**MAINE HEALTHY BEACHES PROGRAM
SUMMARY REPORT OF ENHANCED MONITORING AND
POLLUTION SOURCE TRACKING EFFORTS IN
THE WILLARD BEACH WATERSHED SOUTH
PORTLAND, MAINE
2012-2019**

Photo: Fred Dillon

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with assistance from
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July 2020

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Acknowledgements

Background

South Portland's Willard Beach is a popular recreation area. It is used primarily by families with young children, though a more diverse group of users also access the beach on a regular basis. Routine water quality monitoring at the beach revealed frequently 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.

Maine Healthy Beaches (MHB) partnered with the City of South Portland to conduct intensified monitoring of the Willard Beach stormwater drainage system for the past 8 years (2012-2019). In an effort to pinpoint human pollution sources, the pollution source tracking toolbox approach was used. This method incorporates the collection of data for multiple parameters and monitoring efforts in the Willard beach stormwater system have included: enterococci (ENT) bacteria, optical brighteners (OBs), surfactants, canine detection, pharmaceutical, personal care products (PPCPs), chlorine, ammonia, and microbial source tracking (MST). Typically, as the number of parameters exceeding a threshold or detectable limit increases, so does the confidence that human pollution sources are impacting water quality.

ENT is a fecal indicator bacteria (FIB) that indicates the presence of fecal contamination from warm-blooded animals and the possible presence of disease-causing microorganisms. However, FIBs like enterococci do not differentiate sources of bacterial pollution (e.g. wildlife versus a leaking septic system) and can persist and regrow in the environment. The additional toolbox parameters noted above can be used to target human contamination sources. OBs are commonly used in commercial/retail products such as clothing detergents, dishwashing agents, and personal care products to brighten the whiteness of materials. OBs 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 an illicit discharge. Additionally, the presence of elevated surfactant, chlorine, and/or ammonia levels may also indicate a location with a nearby illicit discharge. Canine detection involves the deployment of dogs trained to detect the scent of human sewage. MST methods target unique DNA markers from specific source hosts, 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 DNA marker, assisting with tracking contamination to the source.

There are six 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 catchments WB15, which collects stormwater from the SMCC athletic fields, and WB17 and WB18, which collect stormwater from a predominantly residential area with several interspersed commercial enterprises. Outfalls WB11, WB12, and WB16 typically have very low discharge volumes and were not consistently monitored as part of this study (Figure 1).

Willard Beach South Portland, ME
2012-2019 Stormwater System Monitoring

Willard Beach Watershed

WB_11

CB_5012

CB_5779

CB_5014

Myrtle Ave

WIL-02

Watershed Area ~ 223 acres

WB_17

DM_1045

DM_0507

Franklin Ter

Fern Ln

Day St

Willow St

Henry St

Lovellt St

DM_0424

DM_0423

CB3294

CB1599

Simonton St

DM_0294

Coolidge Ave

DM_0332

Cottage Rd

In 2019, the City continued partnering with the Maine Healthy Beaches Program on stormwater system monitoring in the Willard Beach watershed. Enterococcus and optical brightener samples were collected simultaneously to distinguish between human and non-human bacteria sources. A limited number of human bacteroides and canine DNA samples were also collected.

○ 2018-19 Sample Locations

Stormwater Catchments
- WB11 (~8 ac)
- WB12 (~9 ac)
- WB15 (~6 ac)
- WB16 (~3 ac)
- WB17 (~117 ac)
- WB18 (~ 23 ac)
- Beach (~24 ac)
- Sewer (~25 ac)
- Spring Point (~ 8 ac)

Stormwater Structures
- Outfall
- Combined Catchbasin
- Catchbasin
- Drain Manhole
- Outlet Control

Stormwater Pipes
- CSO
- Culvert
- Gravity
- Roof Drain

City of South Portland Water Resource Protection

GIS MAPPING & ANALYSIS

NORTH

Date: 4/24/19 by F. Dillon
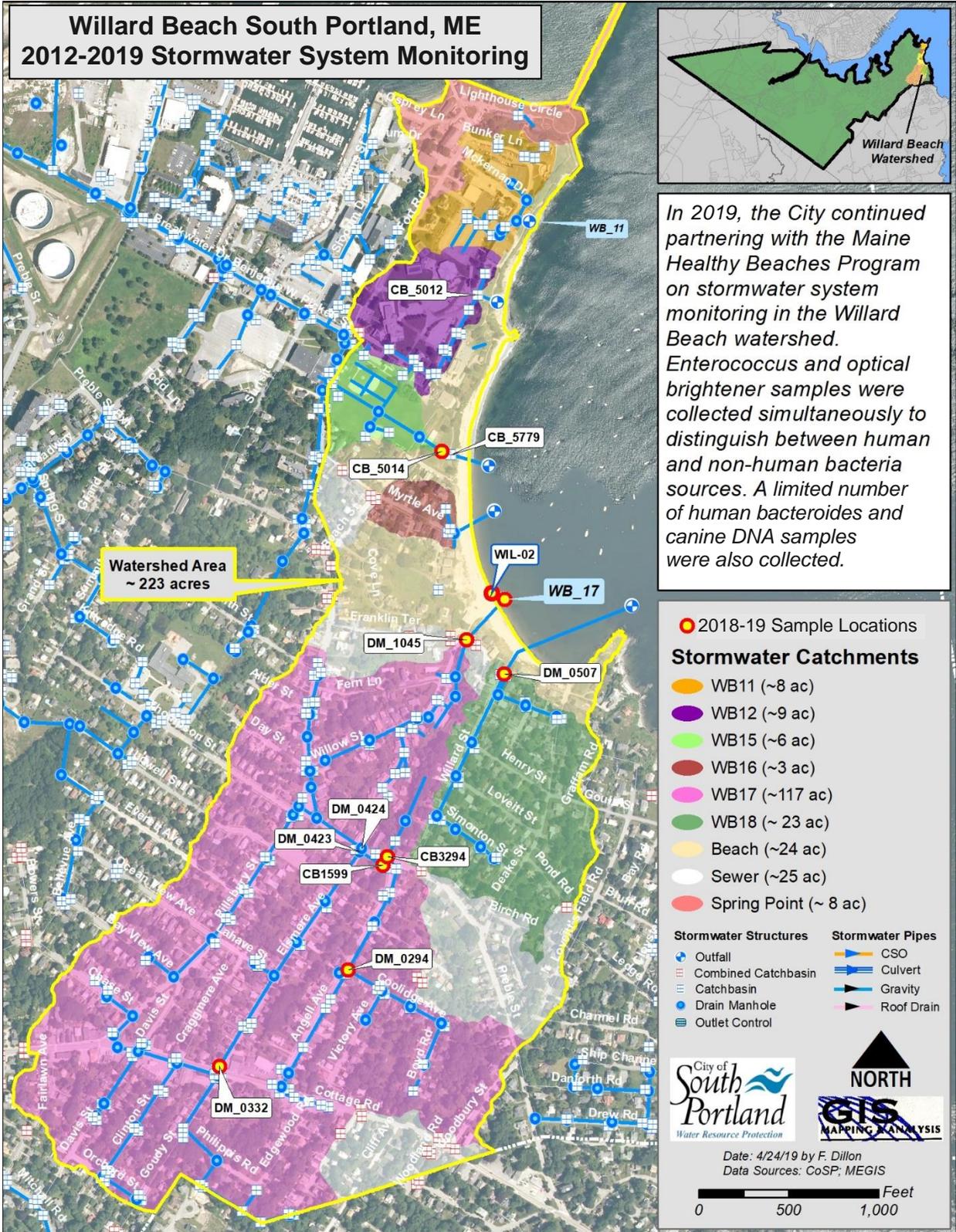Data Sources: CoSP; MEGIS

Feet
0   500   1,000

Figure 1. Willard Beach stormwater drainage area (yellow outline) and stormwater sampling sites/structures monitored by City of South Portland Water Resource Protection Department (2012-2019).

