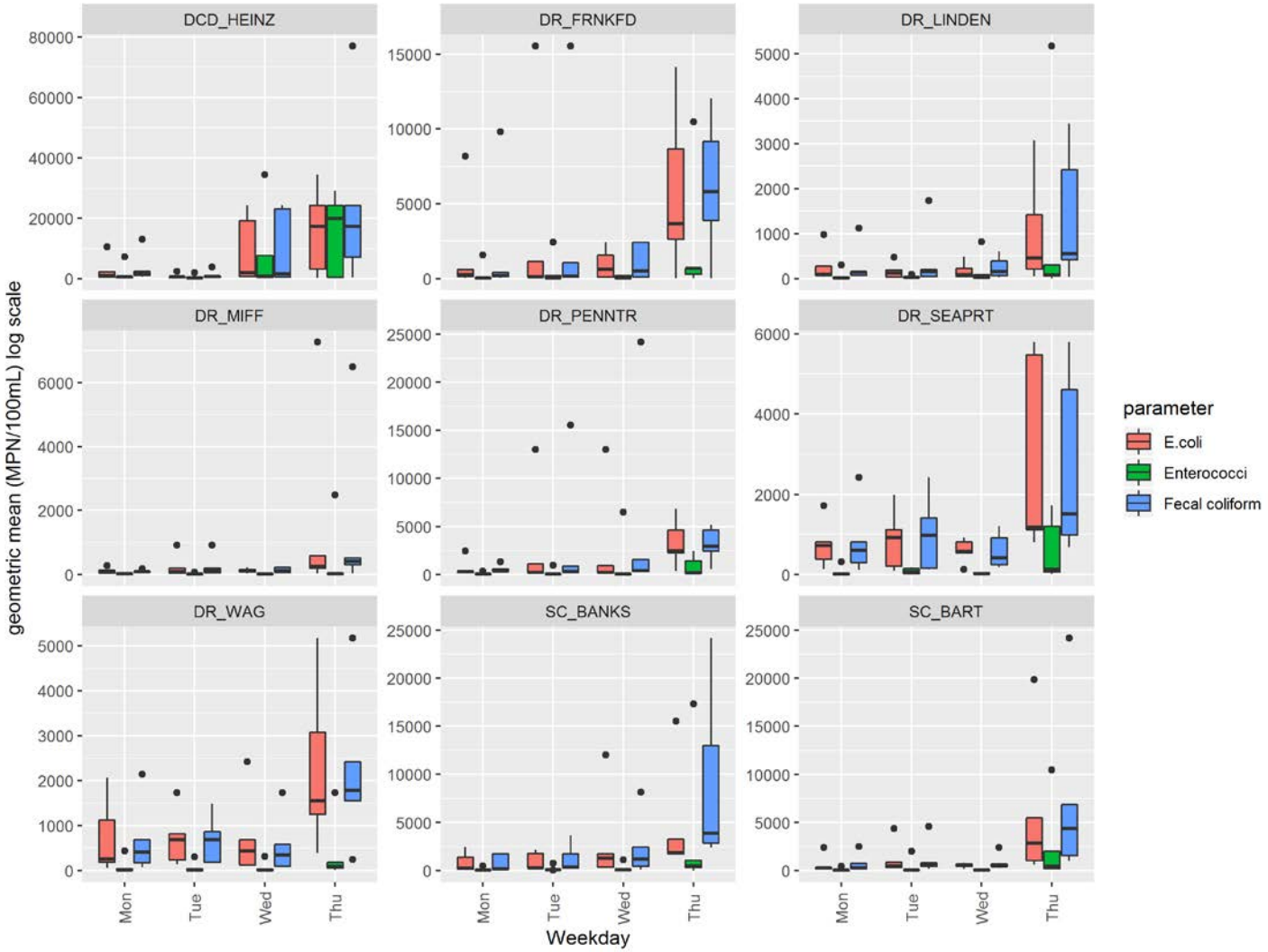
# PWD 2019 Bacteria Results by Zone



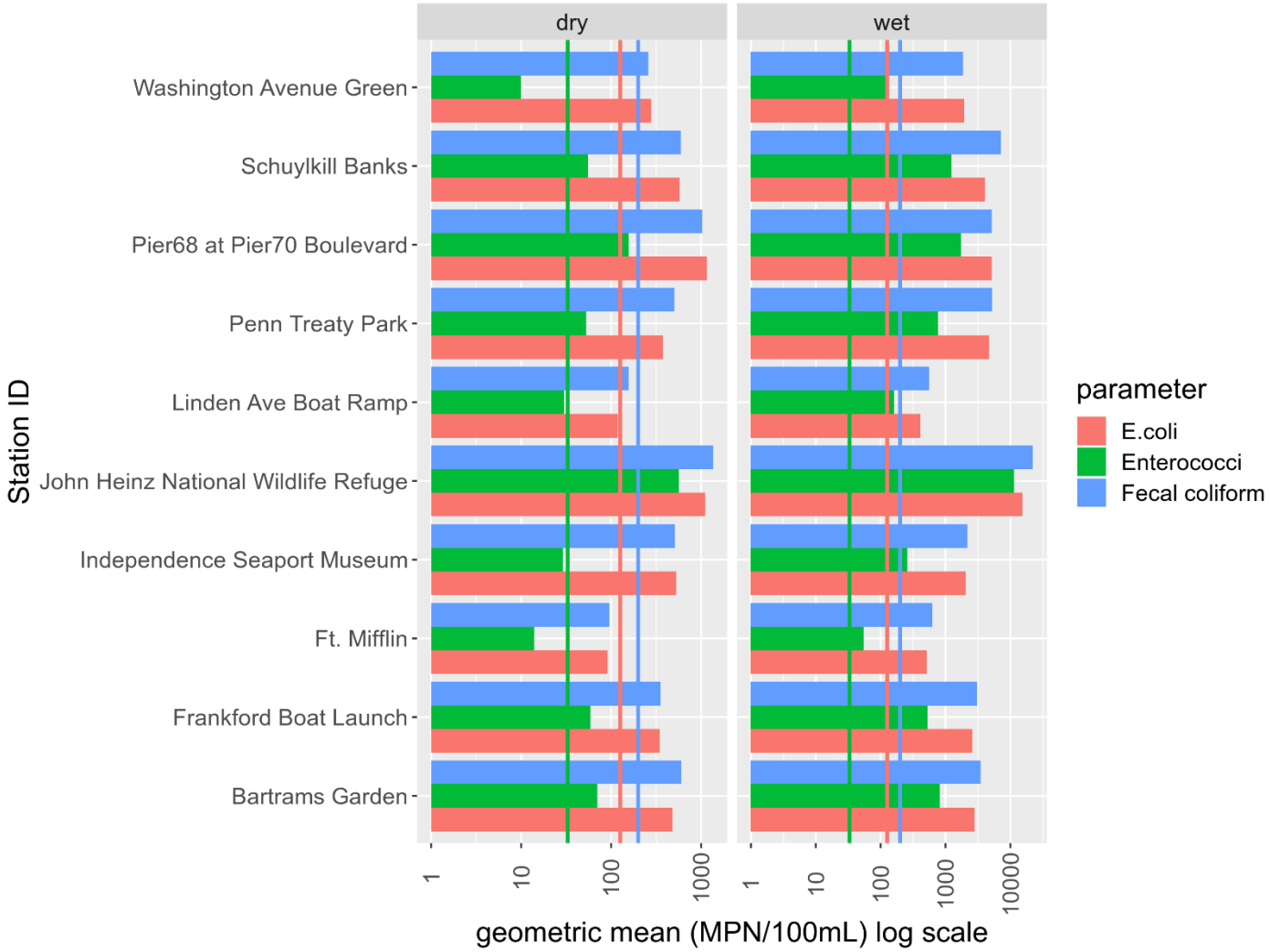
# PWD 2019 Bacteria Wet/Dry by Station

- **Samples flagged as wet or dry using qualitative procedure with daily precipitation and USGS gage stream discharge**
- **Five of 20 samples flagged as wet weather**
  - 6/20/2019
  - 7/18/2019
  - 8/14/2019
  - 8/15/2019
  - 8/22/2019
- **Other flagging procedures are possible**

# PWD 2019 Bacteria Results by Weekday



# PWD 2019 Bacteria Wet/Dry by Station



# Bacteria Monitoring Discussion

- ***E. coli* results often exceeded fecal coliform result for same sample**
- **Right censored (“>” greater than) bacteria data are common in boat run and shore data**
  - >24,196
  - >2,419.6
  - >1,600
  - >600
- **Four PWD samples right- censored (“>”) greater than 24,196 (3 @ Heinz Refuge, 1 @ Bartram’s Garden)**
- **19 PWD samples had MPN 2419.6, 73 results (14%) > 2419.6 would have been right-censored if not diluted 10X**

# Bacteria Monitoring Discussion

- **Relatively large within-zone differences in bacteria densities observed. Is spatial aggregation at the zone scale appropriate for recreation decisions?**
- **Calculation of statistics (*e.g.*, geometric mean) is problematic when large proportion of samples are right-censored (and progressively right censored)**
- **10X dilution appears necessary, at least for wet weather samples**
- **Strong dilution (*e.g.*, 100X) raises issue of sample aliquot representativeness**
- **Recreation decisions potentially confounded by three bacterial indicators**

# Thank you!

- Questions?