7-2017

Summary Report of Enhanced Monitoring and Pollution Source Tracking Efforts in the Willard Beach Watershed, Maine, 2012-2016

M. Sims
University of Maine

K. Kaczor
University of Maine, keri.kaczor@maine.edu

MAINE HEALTHY BEACHES PROGRAM
SUMMARY REPORT OF ENHANCED MONITORING AND POLLUTION SOURCE TRACKING EFFORTS IN THE WILLARD BEACH WATERSHED
SOUTH PORTLAND, MAINE
2012-2016

Photo: Fred Dillon

Meagan Sims and Keri Kaczor – Maine Healthy Beaches Program
with assistance from
Fred Dillon – South Portland Stormwater Program Coordinator

July 2017

TABLE OF CONTENTS

Acknowledgements 1

1. **Background** 2

2. **Project Methods** 4
   - 2.1 Enterococci and Optical Brighteners 4
   - 2.2 Nutrients 4
   - 2.3 Canine Detection 4
   - 2.4 Microbial Source Tracking 4
   - 2.5 Risk Factor Matrix 4

3. **Results/Discussion** 5
   - 3.1 Enterococci and Optical Brighteners 5
   - 3.2 Nutrients 8
   - 3.3 Canine Detection 8
   - 3.4 Microbial Source Tracking 10
   - 3.5 Risk Factor Matrix 10

4. **Local Actions to Improve Water Quality** 12

5. **Appendix A** 13

Acknowledgements

South Portland's commitment to clean water and their willingness to work with partners to transform the collected data to actions to improve water quality is commendable. Special thanks to the Water Resource Protection Department, which provided staff to collect all samples for this analysis and review the report.

Background

Willard Beach is a popular recreation area located in South Portland used primarily by families with young children. Routine monitoring at the beach revealed elevated bacteria levels, prompting the need for enhanced monitoring within the watershed to determine the nature and extent of potential bacteria inputs. Although the waste of domestic and wild animals can contribute to impaired water quality and pose a public health risk, efforts have focused primarily on identifying and removing human sources (e.g. malfunctioning septic systems, faulty sewer lines) of fecal pollution.

As part of this effort, Maine Healthy Beaches (MHB) has partnered with the City to conduct intensified monitoring including paired enterococci (ENT) and optical brightener (OB) monitoring of the stormwater system for the past 5 years (2012-2016). In an effort to pinpoint human sources, the pollution source tracking toolbox approach was used incorporating the collection of multiple parameters including enterococci bacteria, optical brighteners, canine detection, nutrients, and microbial source tracking (MST). Typically, as the number of parameters that exceed a threshold (or detectable) limit increases, so does the confidence that human sources are impacting water quality.

Enterococci bacteria indicate the presence of fecal contamination from warm-blooded animals and the possible presence of disease-causing microorganisms. However, fecal indicator bacteria like enterococci do not differentiate the source(s) of bacterial pollution. To target human-sourced contamination, additional parameters are often used and may include optical brighteners, PPCPs, nutrients, canine detection, and MST. Optical brighteners are commonly used in commercial/retail products such as clothing detergents, dishwashing agents, and personal care products to brighten the whiteness of materials. Optical brighteners and PPCPs are typically flushed down the drain; therefore, when concentrations of these parameters are coupled with elevated fecal bacteria levels, it can be indicative of human-sourced fecal contamination. The presence of elevated surfactants, chlorine, and/or ammonia levels may indicate a location with an illicit discharge nearby or upstream. Canine detection involves the deployment of dogs trained to detect human sewage and MST methods specifically target DNA of individual source markers, allowing for the differentiation of human and non-human fecal contamination sources. Canine detection provides source presence/absence information, whereas MST can also provide the relative strength of the fecal marker, assisting with tracking contamination to the source.

There are 6 stormwater outfalls that discharge directly to the beach and drain stormwater from ~ 1 km^2 of residential, commercial, and institutional areas. Of particular concern are outfalls WB- 15, which collects stormwater from the SMCC athletic fields and WB-17 and WB-18, which collect stormwater from a predominantly residential area with several interspersed commercial enterprises. Outfalls WB-11, WB-12, and WB-16 typically have very low discharge volumes and were not consistently monitored as part of this study (Figure 1).

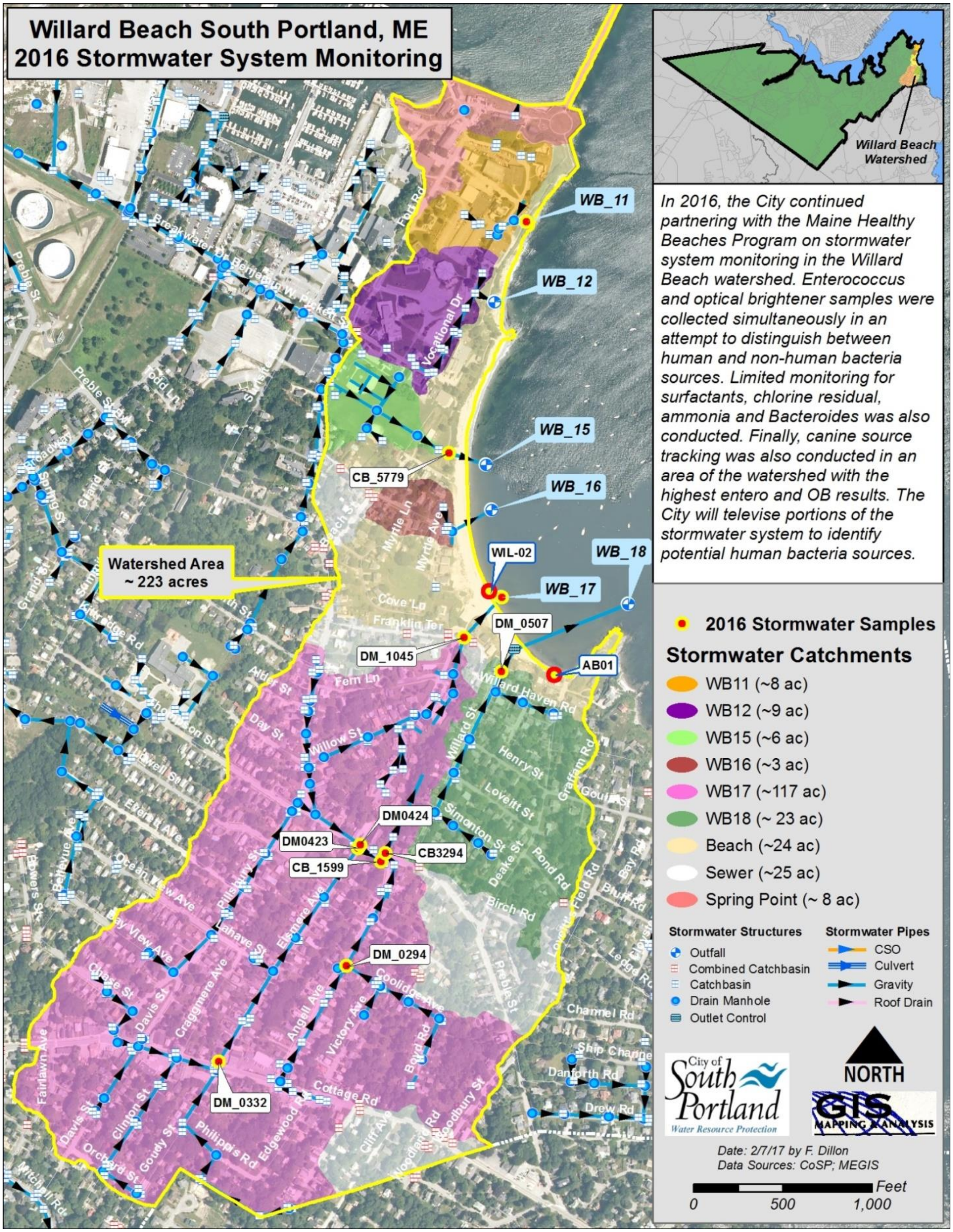


Figure 1. Willard Beach stormwater drainage area (yellow outline) and stormwater sampling stations monitored by MHB and City of South Portland Water Resource Protection Department in 2016.

