Salem Sound Clean Beaches and Streams Program Report for Manchester-by-the-Sea, MA June through August 2024

The following report summarizes results from water quality testing from June through August in Salem Sound Coastwatch's Clean Beaches and Streams Program at coastal outfall pipes and streams. Salem Sound Coastwatch (SSCW) conducts water sampling following a Department of Environmental Protection-approved Quality Assurance Project Plan (QAPP last revised in 2024). All SSCW volunteer water technicians took the required training as spelled out in this QAPP. Sampling and chain of custody protocols were followed, and a minimum completeness range of 90 to 100 percent of the samples for collection was met.

Wolf Trap Estuary, Manchester-by-the-Sea

US EPA National Water Quality Inventory reports runoff from urbanized areas is the leading source of water quality impairments to surveyed estuaries, harming fish and marine plants and animals, killing native vegetation, and making recreational areas unsafe and unpleasant. (EPA 841-F-03-003)

Approach and Methods

While municipalities test bathing waters at public beaches, Salem Sound Coastwatch focuses on stormwater outfall pipes and coastal streams, many of which are located at bathing beaches and near boating areas. SSCW's samples are collected at sites of stormwater discharge at low tide, which means bacterial counts tend to be higher than beach samples taken at high tide in three feet of water where the ocean has diluted the discharge. Testing outfall pipes and streams shows whether bacterial contaminants are making their way from the land into our area waters.

EPA has concluded that *Enterococcus* is the best indicator organism in marine waters to show a correlation with adverse human health effects. Therefore, all states were mandated to use this standard by April 2004. Since 2004, all Salem Sound communities and SSCW have used *Enterococcus* as the indicator organism for marine water testing.

The EPA water quality standard for Class A, B, and C is met if the *Enterococcus* level of a single sample is less than 104 CFU/100mL or if the geometric mean of the most recent five (5) *Enterococcus* levels within the same bathing season does not exceed 35 colonies per 100mL (Massachusetts state sanitary code 105 CMR 445.000). The geometric mean is a statistical averaging method used to even out the average when dealing with a wide range of numbers.

Definition of Dry vs. Wet Conditions

Rain can temporarily elevate bacterial counts at discharge sites and within nearshore coastal waters. Runoff from impervious surfaces (parking lots, roofs, streets) flushes contaminants through storm drains, bringing pollution onto the beaches and other coastal habitats. Therefore, testing under dry conditions gives a better picture of ongoing contamination problems.

SSCW defines "dry" conditions vs. "wet" differently than the municipalities. The municipalities define wet conditions, or a "storm" event, as any precipitation occurrence during sampling or within the 24 hours preceding the sampling. **Under SSCW's definition, dry conditions are less than 0.2" precipitation on the sampling day or less than 0.5" within the three days preceding sampling. Wet conditions are defined as more than 0.2" precipitation 24 hours before sampling or more than 0.5" within three days preceding sampling.** Protocols for wet weather sampling are the same as for dry weather sampling. Graph 1 on page 8 shows the precipitation for the sampling period. Note that if a graph indicates rain when sampling was listed as "Dry," the rain fell after the sample was taken.

Salem Sound Coastwatch Test Results

Manchester's sampling test results are included in Table 2 for June 10 through August 21, 2024. Samples were taken every two weeks within two hours of low tide and driven to Gloucester where Biomarine tested all water samples for Enterococcus. (16 East Main Street, Gloucester MA 01930).

Values above the EPA standard (EPA-823-R-03-008) are indicated in **bold**: ***Enterococcus* >104 CFU/100mL**. In addition, geometric means are included for all sites (n = 6) and a geometric mean for only dry sampling (n = 2).

Even though there was little rain this past summer, rain tended to fall on or around testing days. Four Wet events occurred on June 10 and 24 and August 7 and 21. (Table 2) On these dates, every site had bacterial counts above the EPA standard: *Enterococcus* >104 CFU/100mL. The Wet weather results ranged from 684 to >24,196 CFU/100mL. Dry weather sampling ranged from 987 to >24,196 CFU/100mL.

Results Summary

Wet weather sampling events are removed to determine bacterial hotspots, defined by Salem Sound Coastwatch as sites having Enterococcus counts greater than 1000 CFU/100mL.

