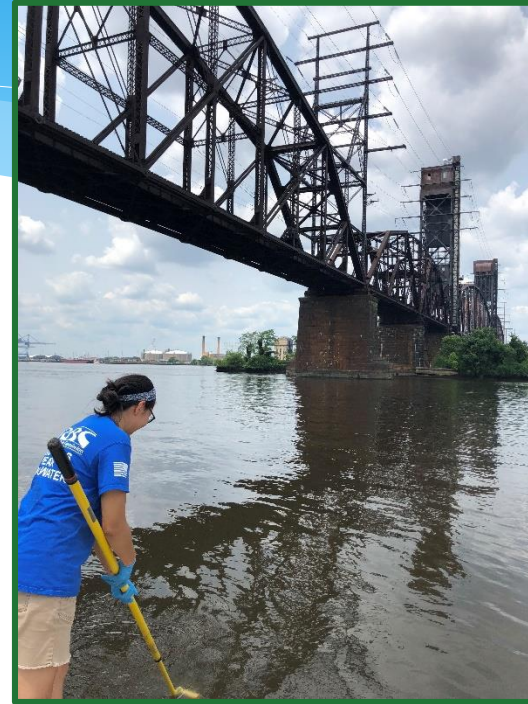


Delaware River Basin Commission

Recreation Uses in the Estuary 2019 Bacteria Sampling Results

John Yagecic, PE
Manager, Water Quality Assessment DRBC

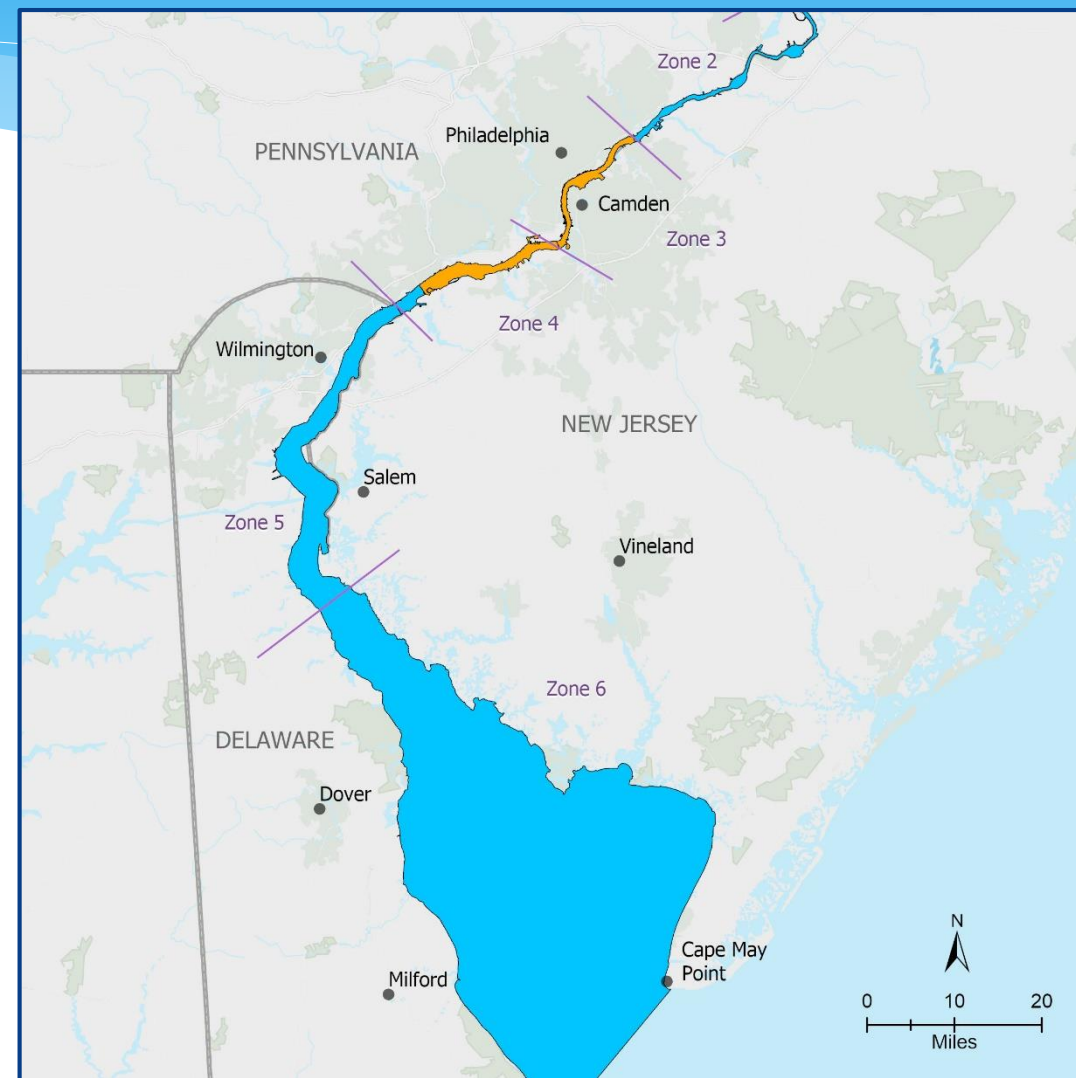
Presented to an advisory committee of the DRBC on April 30, 2020.
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Current Recreational Uses / Criteria in Delaware Estuary (DRBC WQ Regs)