Project Methods

Since 2012, the City of South Portland has used an adaptive monitoring approach for the Willard Beach stormwater system taking into account the presence of wet weather (ensuring adequate water flow) and suspected bacteria "hot spots" (i.e. areas with consistently elevated bacteria levels). As part of this approach, site locations and monitoring frequency have varied each year. Locations consistently monitored[1] include five stormwater drainage locations (DM0507, CB3294, CB5779, DM0332, DM1045), and one site on Willard Beach (Wil 02) also routinely monitored by the MHB Program throughout the summer swimming season (Memorial Day to Labor day). Remaining monitoring locations for each year primarily represent opportunistic collection events (Figure 1).

Enterococci and Optical Brighteners
As a part of these efforts, 183 ENT samples and 181 OB samples have been analyzed at 15 subsurface sites located within the stormwater system and 1 site located on Willard Beach since 2012. In 2016, 45 ENT samples and 44 OB samples were analyzed at 10 sites including 8 subsurface sites, and two beach sites (Wil-02 & AB01) (Figures 1, A1-A2; Table A1).

Nutrients
In 2015-2016, the pollution source tracking toolbox was expanded to include limited monitoring of nutrients including surfactants, chlorine, and ammonia (2016 only) for routine sample locations. EPA recommends these parameters for MS4 Illicit Discharge Detection & Elimination Programs. Monitoring was limited to allow staff to evaluate the methods and establish efficacy. In 2015, 4 structures were tested on 1 date for surfactants and chlorine. Efforts for 2016 included monitoring 4 structures over two dates (8/8/2016 and 9/14/2016) for surfactants, chlorine, and ammonia.

Canine Detection
In an effort to better understand locations within the drainage network potentially impacted by human fecal sources, the City partnered with Environmental Canine Services to employ sewage sniffing dogs trained to alert to the presence of low concentrations of human fecal sources. This source tracking work was conducted in May 2014 and again in October 2016 and included enterococci sample collection (2014 only) in tandem with two sewage sniffing canines, a technique used to ensure even very low levels of human contamination are detected. For both seasons, stormwater structures were located in sub-catchment WB-17. For 2014, 10 structures were sampled located primarily in the lower portion of the sub-catchment and in 2016, 15 structures were monitored focusing in the upper portion (Figures 7, A5).

Microbial Source Tracking
In 2016, the City worked with MHB and the University of New Hampshire to incorporate MST techniques into ongoing pollution identification efforts. As part of this effort, samples were collected in late July at 2 sites suspected to be impacted by human sourced fecal contamination. Samples were tested using polymerase chain reaction (PCR) assays to determine the presence/absence of both general mammal and human fecal DNA markers and quantitative PCR (qPCR) to assess the strength of the detected markers.

Risk Factor Matrix
To better understand areas within the watershed requiring further investigation, the results from the various parameters collected as part of the pollution source tracking toolbox were combined into a

[1] DM0332 and DM1045 monitored 2013-2013, 2015-2016.

risk assessment matrix. Typically, as the number of parameters that exceed a threshold (or detectable) limit increase, so does the confidence that these areas are impacted by human sources.

Results/Discussion

Enterococci and Optical Brighteners

Combining data from 2012-2016, the ENT geometric mean[2] results for each site ranged from 29-552 MPN/100mL and from 12-115 µg/L for mean OBs (Table 1).[3] All monitoring locations except DM0507 exceeded the US EPA-recommended ENT geometric mean safety threshold of 35 MPN/mL for marine waters while one site (CB1599) exhibited an OB mean concentration above 100µg/l.[4] The combined ENT geometric mean value for all sites (125 MPN) was over 3.5 times greater than the 35 MPN/100ml threshold. The combined OB mean value of 44 µg/l was well below the 100 µg/l threshold (Table 1, Figures 2-3).[5]

Table 1. Geomean ENT counts (MPN/100ml), mean optical brightener values (µg/l), and sample size of 16 sites monitored (2012- 2016).

Station	Geomean ENT	Mean OB	Sample Size
DM0507	29	12	31
WIL-02	82	10	27
CB5779	48	30	27
CB3294	504	90	27
DM1045	151	28	22
DM0332	416	86	11
WB-17	175	31	11
CB1599	552	115	8
DM0294*	1403	70	3
ANGELL-CB*	128	72	2
DM0423*	8732	132	2
AB01*	13	4	2
WB-11**	2382	91	1
DM0424**	8164	269	1
MC4**	41	59	1
Total	**125**	**44**	**176**

*Note small sample size (mean value given)
**Single sample value

[2] The typical value of a set of numbers calculated using the product of a set of values rather than using their sum as when arithmetic mean (average). Any ENT results of <10 MPN/100ml were considered 5 MPN/100ml for calculations.
[3] Monitoring sites with 5 samples or greater included in ENT geomean and OB mean data comparisons. Data from all sites used for watershed-wide geomean calculation.
[4] Value MHB considers as a lower threshold for OB results with the potential for human wastewater contamination.
[5] See Appendix A for 2016 data summaries.

Sites CB3294, DM1045, DM0332, WB-17 and CB1599 demonstrated consistently elevated geomean ENT and mean OB levels over multiple seasons, suggesting the potential for human-sourced fecal contamination at these locations. Sites DM0294 and AB01 were monitored for the first time in 2016, and their single sample ENT results ranged from 5-3488 MPN/100mls, an upper concentration of over 33 times the EPA recommended single sample maximum value.[6]

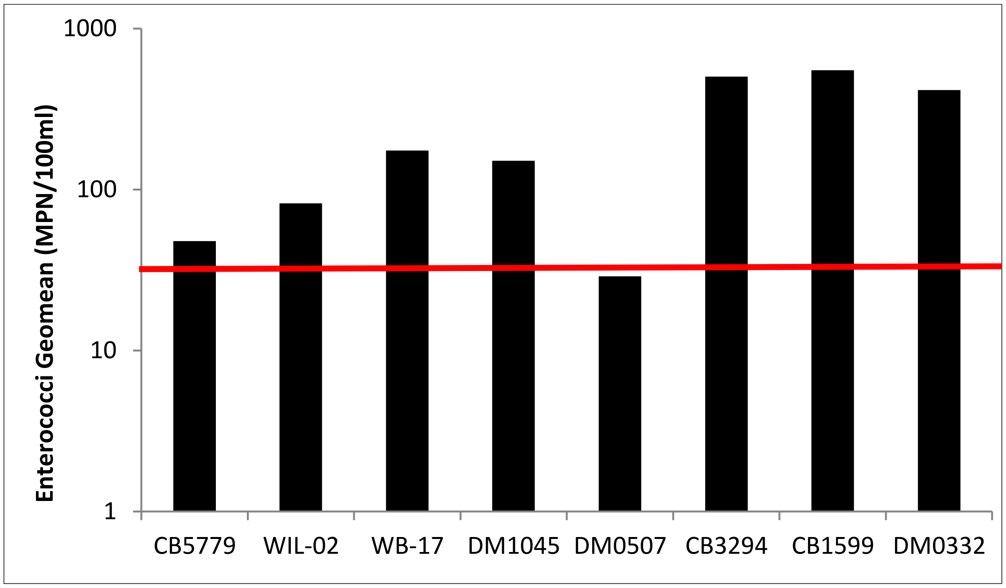


Figure 2. The ENT geometric mean (MPN/100mL) values by monitoring site in the stormwater system impacting Willard Beach from 2012-2016 (monitoring stations with 5 samples or greater included). Red solid line indicates EPA- recommended ENT geometric mean safety threshold of 33 MPN/100mL for fresh water.