Project Methods

The City of South Portland has used an adaptive monitoring approach for the Willard Beach stormwater system since 2012, including the consideration of wet weather prior to monitoring (ensuring adequate water flow) and suspected bacteria "hot spots" (i.e. areas with consistently elevated bacteria levels). As part of this approach, monitoring locations and sampling frequency have varied over time. Locations consistently monitored[1] include five stormwater drainage structures (DM0507, CB3294, CB5779, DM0332, DM1045), and one site on Willard Beach (Wil 02), also routinely monitored by MHB Program volunteers during the summer season (Memorial Day-Labor Day). Remaining locations represent opportunistic collection events (Figure 1).

Enterococci and Optical Brighteners
Since 2012, approximately 230 paired ENT and OB samples have been analyzed at 16 subsurface structures located within the stormwater system and one site located on Willard Beach. In 2019, 9 ENT and 7 OB samples were collected at five sites including four subsurface structures, and one beach site (WIL-02) (Figures 1, A1-A2; Table A1).

Ammonia, Surfactants, and Total Residual Chlorine
In 2015-2016, limited monitoring of ammonia, surfactants, and total residual chlorine (TRC) was conducted throughout the watershed to help further isolate human bacteria sources. 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, four structures were tested on a single date for surfactants and TRC. Efforts in 2016 included monitoring four structures on two dates (8/8/2016 and 9/14/2016) for surfactants, TRC, and ammonia (see appendix A for structures tested). The City plans to resume TRC and ammonia monitoring in 2020.

Canine Detection
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. For both seasons, stormwater structures were located in sub-catchment WB17.

Microbial Source Tracking
In 2016, 2018, and 2019, 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 two structures (2016), in late October at three structures (2018), and in mid-August at three structures (2019). Locations chosen represented those suspected to be impacted by human sourced fecal contamination. Sample analyses included polymerase chain reaction (PCR) assays to determine the presence/absence of both general mammal, human, and canine fecal DNA markers and quantitative PCR (qPCR) to assess the presence and strength of the detected markers.

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[1] DM0332 2012-2013, 2015-2017; DM1045 monitored 2013-2013, 2015-2016, 2018.

Risk Factor Matrix

To better understand locations requiring further investigation, results were combined into a risk assessment matrix highlighting suspect areas warranting further investigation by South Portland (Table 2)[2]. Typically, as the number of parameters that exceed a threshold (or detectable) limit increase, so does the confidence that human source(s) may be contributing. Although wildlife, pet, and waterfowl waste can contribute to impaired water quality, it is recommended to target human sources first.

Results

Enterococci and Optical Brighteners

Combining data from 2012-2019, the site specific ENT geometric mean[3] results ranged from 29-552 MPN/100mL and from 11-120 µg/L for mean OBs.[4] All monitoring locations except DM0507 exceeded the US EPA-recommended ENT geometric mean safety threshold of 35 MPN/100mL for fresh waters, while two structures (CB3294 & CB1599) exhibited OB mean concentrations above 100µg/L, the value MHB considers as a lower threshold or "red-flag" for OB results with the potential for human wastewater contamination.[5] The combined ENT geometric mean value for all locations (120 MPN/100mL) was almost 3.5 times greater than the EPA-recommended geometric mean safety threshold. The combined OB mean value of 50 µg/L was well below the 100 µg/L threshold (Table 1, Figures 2-3).[6]

Structures CB3294, DM0332, DM0294, 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. Mean OB values were relatively low (less than 50 µg/L) for approximately half of sites consistently monitored (2012-2019), suggesting non-human sources (wildlife, pets) may be the principal contributors to stormwater bacterial pollution at these locations. However, human sources cannot be ruled out, as optical brightener concentrations varied between monitoring locations, with mean values for two routinely monitored structures (CB3294, CB1599) and two infrequently monitored structures (DM0423, DM0424)[7] exceeding the 100 µg/L threshold (Table 1, Figures 2-3).

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[2] Matrix includes sites/structures with five or more samples (2012-2018).

[3] A measure of central tendency used to account for large fluctuations (common for bacteria data) by putting less weight on outliers in a data set. Geometric means are calculated using the product of a set of values rather than the sum as is used to calculate the arithmetic mean (average). Any ENT results of <10 MPN/100mL were considered 5 MPN/100mL for calculations.

[4] Monitoring locations with five samples or greater included in ENT geomean and OB mean data comparisons. Data from all sites used for watershed-wide geomean calculation.

[5] All results exceeding the detection limit were considered 400 ug/L for calculations (the concentration of the standard).

[6] See Appendix A for 2019 data summaries.

[7] DM0423 sampled twice (average used), DM0424 sampled once (single sample value used).

Table 1. ENT geomean, OB mean, and sample size of monitoring locations (2012-2019).

Station	GeoMean ENT (MPN/100mL)	Mean OB (μg/L)	Sample Size
DM0507	29	11	40
WIL-02	60	13	38
CB5779	49	29	28
CB3294	433	120	38
DM1045	166	26	24
WB-17	157	31	19
DM0332	551	93	12
DM0294	293	67	13
CB1599	552	115	8
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
CB-5012**	10	17	1
All Sites	**120**	**50**	**230**

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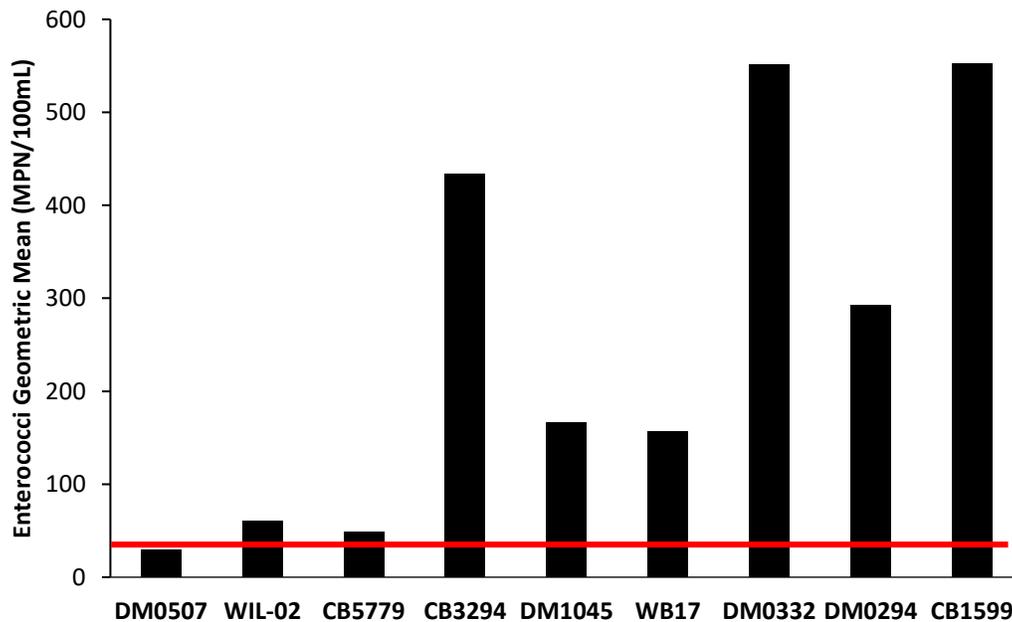