HOTSPOTS:

Hotspots are defined as the Geometric Mean for ONLY DRY weather sampling (n=2) for Enterococcus > 1000 CFU/100mL. Wet dates were not included and are shaded blue.

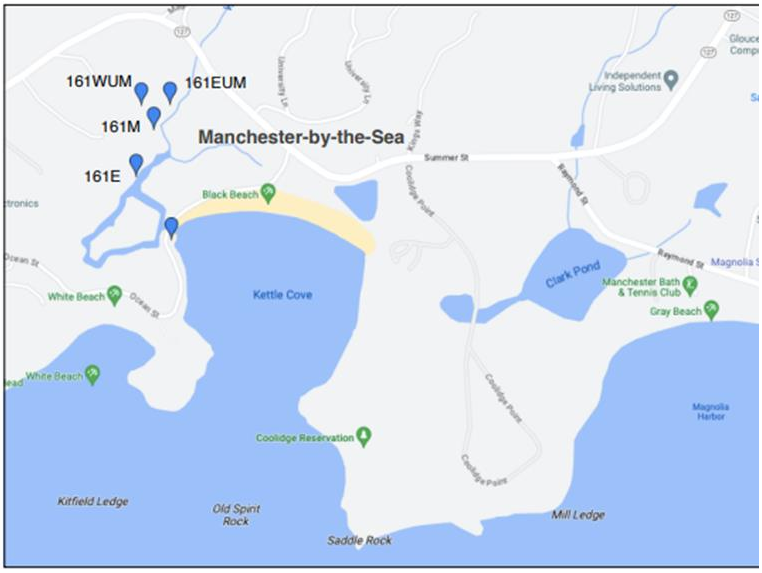
According to SSCW testing results, every site tested was considered a hot spot in 2024.

Table 1: **2024 Hotspot Results from Outfall Pipes and Streams in Manchester-by-the-Sea**

2023 Hot Spots			
Town	**Location**	**Site ID**	**Geometric Mean (DRY)**
Manchester	Black Beach off 127	161	**2,124**
Manchester	Wolf Trap Estuary at bridge	161-E	**5,173**
Manchester	Wolf Trap Estuary from marsh	161-M	**3,735**
Manchester	Wolf Trap Estuary from East upper marsh	161-EUM	**6,288**
Manchester	Wolf Trap Estuary at west upper marsh	161-WUM	**2,735**

Table 2: **Results from Outfall Pipes and Streams in Manchester-by-the-Sea June-August 2024**

2024 Monitoring Results		WET	WET	**DRY**	**DRY**	WET	WET	ALL Days	Dry Days
Location	**Site ID**	**6/10**	**6/24**	**7/10**	**7/24**	**8/7**	**8/21**	**Geometric Mean**	**Geometric Mean**
Manchester									
Black Beach off 127	161	**842**	**2,489**	**1,553**	**2,909**	**14,136**	**3,076**	**2,727.48**	**2,125.48**
Wolf Trap Estuary at bridge	161-E	**3,556**	**7,701**	**2,224**	**12,033**	**3,654**	**6,488**	**5,089.20**	**5,173.14**
Wolf Trap Estuary from marsh	161-M	**2,987**	**7,701**	**987**	**14,136**	**4,884**	**4,884**	**4,439.45**	**3,735.27**
Wolf Trap Estuary from East upper marsh	161-EUM	**1,050**	**3,448**	**2,282**	**17,329**	**4,611**	**2,333**	**3,398.28**	**6,288.46**
Wolf Trap Estuary from West upper marsh	161-WUM	**2,036**	**684**	**1,153**	**6,488**	**>24,196**	**5,172**	**2,219.66**	**2,735.08**