Zone	Use	Fecal Coliform	Enterococcus
		Geometric mean colonies per 100 mL	
2	Recreation	200	33
3	Recreation – Secondary Contact	770	88
Upper 4			
Lower 4	Recreation	200	33
5			35
6			

<http://www.nj.gov/drbc/library/documents/WQregs.pdf>



DRBC Water Quality Regulations

Section 1.20.6

<http://www.nj.gov/drbc/library/documents/WQregs.pdf>

- F. "Recreation" includes all water-contact sports.
- G. "Recreation - secondary contact" restricts activities to where the probability of significant contact or water ingestion is minimal, encompassing but not limited to:
 - 1. boating,
 - 2. fishing,
 - 3. those other activities involving limited contact with surface waters incident to shoreline recreation.

EPA Office of Water 820-F-12-058

Table 1. Recommended 2012 RWQC.

Criteria Elements	Estimated Illness Rate (NGI): 36 per 1,000 primary contact recreators		OR	Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators	
	Magnitude			Magnitude	
Indicator	GM (cfu/100 mL) ^a	STV (cfu/100 mL) ^a		GM (cfu/100 mL) ^a	STV (cfu/100 mL) ^a
Enterococci – marine and fresh	35	130		30	110
OR					
<i>E. coli</i> – fresh	126	410		100	320
Duration and Frequency: The waterbody GM should not be greater than the selected GM magnitude in any 30-day interval. There should not be greater than a ten percent excursion frequency of the selected STV magnitude in the same 30-day interval.					

^a EPA recommends using EPA Method 1600 (U.S. EPA, 2002a) to measure culturable enterococci, or another equivalent method that measures culturable enterococci and using EPA Method 1603 (U.S. EPA, 2002b) to measure culturable *E. coli*, or any other equivalent method that measures culturable *E. coli*.

<https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf>

Existing DRBC Monitoring

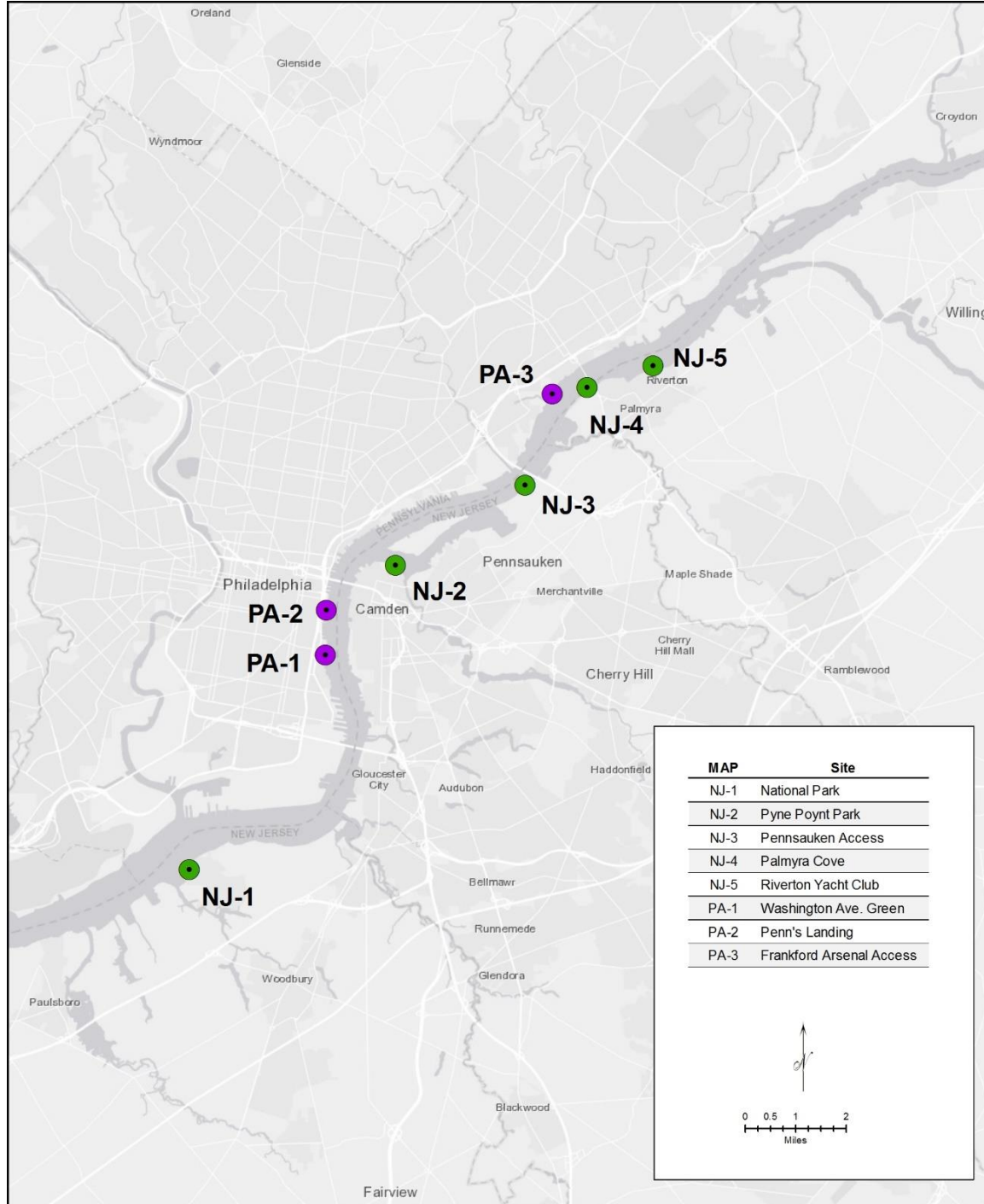
Delaware Estuary Water Quality Monitoring Program
Locations & DRBC Water Quality Zones



