GROWING AREA EM

Pleasant River Bay, Washington County

Sanitary Survey Report

Report Date: 12-28-2016

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Executive Summary

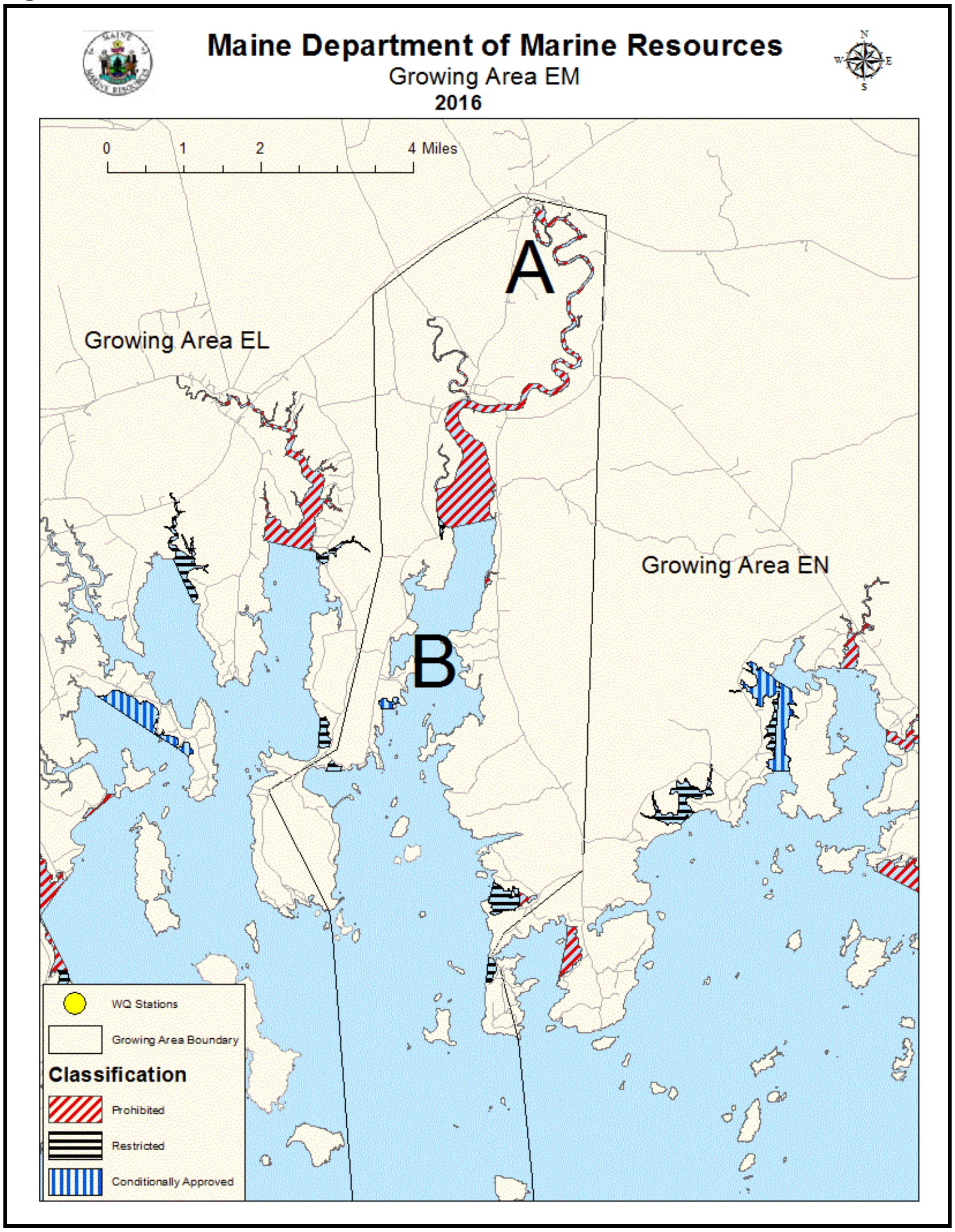
This is a Sanitary Survey report for growing area EM written in compliance with the requirements of the 2015 Model Ordinance and the National Shellfish Sanitation Program (NSSP). No changes in classification are needed at this time. In the last triennial period two stations EM 9 and EM 12 were deactivated because of access, two inactive stations EM 8 and 9 were reactivated, a new station EM 12.5 was created. In 2014, a new seasonal Conditionally Approved (CA) area was created in Ramsdell Cove (53-A (D.1)) at station EM 3. One new Z station EM 3.1 was added to help defend the seasonal CA boundary. In 2015, the Restricted area 53 H (B1) was expanded, a new Prohibited area, 53 A (B2) Harrington was promulgated and a new Restricted area was created, 53-H (B.2). Any necessary changes will be discussed in the summary of this report. The next sanitary survey is due in 2028 and the next Triennial in 2019.