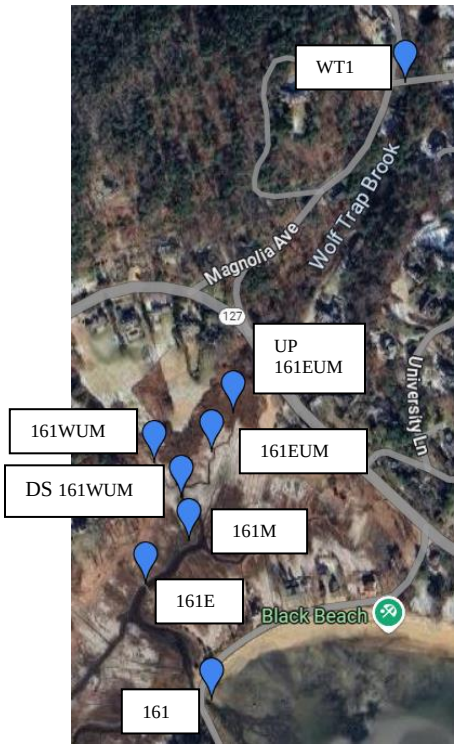


Map 1: **2024 Monitoring Sites in Manchester-by-the-Sea**

Manchester

As the Wolf Trap Brook flows through the salt marsh (#161 E) and exits onto Black Beach at Kettle Cove (#161), hotspots are still a problem. #161 E is a collection location in the salt marsh upstream of the footbridge that crosses the brook. Two sites, 161-EUM and 161-WUM were added to pinpoint the source of contamination upstream of the bridge.

Additional testing through the SSCW Tributary and Water Quality Monitoring Program was done in late August to determine where septic system leakage may be a problem. Those results follow in Table 3. Salem Sound Coastwatch and the Manchester Coastal Stream Team decided to test at the top of Wolf Trap Brook (WT1) and closer to the houses south of Route 127. If results were low before the brook entered the marsh, the source of contamination is not from Magnolia Avenue. Because 161-EUM (857) had higher bacterial counts (than the west 161-WUM (86), an effort was made to go through the phragmites toward Route 127 as far as possible without walking in the brook to avoid disturbing any possible contaminated sediment. The results showed few bacteria at WT1 (10/100mL) and significantly more at UP 161-EUM (1396/100mL). These results lead us to believe that there is a septic leak between the two testing sites warranting investigation.



Map 2: **2024 Monitoring Sites in Manchester-by-the-Sea**

Table 3: **Results from Outfall Pipes and Streams in Manchester-by-the-Sea; Dry Conditions August 29, 2024**

Salem Sound Coastwatch Sampling Sites	Site #	Latitude	Longitude	Time	Flow	Conductiity	Ammonia	Chlorine	pH (strip)	Salinity (ppt)	Entero/ 100 mL	Field Notes
Manchester - Wolf Trap at Overledge Rd	WT-1	42.585413	-70.731603	10:09	T	407.7	0.175	0.01	7	0.2	10	
Manchester - Wolf Trap Estuary from marsh	161-M	42.580033	-70.73504	11:15	M	38.65	0	0.13	7	24.6	201	
Manchester - Wolf Trap Estuary Downstream from West upper marsh	DS-161-WUM	42.580537	-70.735172	11:35	M	33.76	0	0.05	7	21.9	399	
Manchester - Wolf Trap Estuary West upper marsh	161-WUM	42.580973	-70.735683	11:50	M	32	0.175	0	7	20	86	
Manchester - Wolf Trap Estuary from East upper marsh	161-EUM	42.581098	-70.734687	12:05	M	37.25	0.25	0	6	23.7	857	nips, tampon applicator
Manchester - Wolf Trap Estuary from Upper East upper marsh	161-UP-EUM	42.58155	-70.73434	12:25	M	16.17	0	0.02	6	10	1396	near 391 Summer St/ Rte 127

REPORTING LIMITS
Ammonia = 0.1 mg/L
Chlorine = 0.01 mg/L

Sawmill Brook was also tested as part of the SSCW Tributary and Water Quality Monitoring Program (QAPP last revised in 2024) to determine the stream's health for aquatic life. Sampling occurred at the same six sites tested in 2015 starting at the harbor and working upstream to Atwater Ave., north of Rt 128. Bacterial levels were elevated above the EPA water quality standard for Class A, B, and C for Enterococcus level of a single sample less than 104 CFU/100mL. Testing found high counts of Enterococci bacteria from Manchester Harbor (169A-Town Hall Boat Ramp) to Lincoln St (152) and Causeway Brook (153) to warrant further investigation into contamination sources. Surfactant levels were elevated at Manchester Harbor (169A) and found in three of seven downstream samplings. Sawmill Brook will be added to the list of Clean Beaches and Streams sampling sites in the summer of 2025.