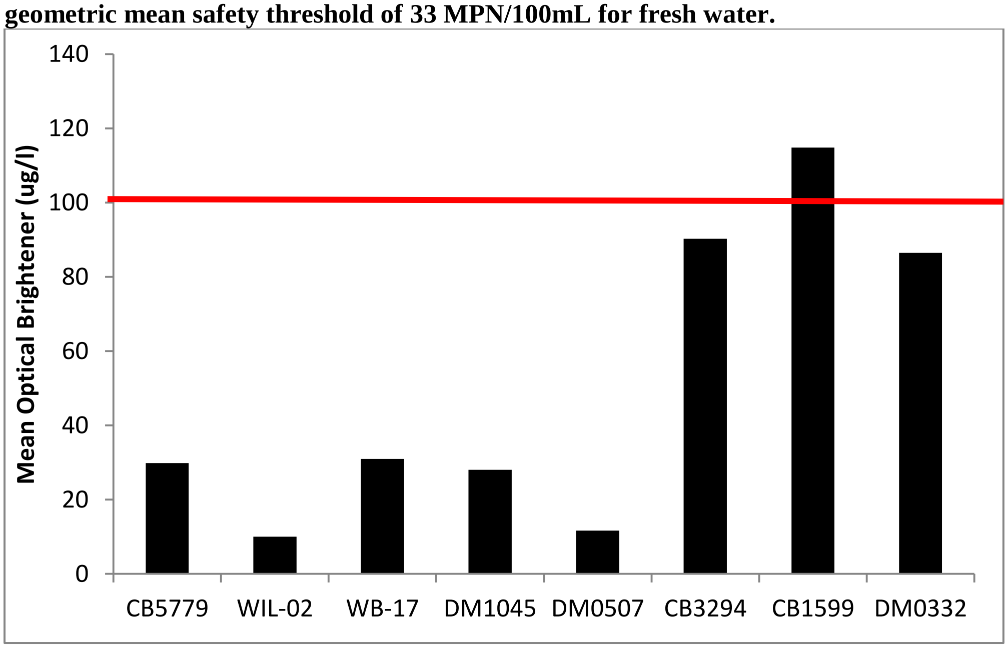


Figure 3. Mean OB (µg/L) concentrations by monitoring site in the stormwater system impacting Willard Beach from 2012-2016 (monitoring stations with 5 samples or greater included). Red solid line indicates the OB lower threshold level considered by MHB as a "red-flag" for potential human wastewater contamination (100 µg/L).

[6] US Environmental Protection Agency (US EPA) recommended single sample maximum value for enterococci in marine waters is 104 (MPN/100 mL) and 61 (MPN/100 mL) for fresh water sites. EPA recommended geometric mean values for marine and fresh waters are 35 (MPN/100 mL) and 33 (MPN/100 mL), respectively.

Overall, mean OB values were relatively low (less than 40 µg/l) for the majority of sites monitored (2012-2016), suggesting non-human sources (wildlife, pets) are likely the principal contributors to stormwater bacterial pollution at these locations. There is also a considerable body of research that suggests bacterial regrowth (i.e., "biofilms") in urban stormwater systems can result in nonattainment of water quality standards. However, human sources cannot be ruled out as optical brightener concentrations varied between monitoring sites, with at least two mean site values (CB1599, DM0423) and one single sample value (DM0424) exceeding the 100 µg/l threshold (Table 1, Figures 2-3).

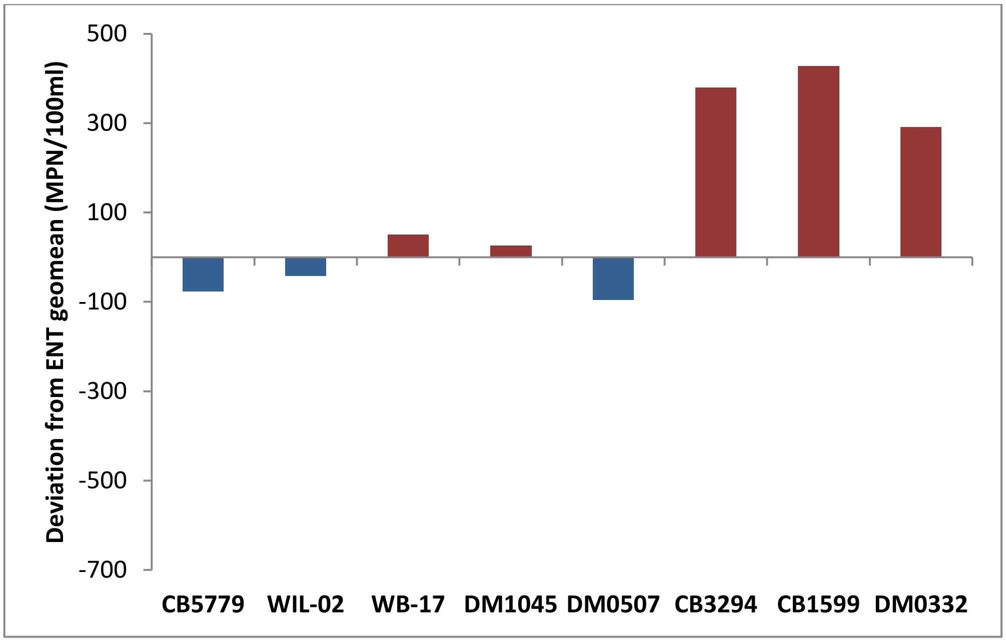


Figure 4. Deviations from 2012-2016 combined ENT geometric mean (125 MPN/100ml) for stormwater sites. Bars above X-axis indicate monitoring sites with ENT values greater than the average geomean and bars below X-axis represent those lower than the average geomean (Note differences in sample size, Table 1).