The growing area lies entirely within the towns of Columbia Falls, population (584), Harrington, population (900), Addison, population (1209), and Columbia, population (445). The main branch of the river is tidally influenced inland to Columbia Falls. There are no municipal sewage treatment facilities in these towns, however there are 10 private licensed overboard discharges between the towns of Columbia Falls, Addison Village and Cape Split. Development along this shore is spotty with clusters of many homes separated by undeveloped land. The upland land cover is predominately evergreen, deciduous and wetland forest with minimal development. All dwellings within 500 feet of the shore, water conduits-ditches or streams or pollution sources were surveyed. In this manner the locations of the pollution problems were identified. Descriptions of all properties and their septic situations are included in the shoreline survey (see Sanitary Survey MARVIN files).

The growing area includes the near sub-tidal waters, inter-tidal flats and a zone of shore property that extends inland to a definite up-land boundary. The upland boundary of this area is described as follows: East of the Marshville Road in Harrington, then southerly of US Route 1 from the intersection of the Marshville Road in Harrington to the intersection of the Indian River Road in Columbia Falls, then westerly of a line drawn due South from Tracy Corner to the Mooseneck Rd in Addison, then west of the Mooseneck Rd in Addison to the intersection of Mooseneck Rd and Cape Split Rd in Addison, then west of the Cape Split Road to the southern end of the growing area.

The upland land cover is predominately evergreen, deciduous and wetland forest with minimal development. Much of upland Addison and Harrington are wetland and sandy glacial till. Blueberry fields are scattered throughout Addison, Harrington and Columbia Falls. Fresh water influence along these shores is the major source and transport mechanism for pollution in this growing area. There are two rivers draining into this area. These are the main and West branches of the Pleasant River. The drainage area for this area is 60.6 sq. /miles (USGS 01022260 Pleasant River near Epping, Maine). Numerous brooks and small streams can be found throughout the growing area. These have been evaluated microbiologically.

Figure 1. Area EM Overview



History of Growing Area Classification

2008: January 22, 2008, Area No. 53H was amended to reclassify a portion of the restricted area in Mash Harbor to Approved due to an updated shoreline survey and a dilution zone calculation for streams impacting the area.

2009: None.

2010: Prohibited area in notice 53A was expanded on 1/19/11 because of water quality not meeting the approved standard at station EM 10 (Figure 2). The closure line was moved down to the next station meeting the approved standard, EM 7.

2011: Area 53H closure was repealed on 5/2/11 because OBD was removed in 2010.

2012: None.

2013: None.

2014: On February 20th a new seasonal conditional area was created in Ramsdell Cove (Harrington).

2015: There were three classification changes that took place in 2015 for Growing area EM. Pollution Area No. 53-H (B.2) Cape Split Causeway, Addison was reclassified to Restricted based on 2014 P90 calculations for station EM 14. Pollution Area No. 53-A (B.2) Carrying Place Cove, Harrington was downgraded to Restricted because 2014 P90 data for station EM 1 does not meet approved standards. Pollution Area No. 53-H (B.1) and 53-H (A.1) Mash Harbor, Addison was reclassified to Prohibited for the head of the cove and Restricted for the mouth of the cove based on 2014 P90 calculations for stations EM 13 and 13.5

2016: A new prohibited area 53H (A3) was promulgated on 4/27/16 at Cape Split due to the presence of an OBD that was discovered during the 2016 shoreline survey.

Current Classification(s)

Please visit the DMR website to view Legal Notices:
http://www.maine.gov/dmr/rm/public_health/closures/closedarea.htm

At the end of the 2016 review year, shellfish growing area EM had areas classified as:

Restricted:
53 A (B1) Dyer Cove (Addison) NP
53 A (B2) Carrying Place Cove (Harrington) NP
53 H (B2) Carrying Place (Addison) NP
53 H (B1) Mash Harbor (Addison) NP

Conditionally Approved:
53 A (D1) Ramsdell Cove (Harrington) wildlife

Prohibited:
53 A (A1) Upper Pleasant River (Addison, Columbia Falls) OBD
53 A (A2) Batson Brook (Addison) NP
53 H (A1) Head of Mash Harbor (Addison) wildlife
53 H (A3) Cape Split (Addison) OBD

Activity during Review Period

2008: A drive through survey was conducted on August 5, 2008. Twenty-two stream samples were collected in 2008.