Dissolved oxygen, temperature, and pH are important factors in aquatic life viability. On 10/8/24 at the farthest upstream site – Atwater Ave (120), stream flow was blocked by branches and debris resulting in a low/impaired dissolved oxygen level (5). Because the water was stagnant, no bacterial testing was done. When sampling was conducted on 12/10/2024, the blockage had freed, and the brook was flowing again. The dissolved oxygen level, bacterial level, and all the other parameters were within the normal range.

Sawmill Brook is known to have low pH, believed to be due to the abundance of oak leaf debris that increases the water's acidity. On 10/08/2024 at Lincoln St. (152), the pH level was 6.37 below the healthy range of 6.5 – 8.5. On 10/08/24, all sites had pH below 7 (6.54,6.37, 6.52, 6.62) except for the harbor sample (169A), but by 12/10/24, all sites had pH above 7 (7.4, 7.04, 7.58, 7.56, 7.57, 7.35).

Table 4: **Results for Sawmill Brook, Manchester-by-the-Sea from October 8 and December 10, 2024**

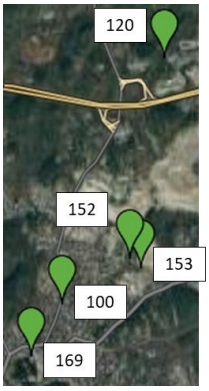
Date A&I/11	Site ID	Time	24 hour rainfall in inches	Entero /100mL	Ammonia mg/L	Surfactants mg/L	Chlorine mg/L	Temperature oC	Salinity ppt	Conductivity mS/cm	pH	Dissolved Oxygen mg/L	Water Body	Field Notes
10/8/2024	169	9:05	0.51	1789	0.2	3	NA	15	21.5	27.5	7.4	10	Sawmill Brook	Low Tide 9:05
10/8/2024	169	9:05	0.51	3448	na	na	na	na	na	na	na	na	Sawmill Brook	Duplicate
12/10/2024	169	8:55	0.27	187	0	na	0.05	5.7	27	26.99	7.04	7	Sawmill Brook	High Tide 6:06
10/8/2024	100	9:56	0.51	2603	0.2	0.25	0	12.2	0.2	0.3065	6.64	7	Sawmill Brook	
12/10/2024	100	9:20	0.27	1467	0	0.25	0	4.2	0.2	0.2938	7.58	9	Sawmill Brook	
10/8/2024	152	10:20	0.51	1071	0.2	0.25	0	12.9	0.2	0.2848	6.37	8	Sawmill Brook	
12/10/2024	152	9:40	0.27	309	0	0.3	0	5.5	0.3	0.3619	7.56	8	Sawmill Brook	
10/8/2024	153	11:02	0.51	414	0.25	0.25	0.09	12.8	0.2	0.1659	6.52	7	Causeway Brook	
12/10/2024	153	10:05	0.27	3255	0	0.3	0.21	3.8	0.2	0.2098	7.57	7	Causeway Brook	
10/8/2024	120	11:35	0.51	na	0.5	0	0	12.3	0.2	0.3875	6.62	5	Sawmill Brook	Stream/riffle blocked by branches and debris; no test done for Enterococci;
12/10/2024	120	10:35	0.27	52	0	0.3	0.02	1.5	0	0.2345	7.35	7	Sawmill Brook	Blockage is gone; Sample taken below riffle
12/10/2024	120	10:35	0.27	75	0	na	na	na	na	na	na	na	Sawmill Brook	Duplicate
12/10/2024	120	10:35	0.27	<10	na	na	na	na	na	na	na	na	Sawmill Brook	Blank

Wet Day

> 104 CFU/100 > 0.5mg/l > 0.25 mg/L > 4 mg/L

> 1.0 ppt > 1.5 mS/cm 6.5 - 8.5 <=6.0

Salinity elevates conductivity



LEGEND	
SITE ID	**LOCATION**
169	Manchester Harbor
100	Brook St/School St
152	Lincoln St
153	Causeway Brook
120	Atwater Ave

Map 3: **2024 Monitoring Sites at Sawmill Brook, Manchester-by-the-Sea**

History of Sampling

Sampling of the Wolf Trap Brook estuary outflow onto Black Beach (161) began in 2006 and the number of sites monitored was expanded in 2007 to the Wolf Trap watershed because of the high bacterial counts at #161.