Figure 2. ENT geometric mean (MPN/100mL) concentrations for sites/structures monitored in the Willard Beach watershed from 2012-2019 (monitoring locations with five samples or greater included). Red solid line indicates Maine's EPA-approved ENT geometric mean safety threshold of 35 MPN/100mL for fresh water.
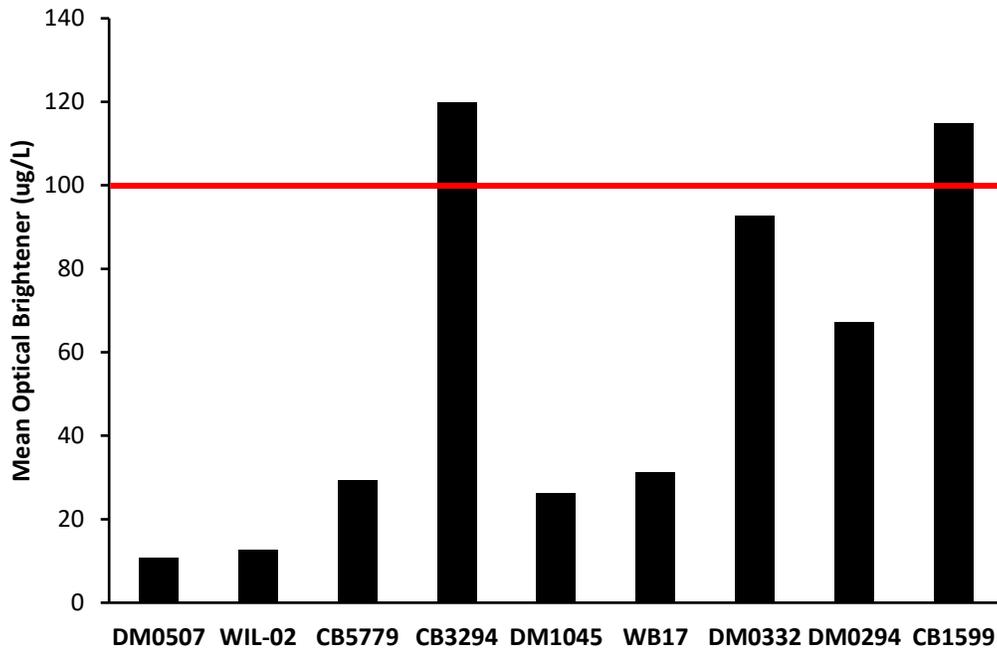
Figure 3. Mean OB (μg/L) concentrations for sites/structures monitored in the Willard Beach watershed from 2012-2019 (monitoring locations with five samples or greater included). Red solid line indicates the OB lower threshold level considered by MHB as a "red-flag" for potential human wastewater contamination (100 μg/L).

For systems like the Willard Beach stormwater system, where a majority of locations exhibit elevated ENT concentrations, a useful approach to identifying "hot-spots" of contamination is to examine how ENT concentrations at each site/structure deviate from the combined (all sites) ENT geomean. Deviation values can distinguish meaningful signals within a variable data set and can help identify the most problematic sites within a system. Sites with positive deviations for both ENT and OB levels represent locations potentially impacted by human sources.

Six structures (CB3294, DM1045, WB17, DM0332, DM0294, CB1599) positively deviated from the watershed ENT geomean (120 MPN/100mL) and 4 of those structures (CB3294, DM0332, DM0294, and CB1599) positively deviated from the watershed-wide OB mean (50 μg/L), suggesting human-sources are potentially contributing to elevated ENT levels at these locations (Figures 1, 4-5).
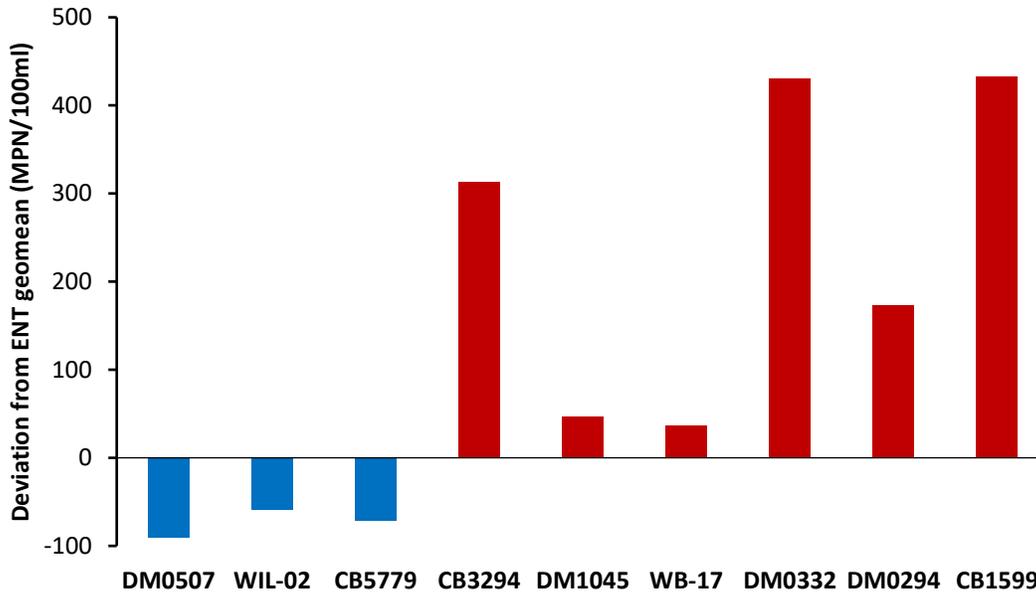
Figure 4. Deviations from the 2012-2019 combined ENT geometric mean (120 MPN/100mL) for stormwater sites/structures. Bars above X-axis indicate monitoring locations with 2019 ENT values greater than the 2012-2019 combined geomean and bars below X-axis represent values lower than the combined geomean (Note differences in sample size, Table 1).
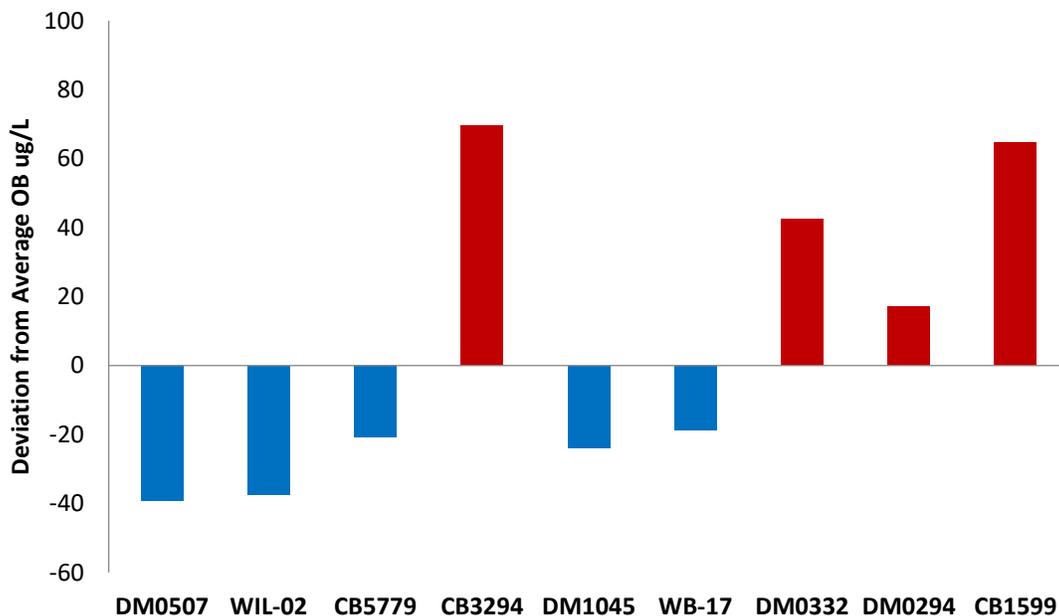

Figure 5. Deviations from the 2012-2019 combined OB mean (50 µg/L) for stormwater sites/structures. Bars above X-axis indicate monitoring locations with 2019 OB mean values greater than the combined 2012-2019 average value and bars below X-axis represent those lower than the average value (Note differences in sample size, Table 1).