2009: A drive through survey was conducted on July 2, 2009. 8/12/09 stream sampling: 12 samples collected

2010: One OBD was removed in Cape Split, Addison and the station monitoring the area EM 15.5 was deactivated. The area is being recommended for an upgrade in classification to Approved. One old inactive station EM 12 was reactivated on 10/6/10. A drive through survey was conducted on October 7 and 14 2010.

2011: Fourteen stream samples were collected. A drive through survey was conducted on October 20, 2011.

2012: Drive through surveys were conducted on March 7, 13 and July 18, 2012

2013: A hot spot survey was conducted in and around Mash Harbor on 06/27/2013 and a drive through survey was completed on 07/31/2013. One potential pollution source was found.

2014: Shoreline Survey of 24 properties around Carrying Place Cove, Harrington conducted in September of 2014. September 26th the area around Mash Harbor was hot spot surveyed again no issues found. Drive through survey conducted on 12/2/14. Ramsdell Cove was surveyed on 1/29/14.

2015: On November 17th, 2015 a drive through survey of growing area EM was completed by DMR staff. A hotspot survey was completed on May 21st, 2015 in Cape Split/ Addison causeway.

2016: Complete shoreline survey was conducted in April 2016. One new pollution source was discovered in Cape Split and a new prohibited area was promulgated. Fifteen stream samples were collected in 2016.

Pollution Sources Survey

The following sections include information on pollution sources which do or may impact water quality in growing area EM. Pollution sources that are reviewed in this section include domestic waste, including both private inground systems and over board discharges (OBDs), marinas and mooring fields, stormwater and pollution from non-point sources (streams), farms and other agricultural activities, domestic animals and wildlife areas, and recreational areas.

Table 1. Area EM Pollution Source Table

GASS ID	Pollution Area	Major P source	Problem	Impact	Description
EM 8	53 A (B1)	FM	Y	AD	+/- 50 llamas
EM 8	53 A (B1)	ST	Y	AD	Stream drains small pond on llama farm
EM 10	53 A (A1)	IG	Y	AD	Riverview Apartments OBD
EM 21	55 A (A2)	ST	Y	AD	Batson Brook,
EM 27	53 H (A1)	ST	Y	PD	duck pond drainage
EM 27	54 H (A1)	ST	Y	AD	stream at cattle farm
EM 27	55 H (A1)	ST	Y	AD	stream at head of Mash Harbor
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 15	53 A (A1)	IG	Y	AD	OBD
EM 28	53 H (A3)	IG	Y	AD	OBD
EM 28	53 H (B.2)	IG	Y	AD	Failing septic