Table 5: **2006 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

Salem Sound Coastwatch--2006 Water Monitoring Results	SITE	DRY	DRY	DRY	DRY	DRY	DRY	*Geomean*
Manchester		**6/14**	**6/28**	**7/11**	**7/26**	**8/8**	**8/23**	
Coolidge Point - Black Beach	151	87	**118**	**839**	**307**	**5,040**	49	***268***
Black Beach - Wolf Trap estuary	161	**806**	**1,045**	**5,654**	**1,462**	**30,760**	**1,462**	***2606***
Wolf Trap upstream	160	21	30	96	**104**	**1302**	**117**	*99*

Failing septic systems in the watershed were considered a possible source of bacterial contamination as well as the presence of wildlife and pet feces being washed into the brooks during rain events. Because the Wolf Trap estuary has 68 septic systems in its immediate watershed (Figure 1 on page 9) and Title V only requires testing of septic systems on the sale of property, in the spring of 2009, the Town Meeting passed the following action:

ARTICLE 19. To see if the Town will request the Board of Health to develop a plan of regular Title V testing of the Town's septic systems that are five years of age or older, with priority given to those systems in areas of environmental vulnerability. And that said Board shall present its plan and an estimation of the cost to the next year's Town meeting.

Two brooks flow into the salt marsh, a small stream on the westerly side (161W) and the Wolf Trap Brook (#161E) on the easterly side; both sites were sampled through 2010. When it became apparent that the higher bacterial counts were predominantly on the east side of the marsh (161E), the focus shifted to gaining a better understanding of the sources of bacteria in the eastern section. Since 2011, sampling has continued at 3 locations: upstream of the marsh in Wolf Trap brook (160D), from the tidal stream at the footbridge in the marsh (161E), and where the tidal stream flows onto Black Beach (#161). Starting in 2012, the water sampled at the footbridge in the middle of the marsh (161E) had higher geometric means than upstream before the marsh (#160D) or downstream at the ocean (#161).

As of 2018, the required septic systems in the area had been tested and replaced if they failed the Title V testing. However, the 2016 bacterial counts did not decrease as much as was expected. Both the Wolf Trap estuary outflow onto Black Beach (161) and the tidal stream at the footbridge in the marsh (#161E) remained hotspots in 2016, 2017, and 2018. (Tables 5 - 7).

Table 6: **2016 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

2016 Monitoring Results	SITE	WET	WET	DRY	DRY	DRY	DRY	DRY
Salem Sound Coastwatch Sampling Locations		9-Jun	23-Jun	7-Jul	21-Jul	4-Aug	18-Aug	***Geometric Mean***
Manchester								
Wolf Trap Estuary - Downstream of Ocean St at Black Beach	161	**402**	**2,490**	**1,050**	**1,260**	**1,080**	**17,300**	***1,707***
Wolf Trap Estuary - East side from Wooden Bridge in marsh	161 E	**1,790**	**3,080**	**10,500**	**6,920**	**11,200**	**24,000**	***6,897***
Wolf Trap Brook - Downstream of rt. 127	160 D	74	**41**	**288**	NS	NS	NS	***96***

Note: #160D was visited each sampling day, but because there was no flow, it was not sampled (NS).

Table 7: **2017 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

2017 Monitoring Results	SITE	DRY	DRY	WET	WET	DRY	DRY	DRY
Salem Sound Coastwatch Sampling Locations		**13-Jun**	**27-Jun**	**11-Jul**	**25-Jul**	**8-Aug**	**22-Aug**	**Geometric Mean**
Manchester								
Wolf Trap Estuary - Downstream of Ocean St at Black Beach	161	**1,320**	**315**	**1,150**	**2,990**	**1,630**	**1,850**	***1,058***
Wolf Trap Estuary - East side from Wooden Bridge in marsh	161 E	**682**	**1,500**	**1,620**	**4,880**	**1,140**	**1,860**	***1,214***
Wolf Trap Brook - Downstream of RT. 127	160 D	52	5	**570**	**368**	**108**	52	*35*

Table 8: **2018 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

2018 Monitoring Results		DRY	WET	WET	DRY	WET	DRY	Dry Days
Salem Sound Coastwatch Sampling Locations	**Site #**	**14-Jun**	**28-Jun**	**17-Jul**	**31-Jul**	**14-Aug**	**28-Aug**	**Geometric Mean**
Manchester								
Wolf Trap Estuary - Downstream of Ocean St. Black Beach	161	**3,080**	**8,160**	**373**	**299**	**719**	**1,160**	***1,022***
Wolf Trap Estuary - East side, Wooden Bridge in marsh	161 E	**19,900**	**3,260**	**1,110**	**408**	**1,900**	**1,350**	***2,221***
Wolf Trap Brook - Downstream of RT. 127	160 D	10	**816**	**134**	30	**284**	74	*28*