- DRBC's long-running (50+ year) monitoring program
- 1x per month
- Center channel
- Just below Trenton to just above Atlantic Ocean
- Bacteria results posted on DRBC website at <https://www.nj.gov/drbc/quality/datum/boat-run.html>

Sampling Site	River Mile	10/7/19 Enterococcus	10/7/19 Enterococcus Std.	10/7/19 Fecal Coliform	10/7/19 Fecal Coliform Std.
Trenton	131.04	137	33	160	200
Florence	122.4	20	33	83	200
Burlington Bristol Br.	117.8	14	33	59	200
Torresdale	110.7	6	33	35	200
Betsy Ross Br.	104.75	6	88	130	770
Benjamin Franklin Br.	100.2	4	88	93	770
Navy Yard	93.2	5	88	27	770
Paulsboro	87.9	11	88	47	770
Eddystone	84.0	5	88	54	770
Marcus Hook	78.1	33	35	400	200
Oldmans Pt.	74.9	37	35	140	200
Cherry Island	71	31	35	60	200
New Castle	66.0	20	35	49	200
Pea Patch Is.	60.6	6	35	51	200
Reedy Island	54.9	5	35	35	200
Liston Pt.	48.2	2	35	37	200
Smyrna River	44.0	5	35	12	200
Ship John Light	36.6	1	35	1	200
Mahon River	31.0	10	35	3	200
Elbow of Crossledge Shoal	22.75	ND	35	ND	200
South of Joe Flogger Shoal	16.5	ND	35	ND	200
South Brown Shoal	6.5	ND	35	ND	200