Figure 2. Pollution Source Map A

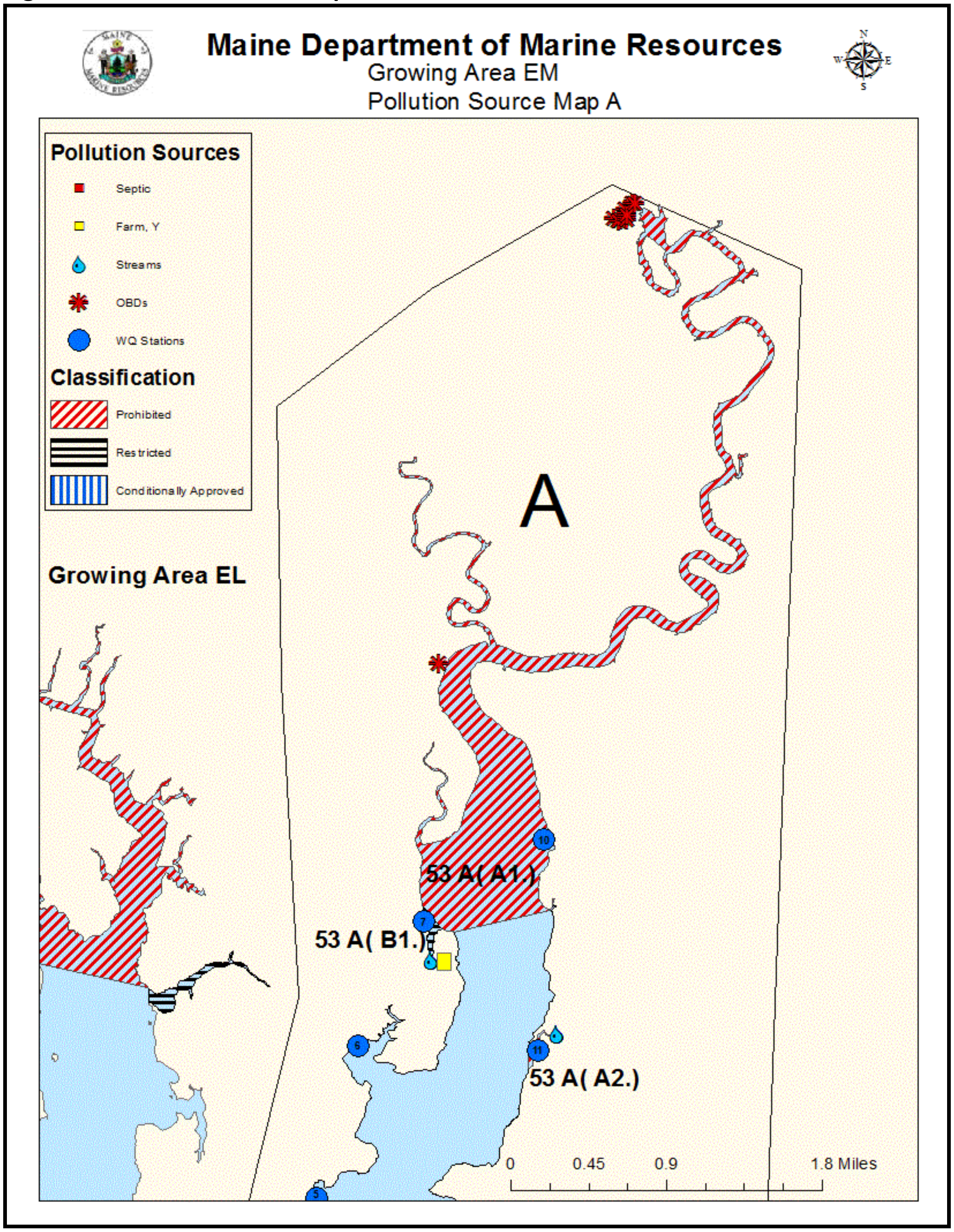
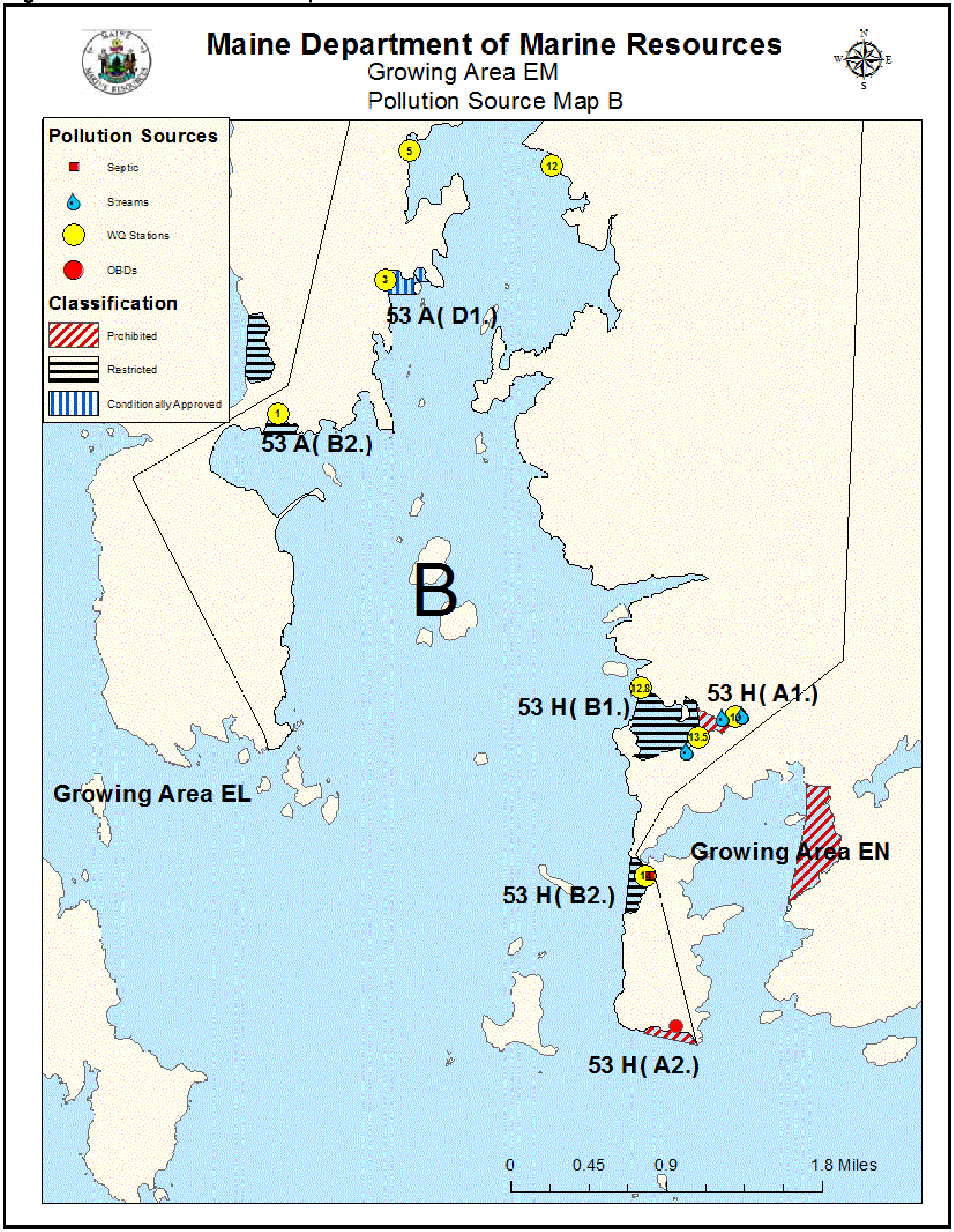