Ammonia, Surfactants and Total Residual Chlorine
Monitoring was not conducted in 2019 for ammonia, surfactants, and TRC. In 2015-2016, limited monitoring at five 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, TRC, or ammonia concentrations above EPA thresholds.[8]

Canine Detection
Canine detection efforts were not conducted in 2019. Canine detection efforts were conducted in 2014 and 2016. It is useful to perform conventional ENT monitoring in conjunction with canine detection work to further determine potential source(s) of bacterial contamination. Elevated bacteria in the absence of human-source detections may indicate another mammalian source or possible regrowth in the stormwater system. ENT sampling was paired with the canine detection efforts when possible, as indicated below. In 2014, six of the 10 visited structures were sampled for ENT 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 one canine detected human sewage at six locations and both canines detected human sewage at the remaining four. Canine work in 2016 focused primarily on structures upland of those tested in 2014 and did not include ENT monitoring. Of the 15 structures tested in 2016, canines detected no sewage at four structures, one canine detected sewage at two structures, and both canines detected sewage at the remaining nine structures (Figures 6-8). The widespread detection of human fecal contamination by both canines in the WB17 sub-catchment suggests contamination in the separated stormwater system may be originating from nearby leaking sewer pipes, particularly those co-located with storm drains.
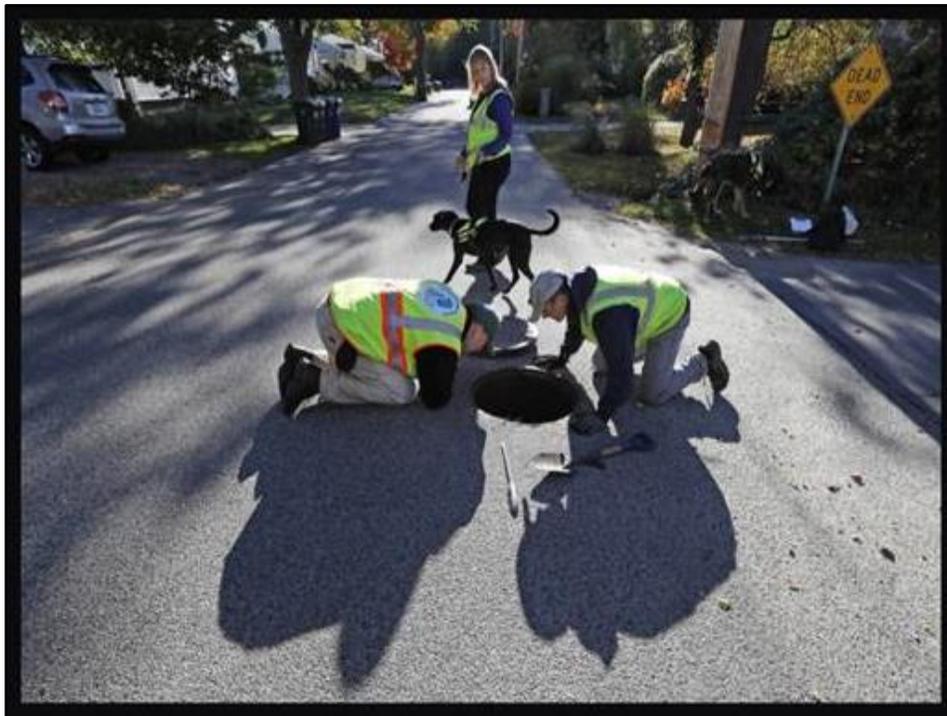
Figure 6. October 2016 canine detection event press (AP Photo/Robert F. Bukaty).

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[8] US EPA recommended screening threshold for surfactant and chlorine monitoring = ≥ 0.25 mg/L and ≥ 0.5 mg/L for ammonia.
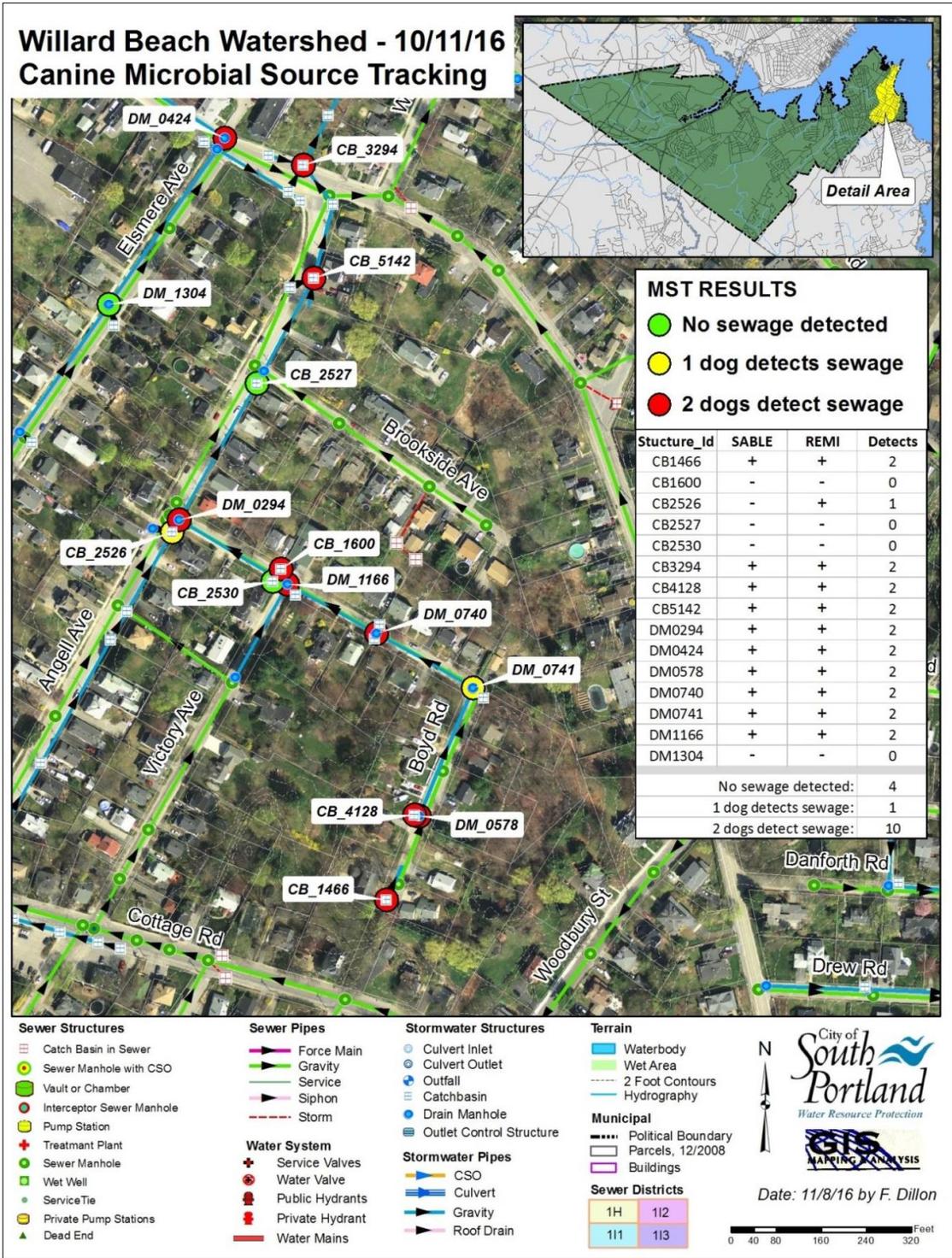
Figure 7. Willard Beach canine source tracking results (October 2016).