Monitoring Summer 2019

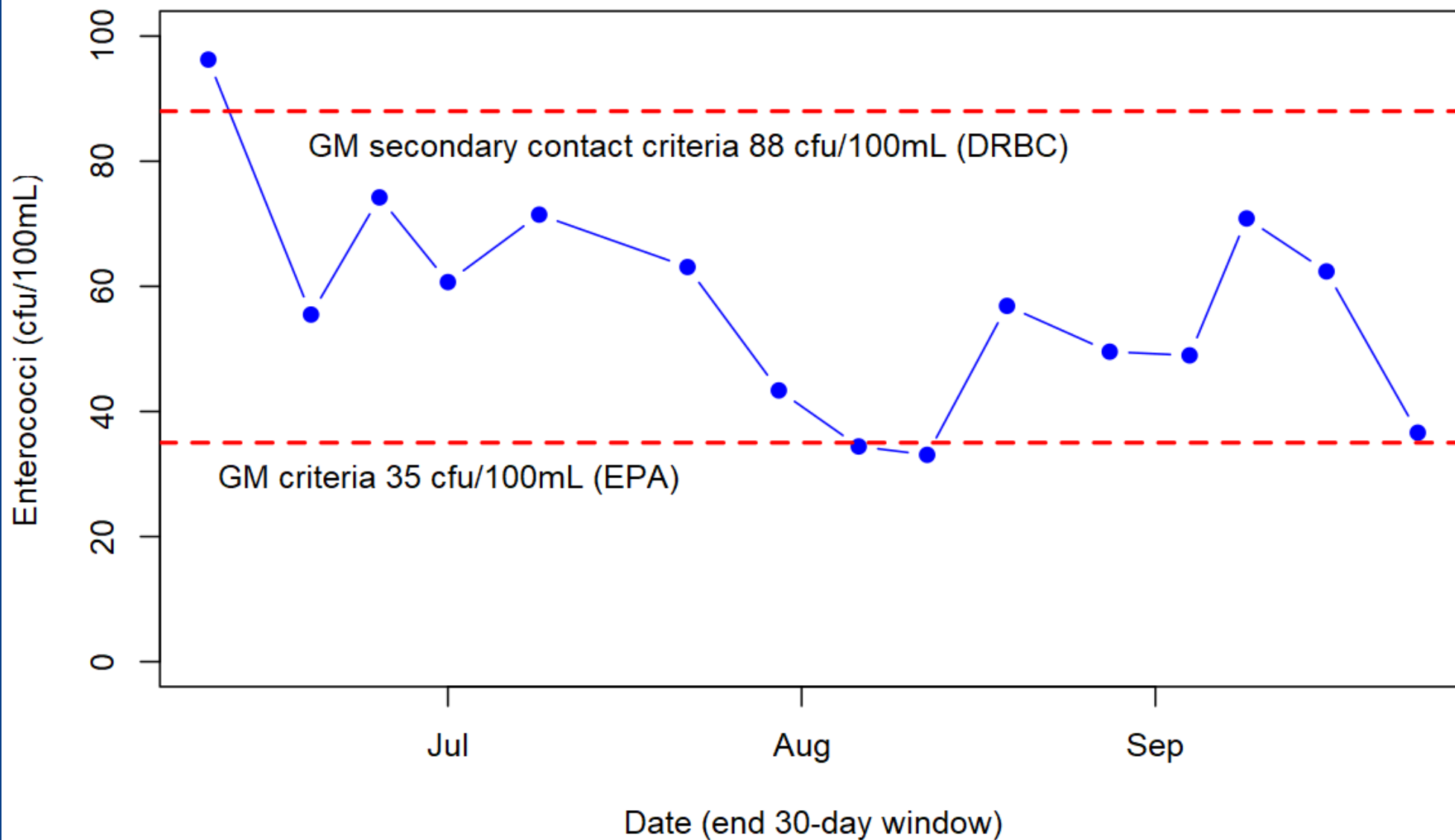


Shore-based, where recreation more likely
 ~ 5x per month, May - September
 Fecal coliform, enterococcus, E. coli

- Riverton Yacht Club
 - Palmyra Cove Nature Center
 - Pennsauken Access
 - Pyne Poynt Park
 - National Park
- } NJ

- Washington Ave. Green
 - Penns Landing Lagoon
 - Frankford Arsenal Boat Ramp
- } PA

Comparison of Delaware Estuary Enterococci to EPA Recommended Criteria, Geometric means



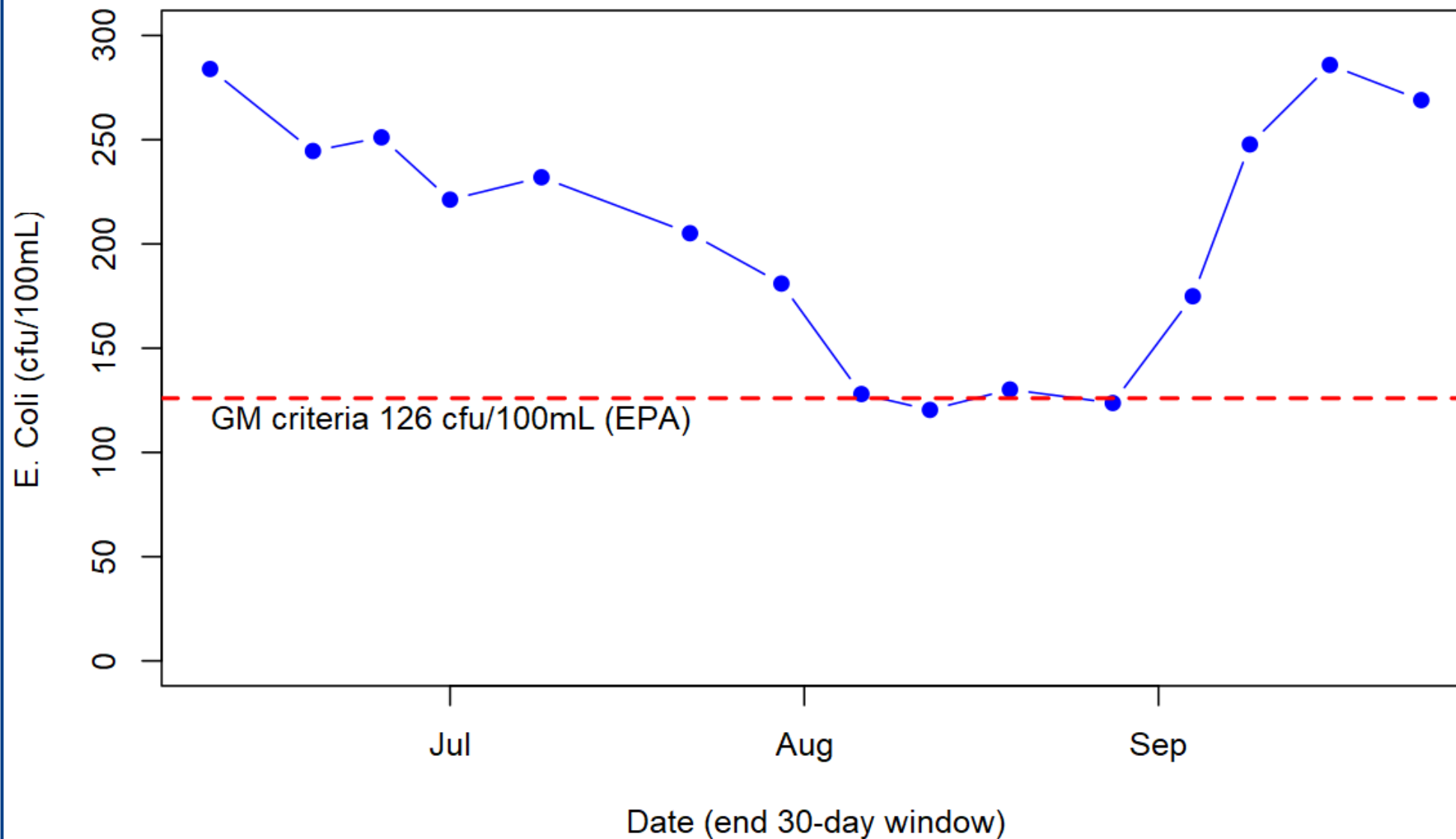
Geometric mean of all data points within sliding 30-day window

Site Specific Comparison to EPA Enterococci Criteria (35 cfu/100mL GM)