Figure 3. Pollution Source Map B



Domestic Waste (IG Systems and OBDs)

Growing area EM consists of 29 two-mile segments (GASSIDs) all within the towns of Addison, Columbia Falls, and Harrington. The growing area consists of 160 residential in ground (IG) systems. All domestic waste systems were visited in 2016 during the sanitary survey. There is only one known issue with residential septic systems. Two problem forms were filed with the town during the Shoreline Survey review period. One of these resulted in the expansion of closure 53 H (A3) in Addison due to a licensed OBD. The other issue was a septic breakout at a private residence found during a 2015 Hot Spot survey and resulted in closure 53 H (B2).

There are 10 over board discharges (OBDs) that discharge their treated effluent into the waters of Area EM (Figure 2). No OBDs have been removed over the past three review years.

An overboard discharge (OBD) is the discharge of wastewater from residential, commercial, and publicly owned facilities to Maine's streams, rivers lakes, and the ocean. Commercial and residential discharges of sanitary waste have been regulated since the mid-1970's when most direct discharges of untreated waste were banned. Between 1974 and 1987 most of the "straight pipes" were connected to publicly-owned treatment works or replaced with standard septic systems. Overboard discharge treatment systems were installed for those facilities that were unable to connect to publicly-owned treatment works or unable to install a septic system because of poor soil conditions or small lot sizes.

All overboard discharge systems include a process to clarify the wastewater and disinfect it prior to discharge. There are two general types of treatment systems; mechanical package plants and sand filters. Sand filter systems consist of a septic tank and a sand filter. In such systems, the wastewater is first directed to a holding tank where the wastewater solids are settled out and undergo partial microbial digestion. The partially treated wastewater then flows from the tank into a sand filter, consisting of distribution pipes, layers of stone and filter sand, and collection pipes within a plastic liner. The wastewater is biologically treated as it filters down through the sand and is then collected and discharged to a disinfection unit. Mechanical package plants consist of a tank, where waste is mechanically broken up, mixed and aerated; mechanical systems require electric power, and must have an operating alarm on a separate electrical circuit that will activate if the treatment unit malfunctions due to a power failure. The aerated treated wastewater is held in a calm condition for a time, allowing for solids to settle and for the waste to be partially digested by naturally occurring bacteria. The clarified water from the tank is then pumped off the top into a disinfection unit. There are two types of disinfection units, UV and chlorinators (most common). In a chlorinator, the treated water contacts chlorine tablets and remains in a tank for at least 20 minutes where bacteria and other pathogens are killed. The treated and disinfected water is discharged from the disinfection unit to below the low water mark of the receiving waterbody (the ocean, a river, or a stream) via an outfall pipe.

OBDs are licensed and inspected by the Maine Department of Environmental Protection. At each inspection, DEP looks for tags on each treatment unit identifying the service contractor and the last date of service. If an OBD is not properly maintained, or if the OBD malfunctions, it has the potential to directly discharge untreated wastewater to the shore; therefore, preventative closures are implemented surrounding every OBD located in growing area EM (Table 1). The size of each closure is determined based on a dilution, using on the permitted flow rate of the OBD (in gallons per day, GPD), and the depth of the receiving water that each OBD discharges to; the fecal concentration used for this dilution calculation is $1.4X10^5$ FC /100 ml. All current closures are of adequate size to protect public health.