The nonpoint sources in and around the marsh make it difficult to identify the nature of the pathogens. However, in 2018 additional testing was done to locate the bacterial sources. Salem Sound Coastwatch and the Manchester Coastal Stream Team worked with EPA Region 1 to conduct advanced molecular source tracking using PhyloChip Technology. COVID-19 interrupted sampling for several years. In 2023, testing resumed in Manchester, and additional sites were added to the east and west above the bridge (161E) to try to pinpoint the source of pollution. (161-WUM and 161-EUM)

Table 9: **2020 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

2020 Monitoring Results		DRY	DRY	WET	DRY	WET	DRY	WET	Dry Days
Salem Sound Coastwatch Sampling Locations	**Site #**	**8-June**	**22-June**	**30-June**	**09-July**	**23-July**	**6-Aug**	**25-Aug**	**Geometric Mean**
Manchester									
Wolf Trap Estuary Outlet	**161**	**1014**	**910**	-	**288**	**12,987**	**1019**	**1378**	**1301**

Table 10: **2023 Manchester Water Quality Monitoring Results from Outfall Pipes and Streams**

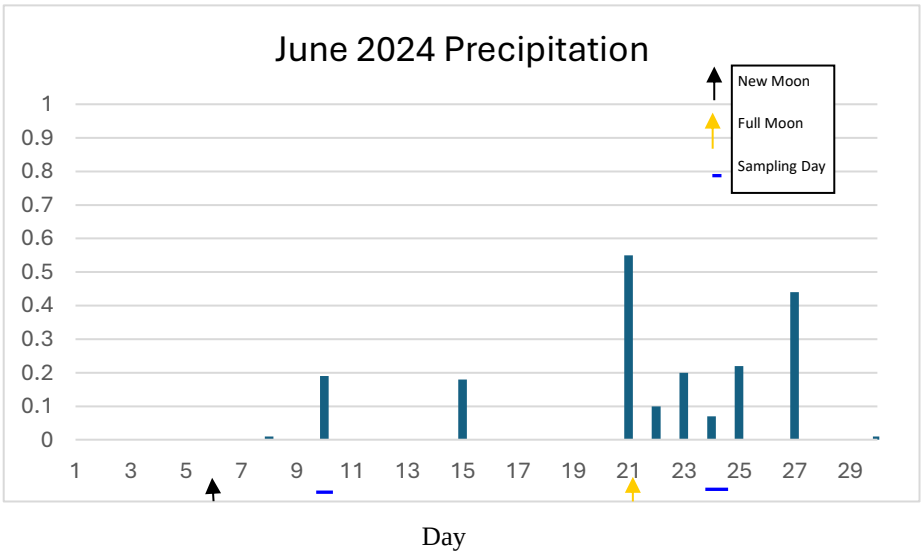
2023 Monitoring Results		DRY	DRY	WET	DRY	DRY	DRY	Dry Days
Salem Sound Coastwatch Sampling Locations	**Site #**	**7-June**	**21-June**	**5-July**	**19-July**	**3-Aug**	**17-Aug**	**Geometric Mean**
Manchester								
Black Beach off 127	161	**368**	**246**	**1,010**	**5,794**	**1,081**	**933**	**880**
Wolf Trap Estuary from the bridge	161-E	**1,223**	**238**	**4,611**	**6,867**	**2,613**	**359**	**1134**
Wolf Trap Estuary from marsh	161-M	**1,935**	**399**	**12,098**	**1,160**	**823**	**459**	**805**
Wolf Trap Estuary - West Upper Marsh	161-WUM	~	~	~	**1,918**	**2,310**	**243**	**1025**
Wolf Trap Estuary - East Upper Marsh	161-EUM	~	~	~	**1,572**	**404**	**332**	**595**