Date	NPK	WAG	PLL	PPP	PSA	FAA	PCN	RYC
6/10/2019	53.3	78.4	23	69	70.6	544.7	251.2	94.9
6/19/2019	33	61.3	11.6	64.3	21.9	349	189.1	41.4
6/25/2019	59	156.6	12.8	87.6	22.6	392.5	175	57.4
7/1/2019	81.4	227.4	15.4	91.8	14.2	129.6	100.8	38
7/9/2019	137.5	181.8	20.4	93.5	14.5	232.7	129.7	43.7
7/22/2019	119.5	50.5	13.9	88.1	16.5	245.2	103.1	105.3
7/30/2019	46.1	27.3	11.8	119.8	11.8	140	91.3	66.1
8/6/2019	27.9	30.9	20.7	167.4	11.5	96.3	36.1	27.5
8/12/2019	31.8	40.1	18.7	132.5	22.4	70.3	18	20
8/19/2019	53.4	83.5	53.8	215	26.1	168.1	26.9	20.7
8/28/2019	44.8	142.9	52.7	205.1	19.6	93.7	21.9	14.1
9/4/2019	83.7	129.8	45.2	99.3	20.8	107.3	22.3	18.7
9/9/2019	307.9	109.1	27.7	87	31.2	154.2	58.2	52.1
9/16/2019	135.6	87.2	26.1	100.5	26.5	127.7	61.6	71.1
9/24/2019	55.5	32.4	11.9	48.8	31.1	56.4	47.1	74.8

NPK	National Park
WAG	Washington Ave. Green
PLL	Penns Landing Lagoon
PTP	Penn Treaty Park
PPP	Pyne Poynt Park
PSA	Pennsauken Access
FAA	Frankford Arsenal Access
PCN	Palmyra Cove
RYC	Riverton Yacht Club

Comparison of Delaware Estuary E. Coli to EPA Recommended Criteria, Geometric means



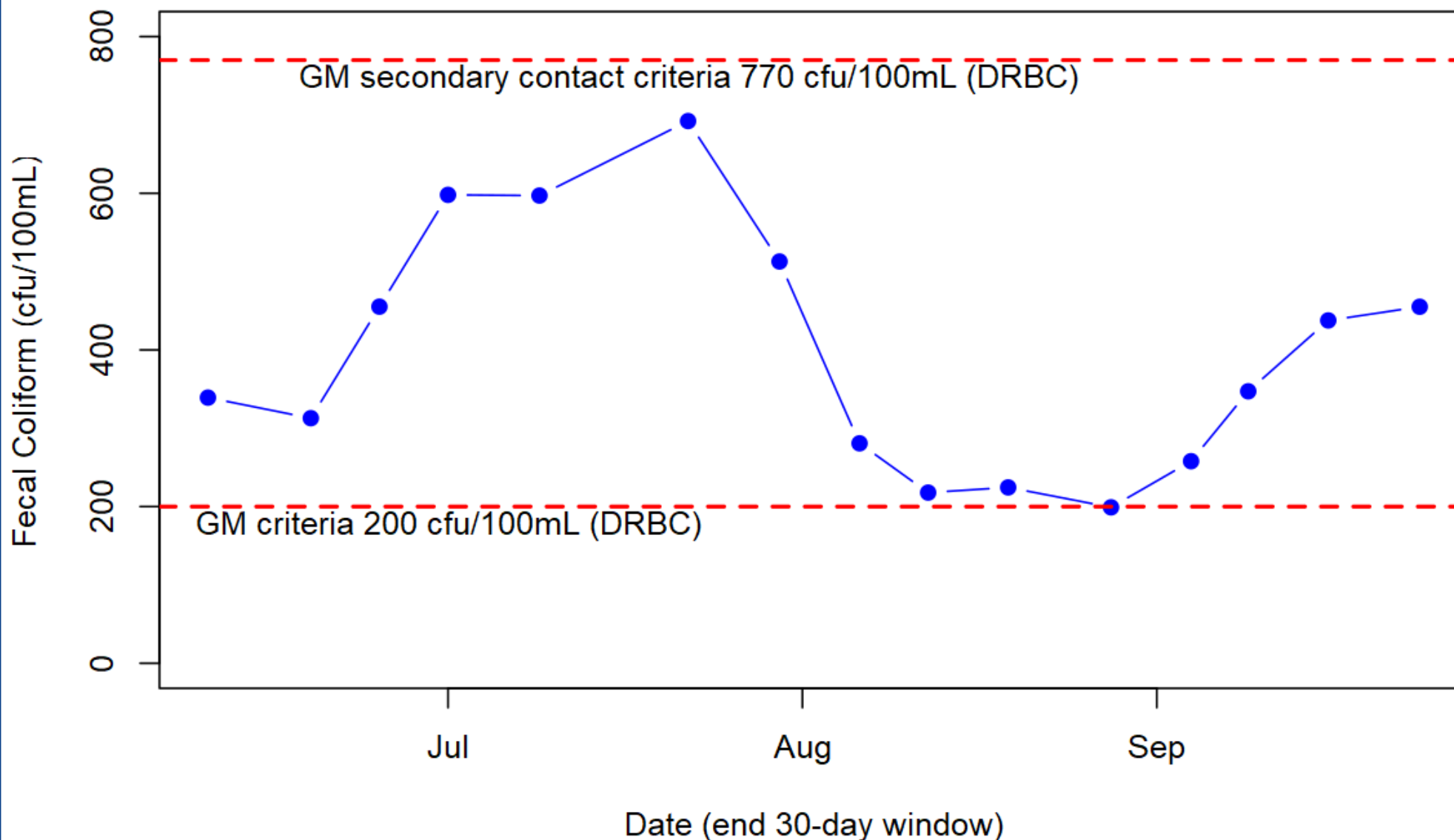
Geometric mean of all data points within sliding 30-day window