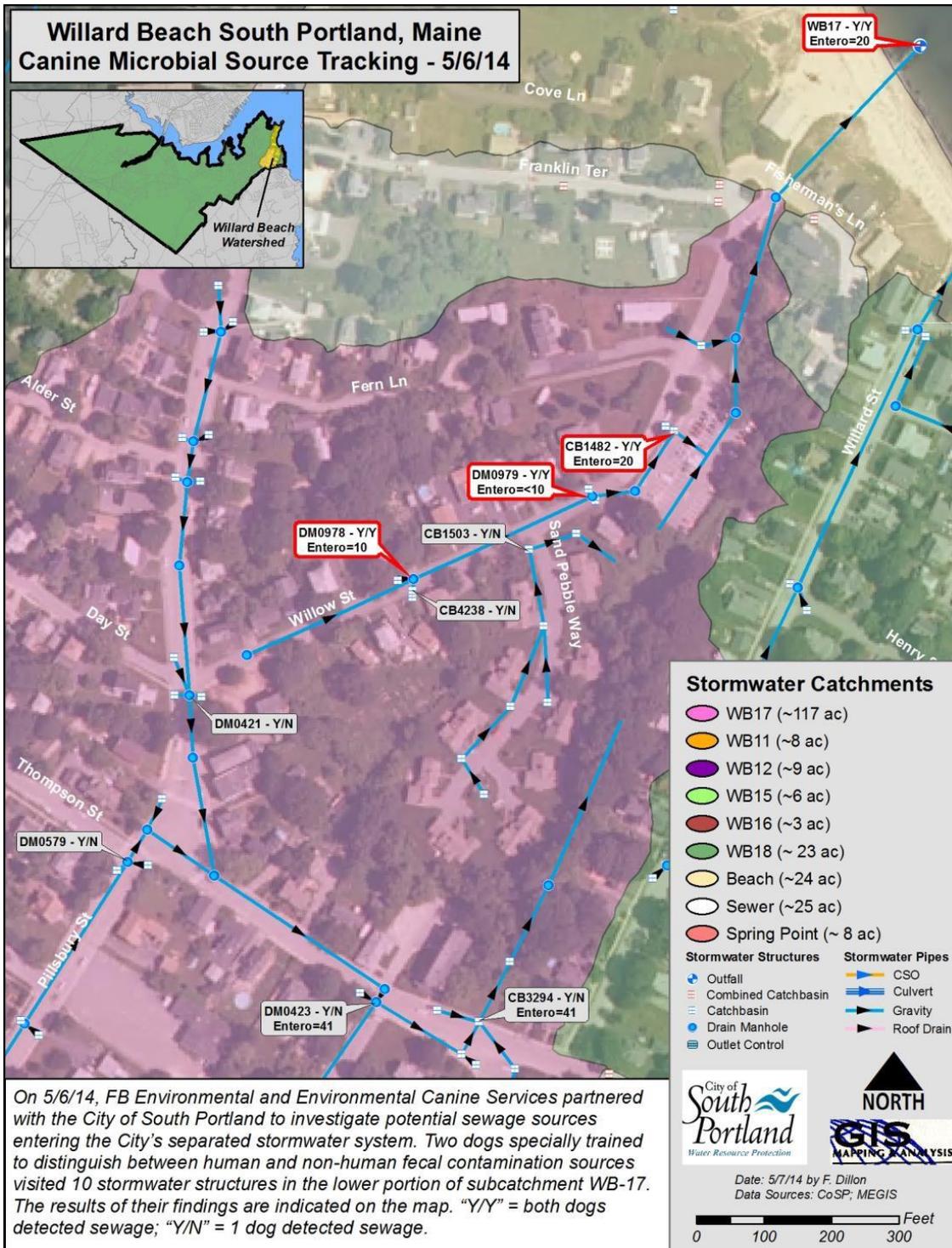| Stucture_Id	SABLE	REMI	Detects
CB1466	+	+	2
CB1600	-	-	0
CB2526	-	+	1
CB2527	-	-	0
CB2530	-	-	0
CB3294	+	+	2
CB4128	+	+	2
CB5142	+	+	2
DM0294	+	+	2
DM0424	+	+	2
DM0578	+	+	2
DM0740	+	+	2
DM0741	+	+	2
DM1166	+	+	2
DM1304	-	-	0
No sewage detected:			4
1 dog detects sewage:			1
2 dogs detect sewage:	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

Figure 8. Willard Beach canine source tracking results (May 2014).

Microbial Source Tracking
MST results indicated the presence of mammal sourced DNA at all structures tested (CB3294, DM1045, DM0294, and WB17). Canine and human DNA was detected at structures CB3294, DM0294, and WB17 (Table A2). These results suggest a combination of human and non-human sources may be contributing to bacterial pollution at those locations[9]. Structures CB3294 and DM0294 are located in the sub-catchment draining to stormwater outfall WB17 (Figure 1). Positive DNA source results suggest a recent fecal contamination event, as the markers quickly degrade outside of their hosts (approximately within 1 week). To better understand the strength of the human source detected, qPCR analysis was also conducted, resulting in a DNA copy number for human source DNA. Given the limited number of monitoring dates, it was not possible to use qPCR results to assess persistence of fecal sources or to track the source of contamination in this study. However, these copy numbers were compared to those obtained for other Maine watersheds and results indicate levels consistent with those found in areas of known or suspected human sewage contamination.

Risk Factor Matrix
Analyzing ENT results in conjunction with other parameters (e.g. optical brighteners, canines, MST etc.) may assist the City in better understanding the contributing sources of fecal pollution in the watershed. Risk matrix factors 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 geomean/mean values at sites/structures exhibited a positive deviation from the geomean ENT and mean OB values, if at least one canine detected human source(s) at a location, and if locations were positive for human MST markers (Table 2).

Monitoring sites/structures with ≥ 4 elevated/positive parameters are highlighted as priority locations 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 result that illicit source(s) are present at identified locations. Continued monitoring and investigations are needed at these locations to better understand what might be contributing to persistent contamination issues.

Table 2. 2012-2019 pollution source tracking toolbox risk factor matrix. Y= Yes, N=No, (-) = not monitored. Sites with five samples or greater included (with the exception of canine detection results where sites were monitored 1-2 dates only).

Monitoring Site/Structure	ENT ≥ 35 MPN/100mL	OB ≥100 µg/L	+ Dev. from ENT Mean	+ Dev. from OB Mean	+ Canine Detection	+ MST (human)
CB5779	Y	N	N	N	-	-
Wil-02	Y	N	N	N	-	-
WB17	**Y**	**N**	**Y**	**N**	**(Y/Y)**	**Y**
DM1045	Y	N	Y	N	-	N
DM0507	N	N	N	N	-	-
CB3294	**Y**	**Y**	**Y**	**Y**	**(Y/Y)**	**Y**
CB1599	**Y**	**Y**	**Y**	**Y**	**-**	**-**
DM0332	**Y**	**N**	**Y**	**Y**	**-**	**-**
DM0294	**Y**	**N**	**Y**	**Y**	**(Y/Y)**	**Y**

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[9] 2016, 2018, and 2019 results combined.

Discussion

All problematic sites/structures identified in the risk matrix were located within sub-catchment WB17 (pink sub-catchment in Figure 1). This is the largest sub-catchment in the watershed. Problematic locations were primarily located along Preble St. between Elsmere Ave. and Angell Ave. as well as a few upland structures draining to this region (Figure 1). Geomean values for all structures highlighted in Table 2 were greater than the 2012-2019 watershed-wide ENT geomean, and average OB values for four structures (CB3294, CB1599, DM0332, DM0294) tested above the watershed OB mean (Figures 4-5). Three sites tested positive for human-sourced fecal contamination using canine detection and MST (WB17, CB3294, DM0294) (Tables 2, A2).

Although a cross connection at DM0294 (discharging into CB3294) was repaired in late 2014, consistently elevated ENT and OBs have persisted at structure CB3294 and upland structures for the past several years (Figure 9-10, 12, A1-A2; Table A1). These results, coupled with limited seasonal precipitation, positive human DNA detection at WB17, CB3294, and DM0294 (and upland structures for human-sourced sewage-sniffing dog detections), suggest human sources are still contributing to elevated bacteria in this region. Using these results to guide CCTV and dye testing efforts, the City successfully identified and remediated an inadvertent cross connection between a private residence's internal plumbing and the City's stormwater system in 2017 (Figures 9-10). Although another human source has been removed, elevated bacteria levels continue to persist in this sub-catchment.