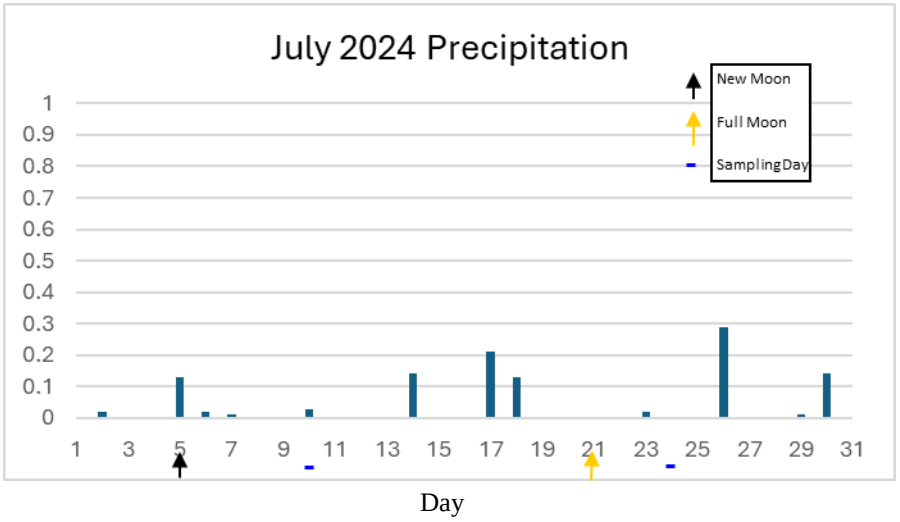
Table 11: **Geometric Mean of *Enterococcus* Counts for Manchester Sampling Sites for 2006 – 2024 (Dry Days Only)**

Year / Site #	**160D**	**161**	**161E**
2006	99	**2606**	~
2007	**165**	**311**	**332**
2008	**252**	**1590**	**920**
2009	34	**413**	**303**
2010	**730**	**1411**	**1718**
2011	**200**	**2786**	**1277**
2012	37	**837**	**1862**
2013	33	**1826**	**2002**
2014	**205**	**478**	**1368**
2015	**131**	**1346**	**2276**
2016	**288**	**2230**	**11822**
2017	35	**1058**	**1214**
2018	28	**1022**	**2221**
2019	~	~	~
2020	~	~	721
2021	~	~	~
2022	~	~	~
2023	~	880	1134
2024	~	2125	5173
Geo Mean	105.0232	1160.089	1468.258

NOTE: Precipitation run-off behaves differently in an estuary environment than in an urban environment; therefore, the same assumptions about the impact of rain preceding testing may not hold true.

Graph 1: **2024 Precipitation Recorded for June, July and August in Beverly (Manchester Similar)**





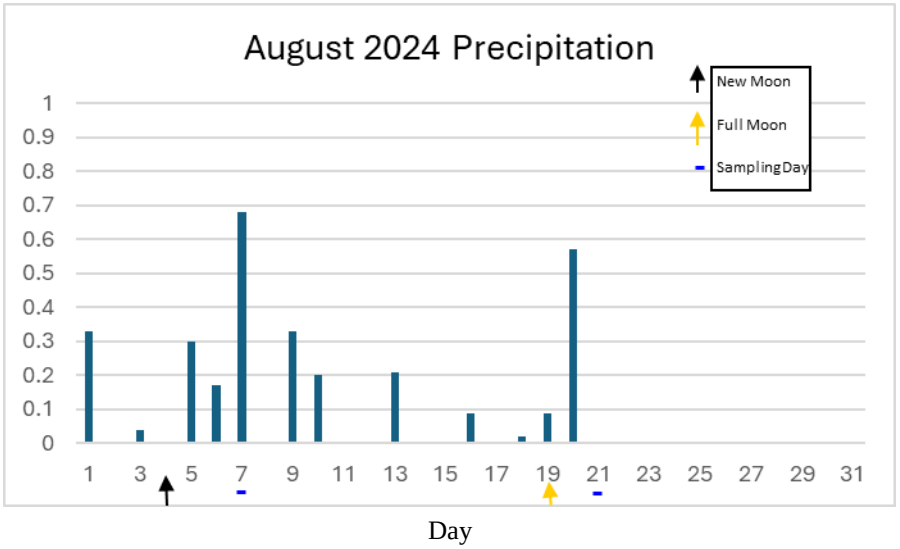


Figure 1: **Map of Kettle Cove Septic Systems January 2015 from the Board of Health**