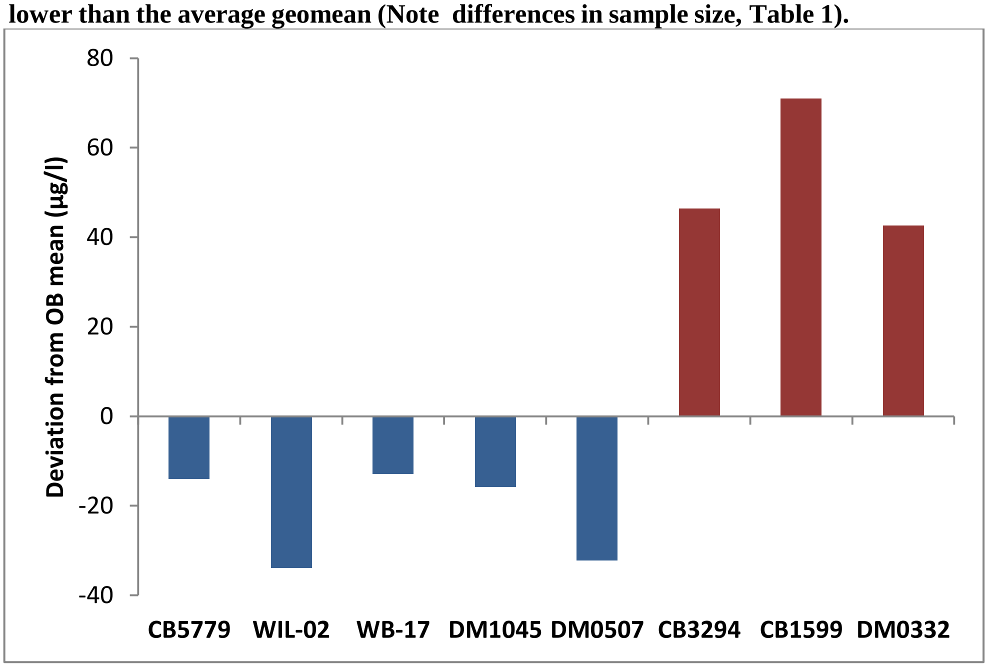


Figure 5. Deviations from 2012-2016 season-wide OB mean (44 µg/l) for stormwater sites. Bars above X-axis indicate monitoring sites with OB values greater than the average value and bars below X-axis represent those lower than the average value (Note differences in sample size, Table 1).

For systems like the Willard Beach stormwater system, where the majority of sites exhibit elevated ENT concentrations, a useful approach to identifying “hot-spots” of contamination is to examine how levels for each site deviate from the combined mean of all sites. These deviations can help pull a meaningful signal from the variability to identify the most problematic sites within the system. Sites with positive deviations for both ENT and OB levels represent locations potentially impacted by human sources (Figures 4-5).

Five sites exhibited positive deviations from the watershed-wide ENT geometric mean of 125 MPN/100ml (WB-17, DM1045, CB3294, CB1599, DM0332, and 4 of those (WB-17 & DM1045 excluded) exhibited positive deviations from the watershed-wide OB mean of 44 µg/l, suggesting the potential for human-sources contributing to elevated ENT levels at these locations (Figures 4-5).

Nutrients

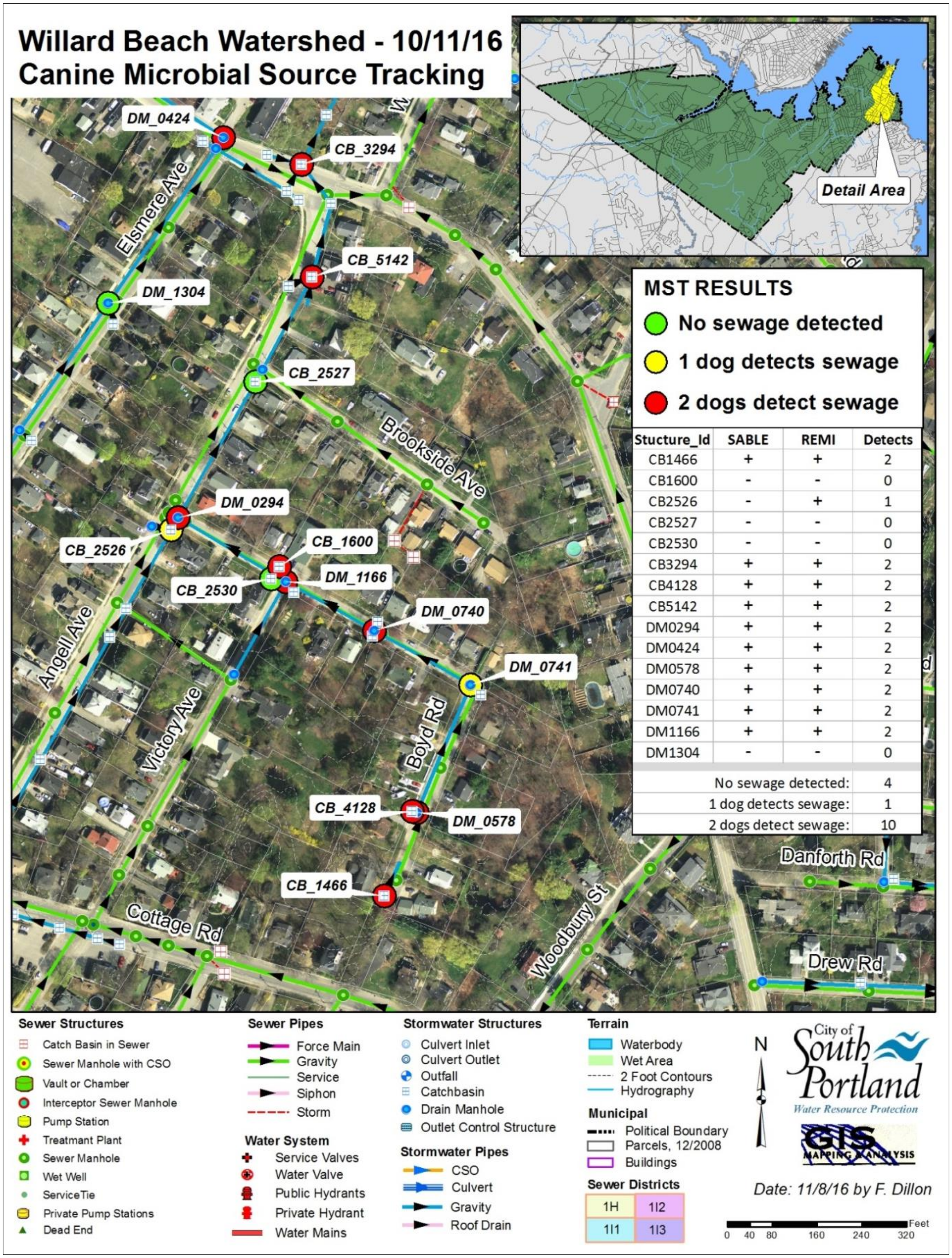
Preliminary monitoring of 5 routine structures (2015 & 2016: DM1045, DM0507, CB3294; 2016: CB5779; 2015:CB1599) within the sub-catchments draining to outfalls WB15, WB17, and WB18 revealed no surfactant, chlorine, or ammonia concentrations above EPA established thresholds.[7]

Canine Detection

Enterococci levels were not analyzed for all sites visited by canine sewage-sniffing dogs. For 2014, 6 of the 10 visited sites were sampled for bacteria in conjunction with canine detection and none of those exceeded the EPA threshold of 104/MPN/100ml. Of the 10 structures tested in 2014, at least 1 canine detected human sewage at 6 locations and both canines detected human sewage at the remaining 4. Canine work in 2016 focused primarily on structures upland of those tested in 2014 and did not include enterococci collection. Of the 15 structures tested in 2016, no sewage was detected by either canine at 4 structures, 1 canine detected sewage at 2 structures, and both canines detected sewage at the remaining 9 structures (Figures 6, 7, A5). The widespread detection of human sourced bacteria by both canines in this sub-catchment (WB-17) suggests contamination in the separated stormwater system may be originating from nearby leaking sewer pipes, particularly those co-located with storm drains.

Figure 6. Willard Beach October 2016 canine detection event press release.

[7] US EPA recommended screening threshold for surfactant and chlorine monitoring = ≥ 0.25 mg/L and ≥ 0.5 mg/L for ammonia.