Table 2. OBD dilution zone Area EM

Dep ID	Town	Mid Tide Depth	Flow GPD	Dilution in Acres Needed	Closure #	Acres Closed
2998	Addison	3	1800	18.41	53 A (A.1)	687
3405	Addison	4.5	300	2.05	53 H (A.2)	10
3406	Columbia Falls	4	480	3.68	53 A (A.1)	687
5102	Columbia Falls	4	315	2.42	53 A (A.1)	687
5103	Columbia Falls	4	315	2.42	53 A (A.1)	687
5104	Columbia Falls	4	315	2.42	53 A (A.1)	687
5105	Columbia Falls	4	315	2.42	53 A (A.1)	687
5106	Columbia Falls	4	300	2.30	53 A (A.1)	687
5107	Columbia Falls	4	315	2.42	53 A (A.1)	687
6212	Columbia Falls	4	300	2.30	53 A (A.1)	687

Marinas and Mooring Fields

There are no significant marinas in the survey area. There is one small anchorage/ mooring area in Addison village, which serves small workboats and one small commercial pier at Greens Point. Pleasure craft and boats likely to represent sewage pollution problems were not observed, and this anchorage is in an existing prohibited area. Individual moorings were observed associated with private properties in a few rare instances. General observations suggest that there is very little pleasure craft activity in this region and that the preponderance of boating activity is by fishermen. Marinas do not represent a threat to water quality in this survey area.

Stormwater

Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground. As the runoff flows over the land or impervious surfaces (paved streets, parking lots, and building rooftops), it accumulates debris, chemicals, sediment or other pollutants that could adversely affect water quality if the runoff is discharged untreated (US EPA 2009). Thus, stormwater pollution is caused by the daily activities of people within the watershed. Currently, polluted stormwater is the largest source of water quality problems in the United States.

The primary method to control stormwater discharges is the use of best management practices (BMPs). In addition, most major stormwater discharges are considered point sources and require coverage under an NPDES permit. In 1990, under authority of the Clean Water Act, the U.S. EPA promulgated Phase I of its stormwater management program, requiring permitting through the National Pollution Discharge Elimination System (NPDES). The Phase I program covered three categories of discharges: (1) “medium” and “large” Municipal Separate Storm Sewer Systems (MS4s) generally serving populations over 100,000, (2) construction activity disturbing 5 acres of land or greater, and (3) ten categories of industrial activity. In 1999, US EPA issued Phase II of the stormwater management program, expanding the Phase I program to include all urbanized areas and smaller construction sites.

Although it is a federal program, in the state of Maine, the Phase II Stormwater permit is issued and regulated by the Maine DEP (Chapter 500 and 502). Under the MS4 regulations, each municipality must implement the following six Minimum Control Measures: (1) Public education and outreach, (2) Public participation, (3) Illicit discharge detection and elimination, (4) Construction site storm water runoff control, (5) Post-construction stormwater management, and (6) Pollution prevention/good housekeeping. The permit required each city or town to develop a draft Stormwater Management Plan by September 3, 2003 that will establish measurable goals for each of the Minimum Control Measures. The Town must document the implementation of the Plan, and provide annual reports to the Maine DEP. Currently the discharge of stormwater from 28 Maine municipalities is regulated under the Phase II permit requirements, however, no municipalities located within the boundaries of growing area EM fall under these regulations. Additionally, the Maine Stormwater Management Law provides stormwater standards for projects located in organized areas that include one acre of more of disturbed area (Maine DEP 2009).

Non-Point Pollution Sources

Freshwater streams, drainages and tidal creeks are the major source of non-point discharge into Growing Area EM. Because of this we manage streams like point source discharges and will calculate dilution areas around them if they impact water quality in the area. A total of 95 samples were taken from freshwater streams during the review period. See pollution maps for stream and drainage locations and Table 3 for stream sample results.