Impaired water quality within the stormwater system draining to Willard Beach is likely due to a combination of point (e.g. leaky sewers, cross-connections between sewer and stormwater infrastructure) and non-point (e.g. runoff including waste from humans, pets, and wildlife) pollution sources. Results suggest structures DM0507, CB5779, and DM1045 may be impacted primarily by non-human sources of bacterial pollution (wildlife, pets) while the primary contributors to elevated bacteria for the majority of the remaining routinely monitored structures (particularly associated with sub-catchment WB17) are likely human-sourced. 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.

Much of the sewer system in the Willard Beach watershed (and throughout New England) has been in service for well over 50 years. 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 11). The prevalence of impervious surfaces has been strongly correlated to bacteria concentrations in downstream surface waters.

To better understand and address the source(s) of pollution impacting water quality on Willard Beach, it is essential to continue monitoring of the stormwater system as well investigate and implement upgrades to existing infrastructure. Ongoing efforts to educate residents about the effects of land use activities (e.g. responsible pet waste management, impacts of stormwater runoff, potential illicit connections between sanitary and stormwater infrastructure) on water quality will be a critical component in any attempts to reduce bacteria loading to Willard Beach.
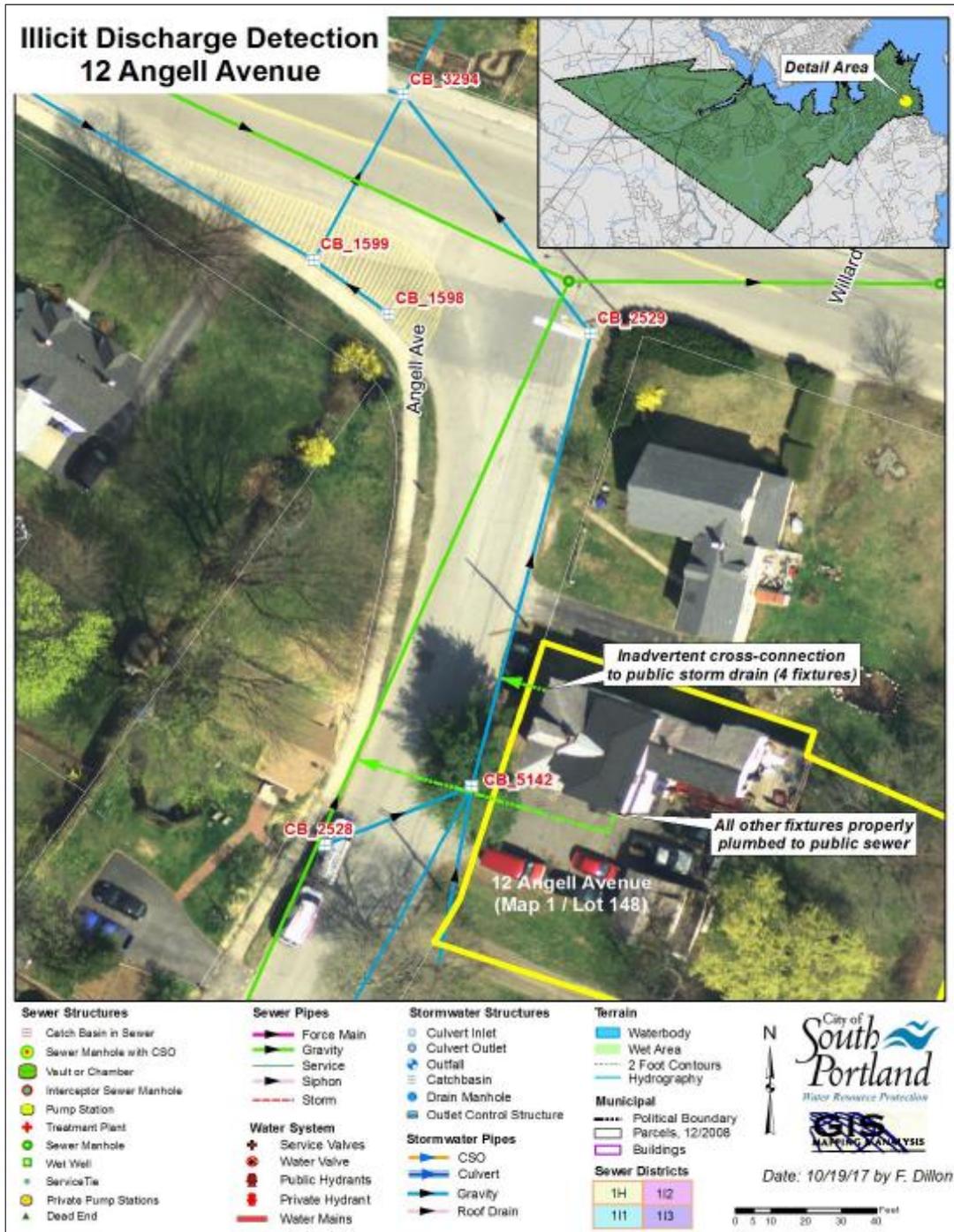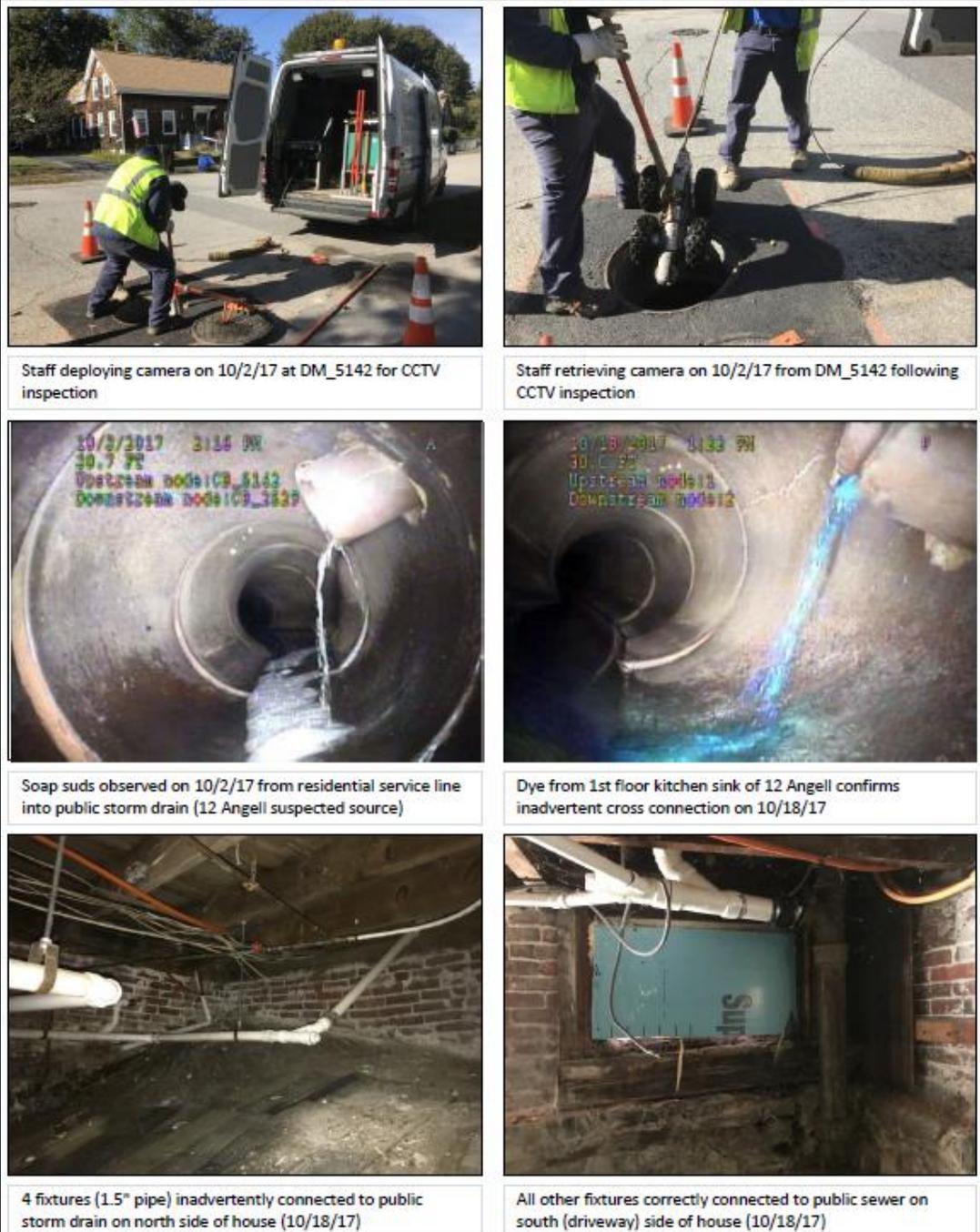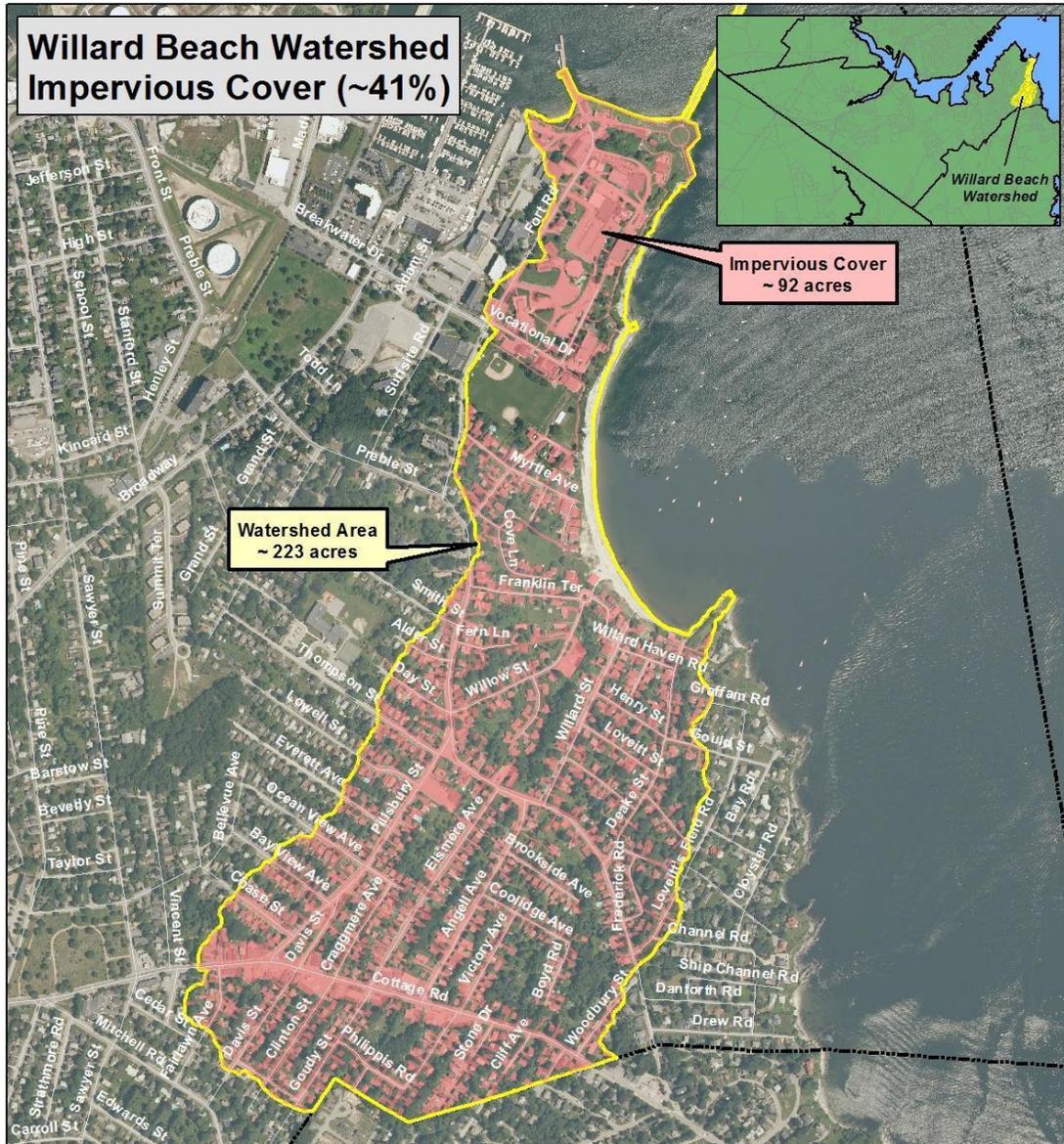
Figure 9. Stormwater system repairs including the removal of a cross connection within the Willard Beach watershed along Angell Ave. in 2017.