Site Specific Comparison to EPA E. Coli Criteria (126 cfu/100mL GM)

<u>Date</u>	<u>NPK</u>	<u>WAG</u>	<u>PLL</u>	<u>PPP</u>	<u>PSA</u>	<u>FAA</u>	<u>PCN</u>	<u>RYC</u>
6/10/2019	132.7	212.9	174.4	759.6	223.3	889.9	300.5	168.5
6/19/2019	104.7	212.9	123.1	809.6	177.2	737.5	309.5	142.6
6/25/2019	185.5	429	177.4	786.8	240.5	105.2	309.5	182
7/1/2019	332.2	737.8	326.8	140.6	194.9	50	301.1	173.8
7/9/2019	316.4	599.5	312.5	168.2	182.3	87.4	381.6	144.5
7/22/2019	414.3	356.6	352.8	92.5	139.1	111.9	359.4	118.2
7/30/2019	182.2	182.3	233.6	138	130.1	283.9	400.3	84.9
8/6/2019	28.6	265.2	292.3	1162.8	95.8	109.6	131.4	38.7
8/12/2019	40.2	172.7	342.8	1716.9	72.2	83.3	47.4	61.7
8/19/2019	57.9	124.5	257.9	1817.9	75.6	137.1	57.1	58.1
8/28/2019	35.2	146.7	296.5	2059.7	76.8	111.8	48.4	55.3
9/4/2019	72.2	200.9	588	1771.8	104.4	186	50.8	76.8
9/9/2019	491.2	134.1	505.8	1279.5	121	285.7	115.8	158.4
9/16/2019	416.1	145.6	516.7	968.6	220.4	388.6	157.3	115.2
9/24/2019	216.4	231.3	892.6	203.9	235.2	362.9	147.2	139.6

NPK	National Park
WAG	Washington Ave. Green
PLL	Penns Landing Lagoon
PTP	Penn Treaty Park
PPP	Pyne Poynt Park
PSA	Pennsauken Access
FAA	Frankford Arsenal Access
PCN	Palmyra Cove
RYC	Riverton Yacht Club

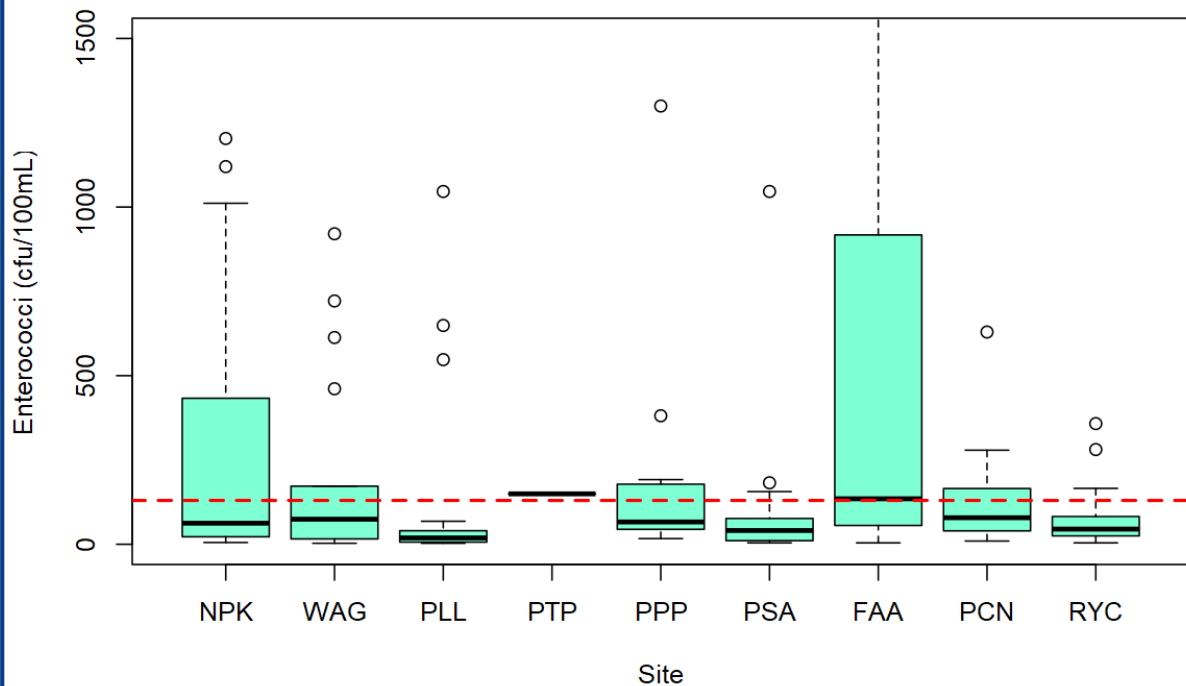
Comparison of Delaware Estuary Fecal Coliform to DRBC Current Criteria Recreational Use, Geometric means