Table 3. Area EM stream samples

Town	Stream ID	Date	CFU/100ml	Flow	Flow Unit	Area Number
Harrington	EM003-1	02-Jun-15	500	0.6	GPM	
Harrington	EM004-293	10-May-11	8			

Town	Stream ID	Date	CFU/100ml	Flow	Flow Unit	Area Number
Harrington	EM004-293	06-Aug-08	46			
Harrington	EM004-293	12-Aug-09	16			
Harrington	EM004-293	30-Sep-08	42			
Harrington	EM005-295	06-Aug-08	10			
Harrington	EM005-295	12-Aug-09	1.9			
Harrington	EM005-295	30-Sep-08	4			
Harrington	EM006-296	25-May-16	1.9			
Harrington	EM006-296	31-Oct-12	280			
Harrington	EM006-296	06-Aug-08	42			
Harrington	EM006-296	06-May-14	1.9	16	GPM	
Harrington	EM006-296	30-Sep-14	740			
Harrington	EM006-296	10-May-11	1.9			
Harrington	EM006-296	18-Sep-14	6	1	GPM	
Harrington	EM006-296	25-Jun-14	1700	3	GPM	
Harrington	EM006-296	30-Sep-08	154			
Addison	EM008-297	25-Jun-14	1700	3	GPM	53 A (B.1)
Addison	EM008-297	06-Aug-08	118			53 A (B.1)
Addison	EM008-297	31-Oct-12	144			53 A (B.1)
Addison	EM008-297	10-May-11	2			53 A (B.1)
Addison	EM008-297	07-Jun-16	52	5	GPM	53 A (B.1)
Addison	EM008-297	06-May-14	2	0.8	GPM	53 A (B.1)
Addison	EM008-297	30-Sep-14	36			53 A (B.1)
Addison	EM008-297	16-Dec-14	40			53 A (B.1)
Addison	EM008-297	25-May-16	380			53 A (B.1)
Addison	EM008-297	18-Sep-14	12	2	GPM	53 A (B.1)
Addison	EM008-298	30-Sep-08	25			
Addison	EM008-298	10-May-11	560			
Addison	EM008-298	06-Aug-08	118			
Addison	EM008-298	12-Aug-09	48			
Addison	EM008-299	10-May-11	120			
Addison	EM008-299	12-Aug-09	480			
Addison	EM008-299	06-Aug-08	152			
Addison	EM008-299	30-Sep-08	160			
Addison	EM009-300	10-May-11	14			
Addison	EM009-300	06-Aug-08	80			
Addison	EM009-300	31-Oct-12	240			
Addison	EM009-300	12-Aug-09	140			

Town	Stream ID	Date	CFU/100ml	Flow	Flow Unit	Area Number
Addison	EM010-301	06-Aug-08	102			
Addison	EM010-301	10-May-11	16			
Addison	EM020-302	31-Oct-12	114			
Addison	EM020-302	10-May-11	5			
Addison	EM020-302	06-Aug-08	36			
Addison	EM020-302	12-Aug-09	340			
Addison	EM020-303	10-May-11	480			
Addison	EM021-304	25-May-16	27			53 A(A.2)
Addison	EM021-304	13-Sep-16	200	5	GPM	53 A(A.2)
Addison	EM021-304	12-Aug-09	29			53 A(A.2)
Addison	EM021-304	18-Sep-14	16	387	GPM	53 A(A.2)
Addison	EM021-304	31-Oct-12	120			53 A(A.2)
Addison	EM021-304	06-May-14	1.9	0.8	CFS	53 A(A.2)
Addison	EM021-304	20-Aug-15	90			53 A(A.2)
Addison	EM021-304	10-May-11	20			53 A(A.2)
Addison	EM021-304	07-Jun-16	144			53 A(A.2)
Addison	EM021-304	06-Aug-08	10			53 A(A.2)
Addison	EM021-304	16-Dec-14	1.9	32	GPM	53 A(A.2)
Addison	EM021-304	30-Sep-14	54	2.4	GPM	53 A(A.2)
Addison	EM021-304	25-Jun-14	1700	1	GPM	53 A(A.2)
Addison	EM021-304	30-Sep-08	18			53 A(A.2)
Addison	EM021-304	29-Jun-16	700			53 A(A.2)
Addison	EM021-304	25-Oct-16	16			53 A(A.2)
Addison	EM027-306	25-Sep-13	6	5	GPM	
Addison	EM027-306	20-Jun-11	6			
Addison	EM027-307	06-May-14	2			53H(A.1)
Addison	EM027-307	18-Sep-14	1.9	2.8	GPM	53H(A.1)
Addison	EM027-307	25-Jun-14	1500	0.3	GPM	53H(A.1)
Addison	EM027-307	12-Aug-09	600			53H(A.1)
Addison	EM027-308	18-Sep-14	14			53H(A1.)
Addison	EM027-308	20-Jun-11	8			53H(A1.)
Addison	EM027-308	26-Jun-14	1700	1.5	GPM	53H(A1.)
Addison	EM027-308	02-Jun-15	1040	20	GPM	53H(A1.)
Addison	EM027-308	25-Sep-13	74	50	GPM	53H(A1.)
Addison	EM027-308	10-May-11	36			53H(A1.)
Addison	EM027-308	13-Sep-16	16	5	GPM	53H(A1.)
Addison	EM027-308	06-Aug-08	28			53H(A1.)