Stucture_Id	SABLE	REMI	Detects
CB1466	+	+	2
CB1600	-	-	0
CB2526	-	+	1
CB2527	-	-	0
CB2530	-	-	0
CB3294	+	+	2
CB4128	+	+	2
CB5142	+	+	2
DM0294	+	+	2
DM0424	+	+	2
DM0578	+	+	2
DM0740	+	+	2
DM0741	+	+	2
DM1166	+	+	2
DM1304	-	-	0
		No sewage detected:	4
		1 dog detects sewage:	1
		2 dogs detect sewage:	10

Figure 7. Willard Beach canine source tracking results (October 2016).

Microbial Source Tracking

MST results indicate the presence of mammal sourced DNA in both structures tested (CB3294 & DM1045) and human DNA at site CB3294, suggesting human sources may be contributing to bacterial pollution at that location. Both structures are located in the sub-catchment draining to stormwater outfall WB17 (Figure 1). A positive PCR assay for either source marker suggests a recent fecal contamination event as the markers quickly degrade outside of their host (approximately within 1 week). To better understand the strength of the human source detected at CB3294, a quantitative PCR test was conducted resulting in a DNA copy number. Samples were collected on just one monitoring date, and therefore it was not possible to use qPCR results to assess persistence of fecal sources or to further track the source of contamination. However, these copy numbers were compared to those obtained for other Maine watersheds and results indicate levels consistent with those found for areas of known or suspected human sewage contamination.

Risk Factor Matrix

Analyzing ENT results in conjunction with other parameters (i.e. optical brighteners, canines, nutrients, MST etc.) may assist the City in better understanding the contributing sources of fecal contamination in the watershed. Risk matrix factors included for the Willard Beach stormwater system included whether or not ENT geomean results exceeded the EPA 35 MPN/100ml threshold, if mean OB concentrations exceed the 100 µg/l "red-flag threshold, if sites exhibited a positive deviation from the geomean ENT and mean OB values, if at least one canine detected human source(s) at a site, and if sites were positive for human MST markers (Table 2).

Table 2. 2012-2016 Pollution source tracking toolbox risk factor matrix. Y= Yes, N=No, (-) = not monitored, S=surfactant, C=chlorine, A=ammonia. Sites with 5 samples or greater included.

MONITORING STATION	ENT ≥ 35 MPN/100ml	OB ≥100 µg/l	+ Dev. from ENT Mean	+ Dev. from OB Mean	+ Canine Det. (2014/2016)	+ Nutrients (S/C/A)	+ MST (human)
CB5779	Y	N	N	N	-	N	-
Wil-02	Y	N	N	N	-	-	-
WB-17	Y	N	Y	N	(Y/-)	-	-
DM1045	Y	N	Y	N	-	N	N
DM0507	N	N	N	N	(-/Y)	N	-
CB3294	Y	N	Y	Y	(Y/Y)	N	Y
CB1599	Y	Y	Y	Y	-	N	-
DM0332	Y	N	Y	Y	-	-	-

Monitoring stations with ≥ 3 elevated/positive parameters are highlighted as priority sites with the potential for human sourced fecal pollution. The matrix is used as an indicator of the potential for human-sourced fecal pollution and not a conclusive indicator that illicit source(s) are present at identified sites. Continued monitoring and investigations are needed at these locations to better understand what might be contributing to persistent contamination issues.

Problematic sites identified in the risk matrix were all located within the catchment area contributing to the stormwater released at the WB-17 outfall, particularly those structures along Preble between Elsmere Ave and Angell Ave. as well as, a few structures draining to this region directly upland (Figure 1). All structures highlighted tested above the 2012-2016 watershed-wide geomean for enterococci and three (CB 3294, CB1599, DM0332) exhibited elevated OB results over the watershed-wide mean. Two tested positive for canine detection (WB-17 & CB3294), and one (CB3294) tested positive for human sourced DNA markers (Table 2).

Although values remained elevated at site CB3294 for the 2015 and 2016 seasons (Table A1; Figures A2-A3), the repair of a cross connection at DM0294 (discharging into CB3294) in late

2014 may account for the decreased ENT geomean for 2015 compared to previous years (Figures A3, A4). However, the persistently elevated enterococci observed at that location (and upland sites) coupled with very little seasonal precipitation, elevated optical brighteners, positive canine detection (CB3294, DM0294, and many structures upland), and positive human DNA marker detection at CB3294 suggest human sources are still contributing to elevated bacteria in this region.

Impaired water quality within the stormwater system draining to Willard Beach is likely due to combination of point (i.e. leaky sewers, potential cross-connections between sewer and stormwater infrastructure) and non-point (runoff including waste from humans, pets, and wildlife) pollution sources. Results suggest some areas are primarily impacted by non-point sources with the potential for point source contributions such as those draining to DM1045 and DM0507, whereas the primary contributor to elevated bacteria in other areas is potentially human-sourced. Much of the sewer system in the Willard Beach watershed (and throughout New England) has been in service for well over 50 years. Consequently, as this infrastructure ages it becomes more prone to exfiltration and can potentially result in inadvertent cross-contamination of separated stormwater systems. It is also important to consider that the Willard Beach watershed is a densely developed residential area. Impervious surfaces, such as roads, houses and driveways cover approximately 41% of the total watershed area (Figure 8). The prevalence of impervious surfaces has been strongly correlated to bacteria concentrations in downstream surface waters.

To address these issues, it is essential to continue monitoring of the stormwater system to better understand the source(s) of pollution impacting water quality on Willard Beach coupled with investigations and upgrades to infrastructure. Additionally, ongoing efforts to educate residents about the effects of land use activities on water quality will be a critical component in any attempts to reduce bacteria loading to Willard Beach.