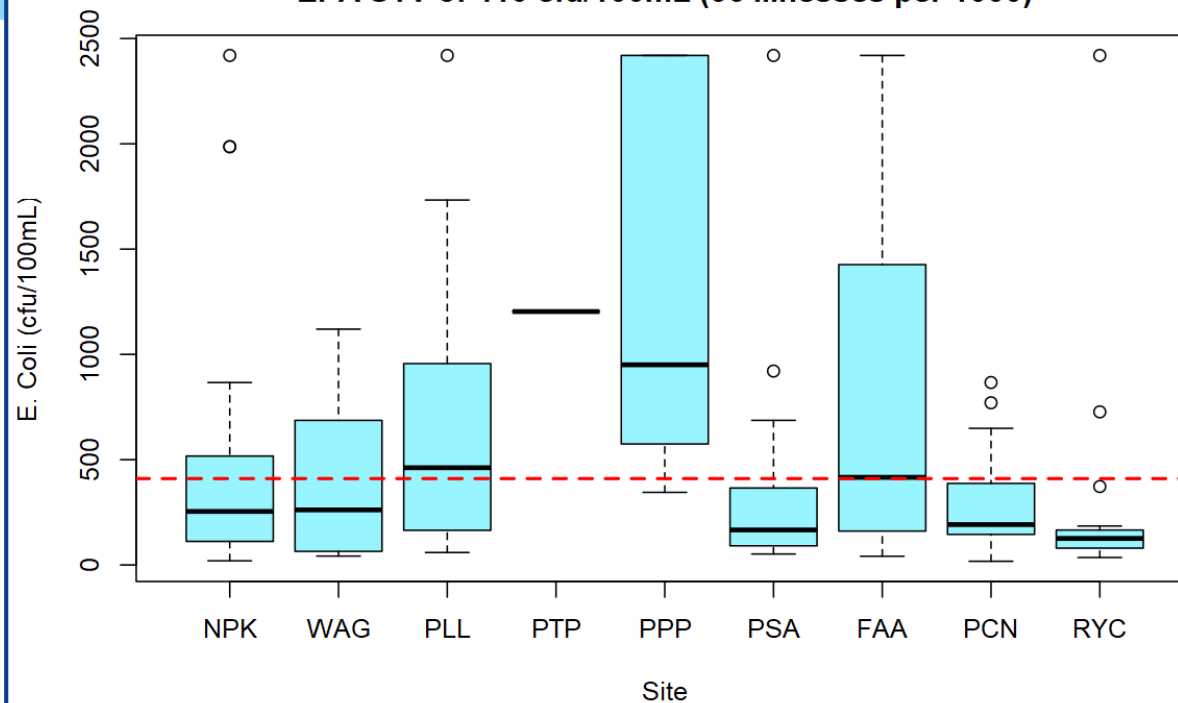
Geometric mean of all data points within sliding 30-day window

Comparison to EPA STV Criteria

Enterococci by Sample Site compared to EPA STV of 130 cfu/100mL (36 illnesses per 1000)



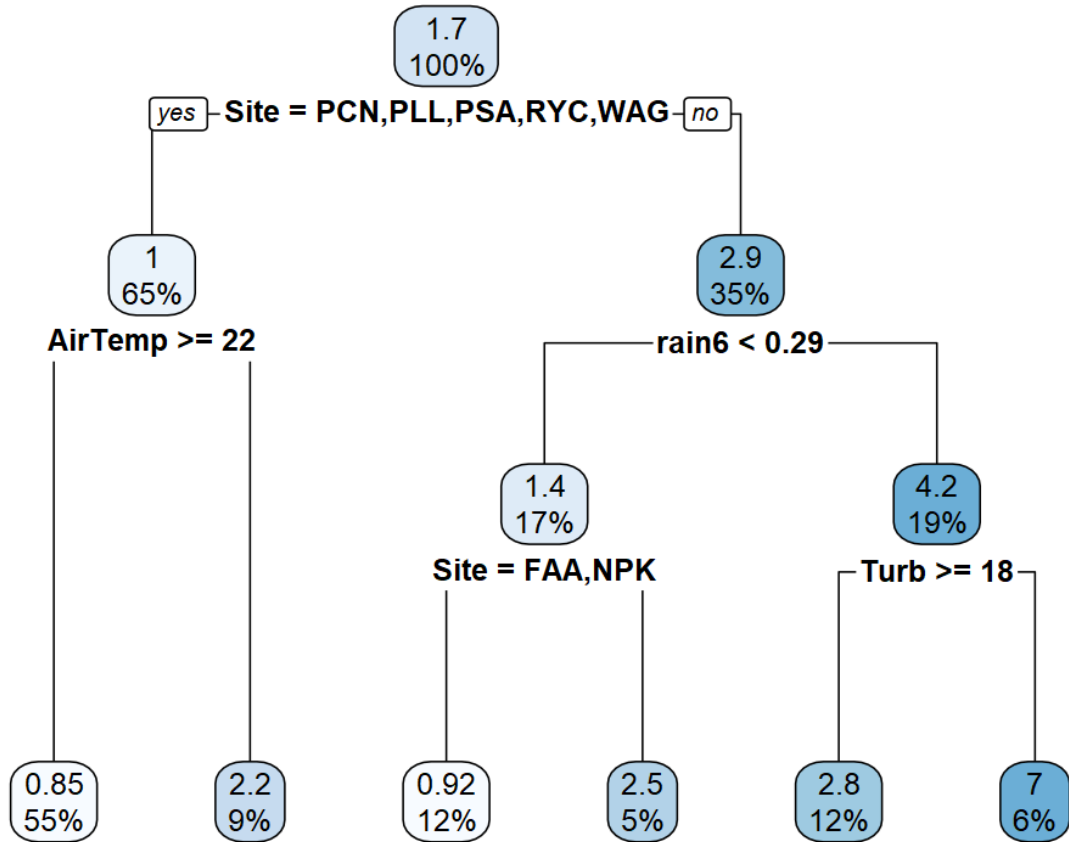
E. Coli by Sample Site compared to EPA STV of 410 cfu/100mL (36 illnesses per 1000)