Figure 10. Detailed identification and repair efforts for the removal of a cross connection within the Willard Beach watershed along Angell Ave. in 2017.

Figure 11. Willard Beach watershed drainage area (yellow line) and % impervious coverage.

Local Actions to Improve Water Quality & Next Steps

In 2019, the City continued routine/ongoing improvements and maintenance to sewer and stormwater infrastructure, including street sweeping and catch basin and sewer line cleaning. The City continued implementing an ordinance to reduce the use of synthetic pesticides and is in the process of establishing a fertilizer ordinance in 2019-20.

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 13). 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 12). A recent review of the TV inspection videos also identified several residential foundation drain laterals connected to the City's storm drain, though no overt signs of potential sewage were observed. The City will dye test these laterals in 2020 to confirm no potential cross connections exist.
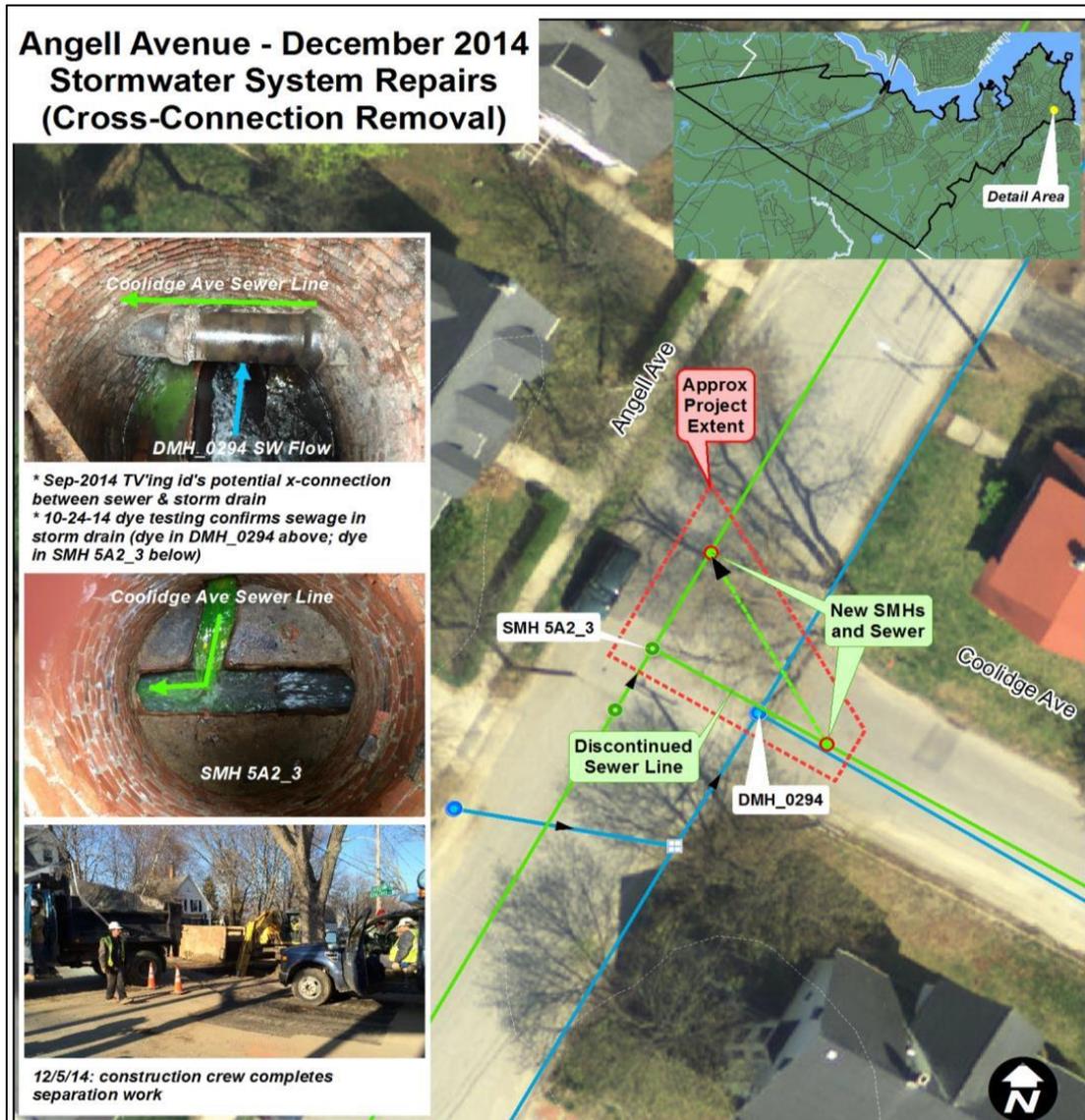