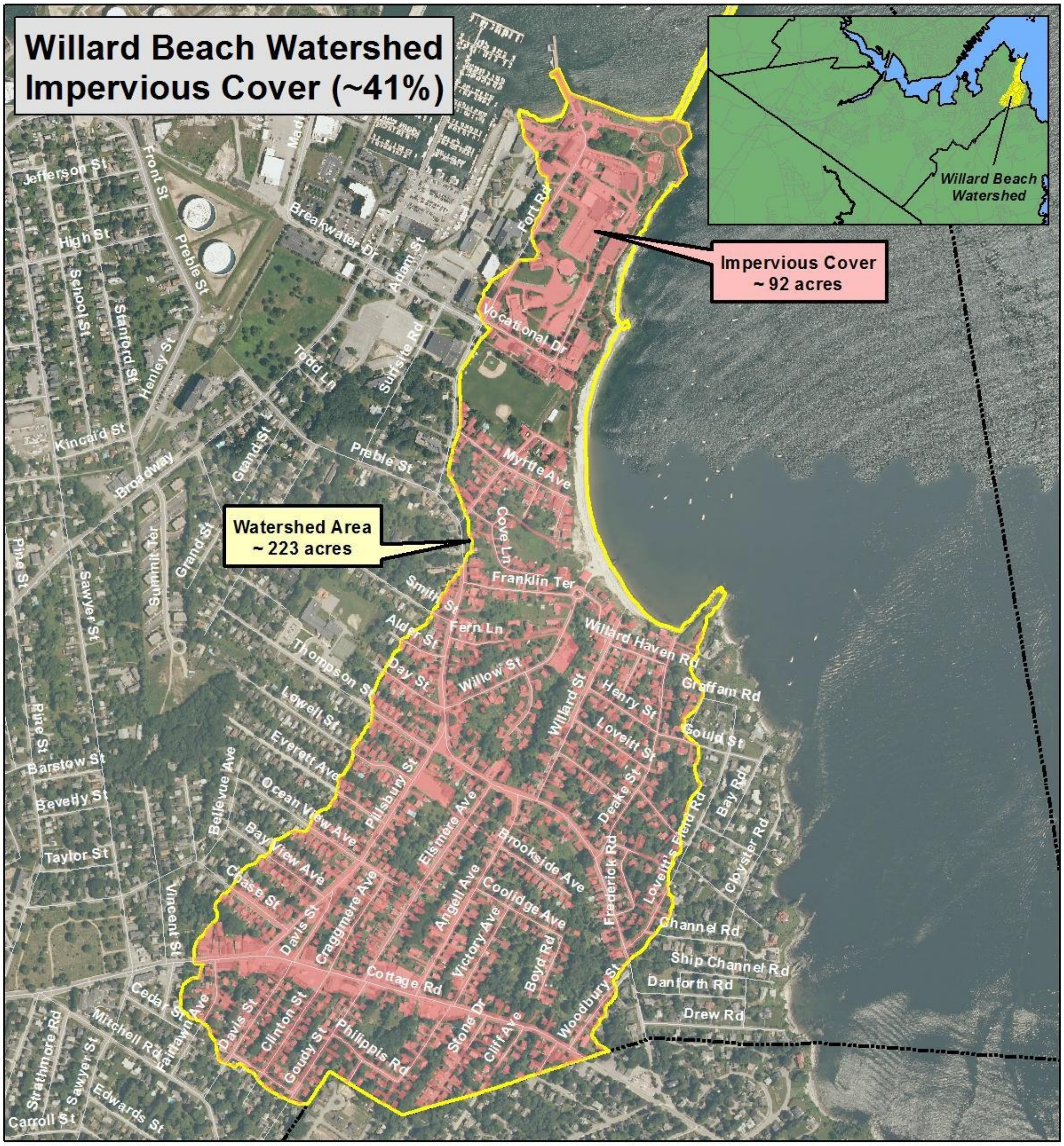


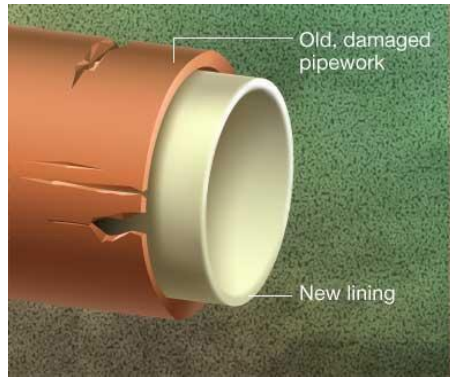
Figure 8. Willard Beach watershed drainage area (yellow line) and % impervious coverage.

Local Actions to Improve Water Quality & Next Steps

In 2016, the City continued routine/ongoing improvements and maintenance to sewer and stormwater infrastructure including street sweeping as well as catch basin and sewer line cleaning. City staff conducted closed-circuit television (CCTV) inspections of the sanitary system to identify possible cross-connections with the stormwater system. South Portland also approved an ordinance to reduce the use of synthetic pesticides throughout most of the City.

Additionally, South Portland continued education/outreach initiatives to promote water resource protection including numerous presentations to municipal officials and local schools. Since 2014, the City has also participated in the annual April Stools Day event hosted by PetLife and Friends of the Eastern Promenade to educate the public regarding responsible pet waste management and related efforts to protect the city's water resources. As part of this event, the city distributed a pet waste brochure co-developed with MHB that educates citizens about stormwater and best practices for discarding of pet waste within the Willard Beach watershed. South Portland also continued upgrades to sewer and stormwater infrastructure and continued posting precautionary rainfall advisories and flags at Willard Beach when local rainfall levels exceeded 1 inch.

In 2017, South Portland Water Resources Protection (WRP) Department will post this report on the City's website. The City will continue enhanced monitoring and pollution source tracking efforts in the Willard Beach watershed, including CCTV inspections of the stormwater system and/or dye testing of sewer lines to identify potential sources of cross-contamination with the separated stormwater system. The condition of sewer lines passing through separated stormwater structures will be assessed and repaired as needed. Potential repair options include cured in place pipe lining or pipe replacement and relocation. For 2017 monitoring efforts, the City plans to continue enterococci and optical brightener monitoring and further explore the use of additional parameters in the source tracking toolbox to hone in on human sources.



http://www.resolvetrenchless.com/pipe-lining/

The City also hopes to expand its efforts to inform dog owners regarding the impacts from improper pet waste disposal, particularly in the Willard Beach and Hinckley Park areas. The City will participate in the 2017 April Stools Day event in partnership with PetLife, Friends of the Eastern Promenade, SoPoDog, and MHB promoting responsible management of pet waste.

Disclaimer

This report has been compiled to the best of the Maine Healthy Beaches Program's knowledge. Please submit any comments or additions to the MHB program.

Appendix A- 2016 Data Summaries and Additional Efforts to Improve Water Quality

2016 Data Summaries

Table A1. Geomean enterococci counts (MPN/100ml), mean optical brightener values (μg/l), and sample size of 10 sites monitored in 2016.

Station	Geomean ENT	Mean OB	Sample Size
DM0507	53	6	8
CB3294	453	77	8
CB5779	36	20	8
DM1045	295	15	7
WIL-02	73	7	6
WB17	139	9	2
CB1599	12467	140	2
AB01	13	4	2
DM0332*	13000	247	1
DM0294*	3448	86	1
Total	**144**	**35**	**45**

*Averages for WB17, AB01

**Single sample for DM0332, DM0294

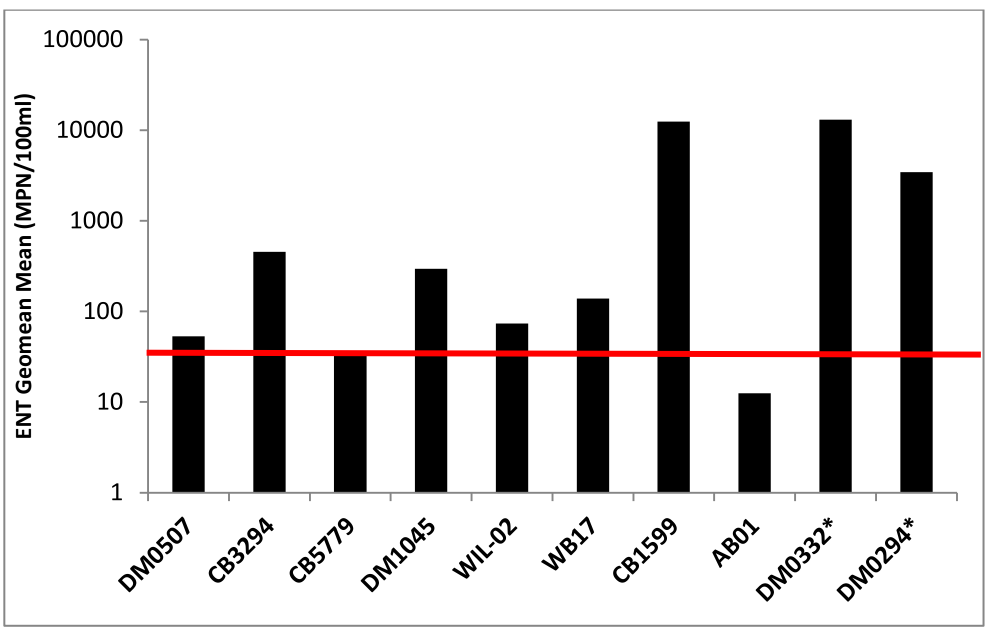


Figure A1. The 2016 geometric mean ENT (MPN/100mL) values by monitoring site in the stormwater system impacting Willard Beach. Red solid line indicates EPA-recommended ENT geometric mean safety threshold of 35 MPN/100mL for marine sample water.