What contributes to bacterial variability?

- Focus on STV, 36 illnesses per 1000, both E. Coli and Enterococci (EPA)
- Assume both E. Coli and Enterococci would need to be below their STV values for the 'recreation area' to be 'open'
- Used an index: $((EC/STV_{EC}) + (ENT/STV_{ENT}))/2$
 - Values < 1 : good
 - Values > 1 : bad

Classification / Regression Tree



Possible explanatory variables

- Cumulative rainfall for prior 1 day (rain1), 2 days (rain2)...10 days (rain10)
- Weather (wind, air temp)
- Tide condition during sampling
- Site, RM, side
- Water temp, SC, pH, chl-a
- Turbidity

What's Important?

- Site, 6 day cumulative rainfall, Turbidity, maybe air temperature (might just be season)

% 'Open' based on EPA STVs only

Site Name	Site	Closed	Open	% Open
Pennsauken Access	PSA	3	15	83%
Riverton Yacht Club	RYC	4	14	78%
Palmyra Cove Nature Center	PCN	6	12	67%
Penns Landing Lagoon	PLL	6	12	67%
National Park	NPK	7	10	59%
Washington Avenue Green	WAG	8	10	56%
Frankford Arsenal Boat Ramp	FAA	11	5	31%
Payne Poynt Park	PPP	12	3	20%

Observations

- Assessment by geometric mean, system-wide: Unfavorable
- Assessment by geometric mean, site-by-site: Mixed
- Assessment by STV, site-by-site: More favorable

- May predict conditions based on: Location, Cumulative rainfall
 - Need a larger, more robust data set than this one

DRBC Next Steps

- ~~Can we use other variables & real-time measurements to predict high bacteria?~~
 - ~~Recent rainfall~~
 - ~~Season, weather, temperature~~
 - ~~Tide stage~~
 - ~~Turbidity~~
 - ~~Location~~
- Written report
- Boat-based transect monitoring in 2020 to determine if near-shore concentrations are higher than center channel concentrations
- Coordination with Water Quality Advisory Committee (WQAC)
- https://www.nj.gov/drbc/about/advisory/WQAC_index.html

Other Hazards / Other Challenges

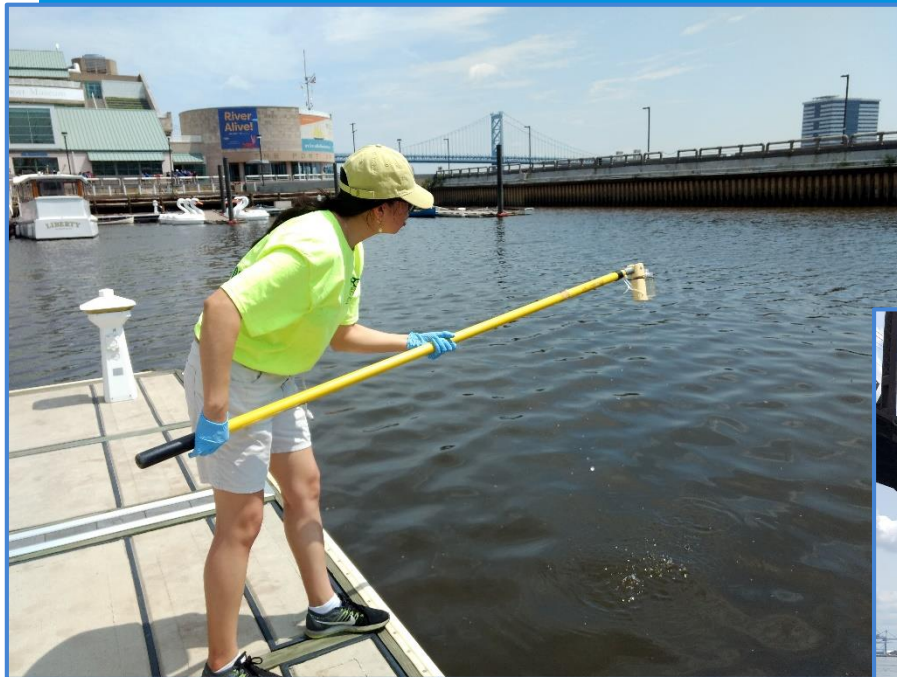


- **Busy shipping ports**
- **Hazardous currents**
- **Debris, pilings, junk**

- **Beaches have an elaborate protocol for monitoring, beach closures, re-opening**

- **Liability versus Responsibility & Authority**

Questions & Discussion



Contact

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