Figure 12. Stormwater system repairs including the removal of a cross connection within the Willard Beach watershed along Angell Ave. (Dec. 2014).

In 2020, South Portland Water Resources Protection 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 a review of the City's CCTV inspection records to identify laterals into the stormwater system and dye and/or smoke 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

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

be assessed and repaired as needed. Potential repair options include cured in place pipe lining or pipe replacement and relocation.
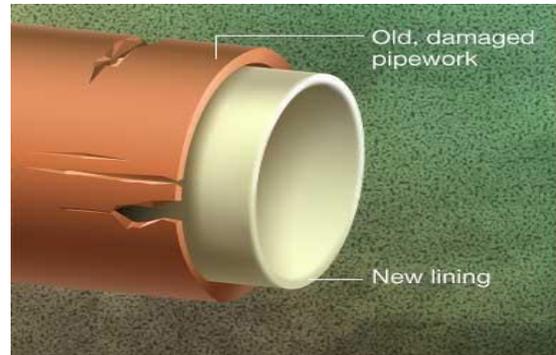
Monitoring efforts in 2020 include plans by the City to continue paired enterococci and optical brightener monitoring as well as resume chlorine, ammonia, and possibly MST testing to further hone in on human sources.

Figure 13. City of South Portland's closed-circuit television inspection van assessing the condition of the sewer and stormwater systems in the Willard Beach watershed.

Additionally, South Portland continued education/outreach initiatives to promote water resource protection, including numerous presentations to municipal officials and local schools in 2019. From 2014-2017, the City 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 (Figure 14). 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 watershed. South Portland also continued upgrades to sewer and stormwater infrastructure and posting precautionary rainfall advisories and flags at Willard Beach following moderate to heavy rainfall.

In 2020, the City is expanding its efforts to inform dog owners regarding the impacts of improper pet waste disposal, particularly in the Willard Beach and Hinckley Park areas, and will continue to partner with MHB to promote responsible management of pet waste.

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 14. Article for South Portland newsletter highlighting 2017 April Stools Day event.

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.
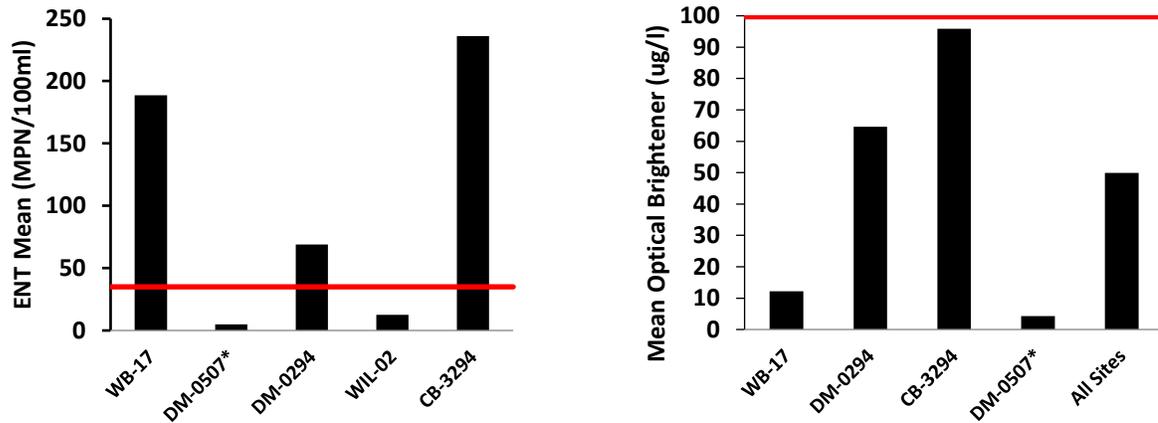
Appendix A- 2019 Data Summaries

2019 Data Summaries

Table A1. Mean ENT (MPN/100mL), mean OB values (μg/L), and sample size of 2019 monitoring sites (mean ENT used due to small sample sizes <5).

Station	Mean ENT	Mean OB	Sample Size
WB-17	188.5	12.2	2
DM0507*	5	4.3	1
DM0294	69	64.6	2
WIL-02	12.5	NA	2
CB3294	236	95.9	2
Total	**141.7**	**45**	**9**

*Single Sample

Figures A1 & A2. 2019 mean ENT (MPN/100mL) and mean OB (μg/L) concentrations for Willard Beach watershed sites. Red line (left) indicates EPA-recommended ENT geometric mean freshwater safety threshold of 35 MPN/100mL. Red line (right) indicates the OB lower threshold level considered by MHB as a "red-flag" for potential human wastewater contamination (100 μg/L).

Table A2. 2016, 2018, and 2019 PCR/qPCR summary for Willard Beach watershed monitoring locations. All percentages are rounded to the nearest whole number.

Monitoring Location	Samples Submitted	Source Marker Percent Detection Samples Submitted, Samples Positive, % Detected		
		Mammal	Human	Canine
CB3294	4	4, 4, 100%	4, 4, 100%	3, 3, 100%
2016	1	1, 1, 100%	1, 1, 100%	-
2018	1	1, 1, 100%	1, 1, 100%	1, 1, 100%
2019	2	2, 2, 100%	2, 2, 100%	2, 2, 100%
DM0294	2	2, 2, 100%	2, 1, 100%	2, 2, 100%
2018	1	1, 1, 100%	1, 1, 100%	1, 1, 100%
2019	1	1, 1, 100%	1, 0, 0%	1, 1, 100%
DM1045 (2016)	1	1, 1, 100%	1, 0, 0%	-
WB-17	3	3, 3, 100%	3, 1, 33%	3, 1, 33%
2018	1	1, 1, 100%	1, 1, 100%	1, 1, 100%
2019	2	2, 2, 100%	2, 0, 0%	2, 0, 0%
2016 Total	2	2, 2, 100%	2, 1, 50%	-
2018 Total	3	3, 3, 100%	3, 3, 100%	3, 3, 100%
2019 Total	5	5, 5, 100%	5, 2, 40%	5, 3, 60%
Total	10	10, 10, 100%	10, 6, 60%	8, 6, 75%