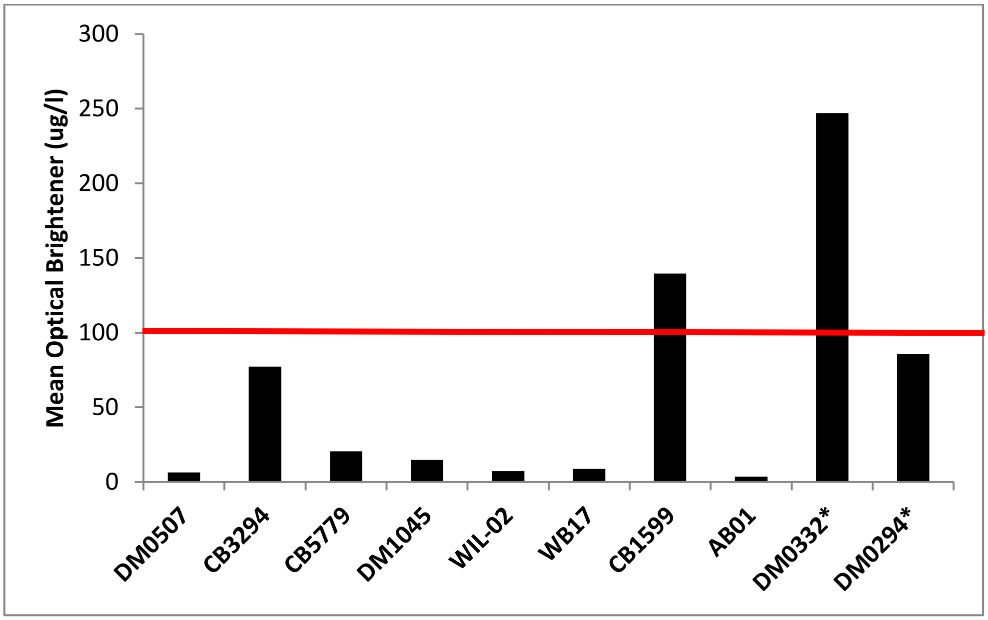


Figure A2. 2016 mean OB (µg/L) concentrations by monitoring site in the stormwater system impacting Willard Beach. Red solid line indicates the OB lower threshold level considered by MHB as a "red-flag" for potential human wastewater contamination (100 µg/L).

Cross Connection Identification & Repair

Following the August 2014 discovery of significantly elevated bacteria results in a portion of the separated stormwater system, City staff conducted closed-circuit television inspections in September 2014 to identify potential cross-connections with the public sewer (Figure A4). While no direct connections of sewer service laterals from residences into the separated stormwater system were observed, there were three instances of the public sewer main crossing directly through separated stormwater structures. Subsequent dye testing by City staff identified and eliminated an illicit cross connection between the sewer and stormwater infrastructure at site DM0294 (Figure A5).

Figure A3. City of South Portland's closed-circuit television inspection van assessing the condition of the sewer and stormwater systems in the Willard Beach Watershed.

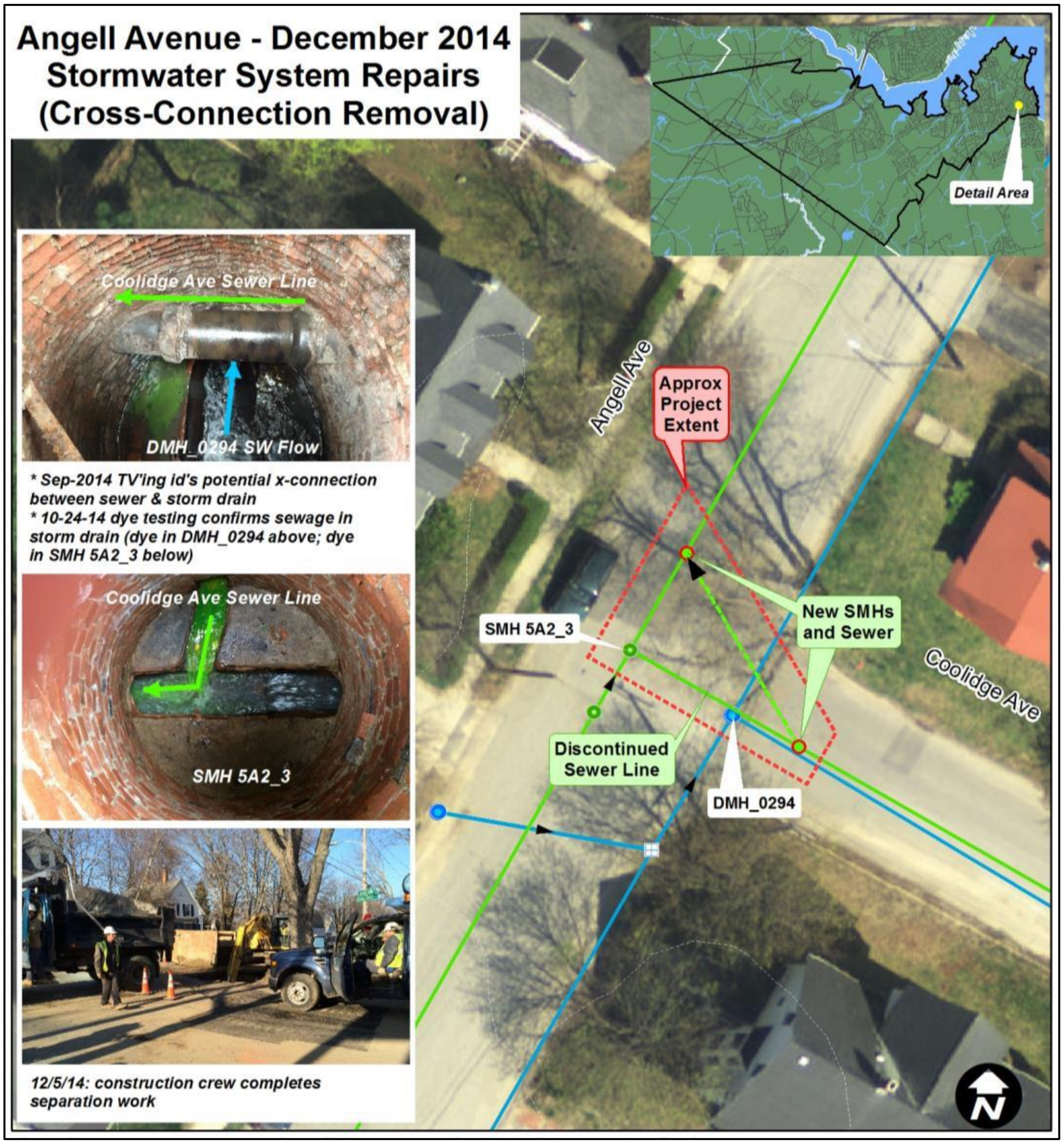


Figure A4. Stormwater system repairs including the removal of a cross connection within the Willard Beach Watershed along Angell Avenue (December 2014).

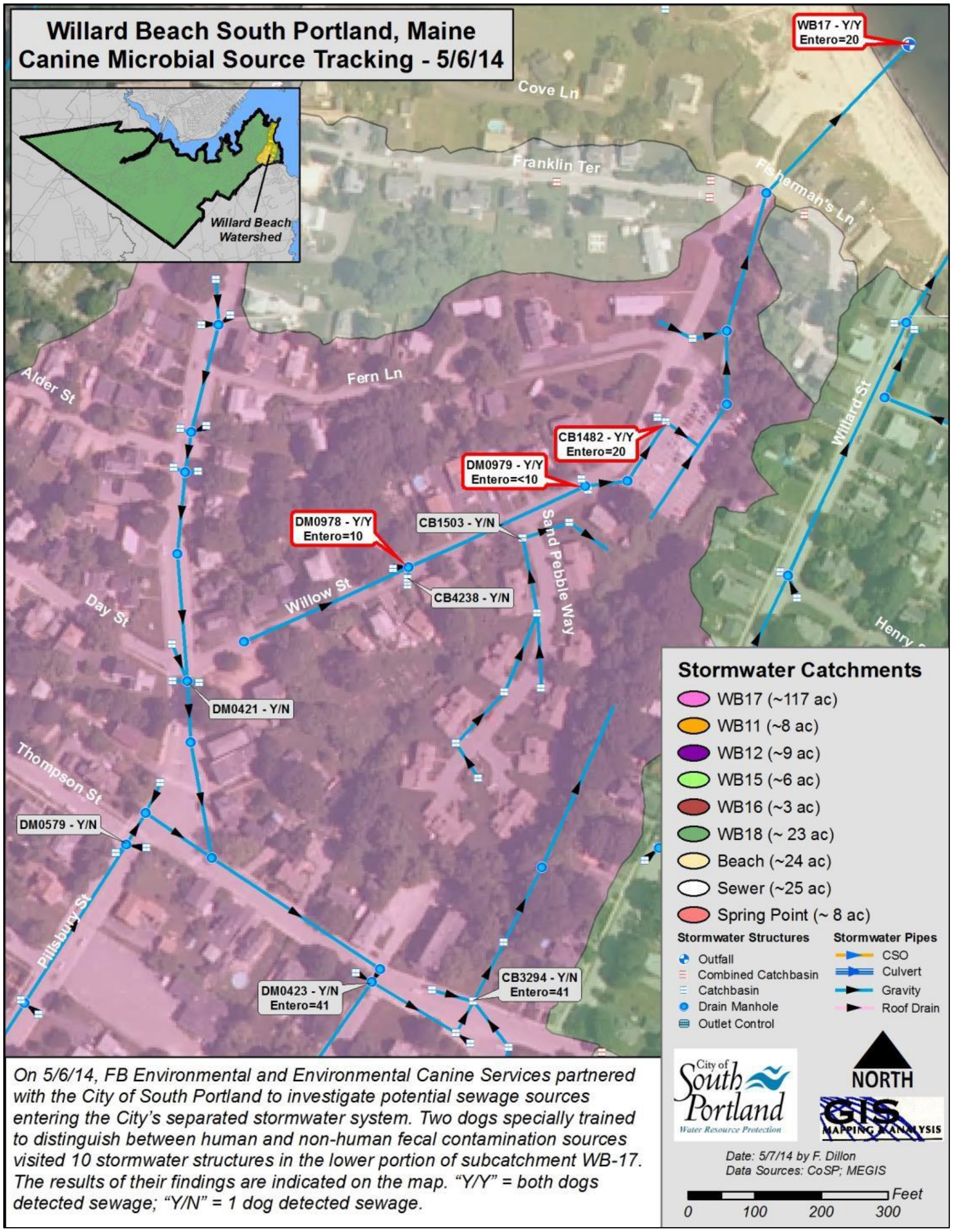


Figure A5. Willard Beach Canine Source Tracking Results (May 2014).

Community Outreach Events

Since 2014, the City has participated in the annual April Stools Day event hosted by PetLife and Friends of the Eastern Promenade to educate the public about responsible pet waste management and efforts to protect the city's water resources (Figure A6).

2017 APRIL STOOLS DAY FOR CLEANER WATER RESOURCES & PARKS

On April 22nd (Earth Day), after a long, hard winter of frigid temperatures and seemingly unending snow storms, residents from South Portland and surrounding communities endured another cold and damp day to walk their dogs in the City's parks. Like the previous three years, City staff and project partners were there to greet them at Hinckley Park, Willard Beach and Bug Light Park for our 4th annual "April Stools Day." The City once again partnered with Pet Life, the Maine Healthy Beaches Program and the Friends of the Eastern Promenade in Portland. The event was held to raise awareness about the adverse effects of improper pet waste disposal. Rainwater or snow melt can carry parasites, bacteria and viruses from dog waste left on the ground into nearby surface waters resulting in health risks to canines and humans. Dog waste can also degrade water quality by promoting algal growth and decreasing dissolved oxygen levels.

At Hinckley Park, Pet Life Manager Jessie Ellebracht and South Portland Stormwater Program Coordinator Fred Dillon provided visitors with "doggie bags", dog treats and store coupons along with a quick overview of why picking up dog waste is so important for local water quality protection efforts. Meanwhile, citizen volunteers from the South Portland Land Trust and Protect South Portland picked up over 50 pounds of dog waste from the trails and woods next to Hinckley Pond. Pet Life employees Patrick and Tanya Scott and Carrie London provided similar services at Willard Beach and Bug Light Park, respectively. Staff from the City's Parks & Recreation Department had the toughest part of the job in properly disposing of the dog waste collected at all 3 locations.

Pet Life's Jessie Ellebracht greets Protect South Portland volunteers at Hinckley Park.

Protect South Portland volunteers remove dog waste from the woods next to Hinckley Pond.

Despite inhospitable weather, Patrick and Tanya Scott provide smiles and goodies at Willard Beach.

Carrie London dispenses words of pet waste management wisdom at Bug Light Park.

5/1/17 *2017 April Stools Day Newsletter Article.docx*

Many of Hinckley Park's trails drain directly to a pair of ponds that flow into Casco Bay via Kimball Brook. At Willard Beach and Bug Light Park, the connection between poorly managed dog waste and Casco Bay is even more direct. Both locations are very popular destinations for swimmers, sunbathers and boaters in the summer. Dog waste left on the beach or ground in the surrounding neighborhoods has a much greater likelihood of coming into contact with humans and canines through direct discharge from the City's storm drain system. The City's life guards collect water samples to test for bacteria at Willard Beach during the summer months. Bacteria levels can be elevated significantly following a heavy rain event and it is likely that improperly managed dog waste is a contributor to this problem.

A sign on one of Hinckley Park's main trails reminds dog owners to properly pick up after their pets.

Pet Life Manager Jessie Ellebracht presents the "Golden Turd" award to Dan McLatchy at Hinckley.

Stormwater outfalls at Willard Beach can experience high bacteria levels after heavy rain storms.

Green flag at Willard Beach indicates low bacteria levels and safe swimming conditions in the summer.

Maine's Stormwater Permit requires South Portland and other regulated municipalities to conduct education & outreach efforts and increase public awareness about polluted stormwater runoff. Poorly managed dog waste is a small but important contributor to overall water quality problems because it is largely preventable. For more information about the City's Stormwater Management Program, please contact Stormwater Program Coordinator Fred Dillon at 207-347-4138 / fdillon@southportland.org.

The City would also like to thank Verbena and Otto's Pizza for their generous contributions to the 2017 April Stools Day event

5/1/17 *2017 April Stools Day Newsletter Article.docx*

Figure A6. Article for South Portland newsletter highlighting 2016 April Stools Day event.