Town	Stream ID	Date	CFU/100ml	Flow	Flow Unit	Area Number
Addison	EM027-308	12-Aug-09	36			53H(A1.)
Addison	EM027-308	22-Sep-14	1.9	1	GPM	53H(A1.)
Addison	EM027-308	25-Oct-16	20	15	GPM	53H(A1.)
Addison	EM027-308	16-Dec-14	2	1	GPM	53H(A1.)
Addison	EM027-308	30-Sep-08	6			53H(A1.)
Addison	EM027-308	29-Jun-15	46	93	GPM	53H(A1.)
Addison	EM027-308	31-Oct-12	180			53H(A1.)
Addison	EM027-308	29-Jun-16	1700	0.08	GPM	53H(A1.)
Addison	EM027-308	07-Jun-16	80	1	GPM	53H(A1.)
Addison	EM027-308	25-May-16	60			53H(A1.)
Addison	EM027-318	25-May-16	1.9			53H(A1.)
Addison	EM027-318	22-Sep-14	8			53H(B.1)
Addison	EM027-318	29-Jun-15	60	0.8	GPM	53H(B.1)
Addison	EM027-318	06-Oct-14	64			53H(B.1)
Addison	EM027-318	02-Jun-15	1700	0.8	GPM	53H(B.1)
Addison	EM027-318	25-Sep-14	64			53H(B.1)
Addison	EM027-328	01-Nov-16	1060	2	GPM	

Agricultural Activities

There is one medium-sized agricultural operation in the study area, which practices husbandry of domestic animals. This is the Pleasant River Bed & Breakfast/Llama Keep. This llama keep raises llamas for sale to other livestock farms (for predator deterrence). In addition, they raise Red deer. The llama population fluctuates up to 50 animals at any one time and the number of Red deer is around 30. This farm is at the south end of Dyer Cove on the western shore of Pleasant Bay. The pastures for the llamas surround a tidal marsh and therefore pose a direct threat to the water quality here. Closure 53 A (B1) serves this area. The deer pasture is in a different area and has 200’ of grass buffer before hitting the shoreline.

Domestic Animals and Wildlife Activity

The salt marshes and mudflats of the growing area provide valuable habitat to a variety of wildlife. Commonly observed bird species include a variety of gulls, sea and inland ducks, cormorants, geese, great blue herons, egrets, swans, and others. Mammals living within the growing area include dogs, cats, whitetail deer, muskrat, squirrels, chipmunks, rabbits, moles, mice, bats, shrews, weasels, skunks, raccoons, and others. Maine Inland Fish and Wildlife surveys indicate that migratory waterfowl numbers begin to increase in the early autumn months, and typically peak in late fall or early winter. Although large numbers of birds can, in theory, pose a threat the growing area water quality, such occurrences are very difficult to document. No such significant water quality impacts have been documented for the area to date.

Conservation/Recreation Areas (beaches, trails, etc.)

There are no public beaches in this growing area. There are a few recreational hiking trails in this area that get limited use and pose no threat to water quality.

Hydrographic and Meteorological Assessment

Tides and Currents

Coastal Maine experiences a mixed, semi-diurnal tide, with diurnal inequalities that are more pronounced on spring tides. National Oceanic and Atmospheric Administration data for a station at Eastport indicate a mean tidal range of 18.35 ft.

Currents in the area are predominantly driven by the tides. All along the coast of eastern Maine, the tide generally floods to the north and east and ebbs to the south and west. Along the coast and in the wider bays, the current seldom exceeds 2 knots. Weather conditions affect tidal ranges and current speeds, sometimes very strongly. Strong winds may reverse the direction of currents.

To examine the effects that tidal stage might have on fecal coliform concentrations, data collected under the Systematic Random sampling strategy (all months, all samples) were queried for all active sample sites (2008-2016). The data were broken down into total samples all tide stages and then grouped by total samples for the flood tide stage, the ebb tide stage, the low; low ebb; and low flood tide stages and the high; high ebb; and high flood stages. The data were broken out this way to better represent how sample frequency occurred on the higher tide stage and the lower tide stage.

Table 4. Tide Stage Breakdown

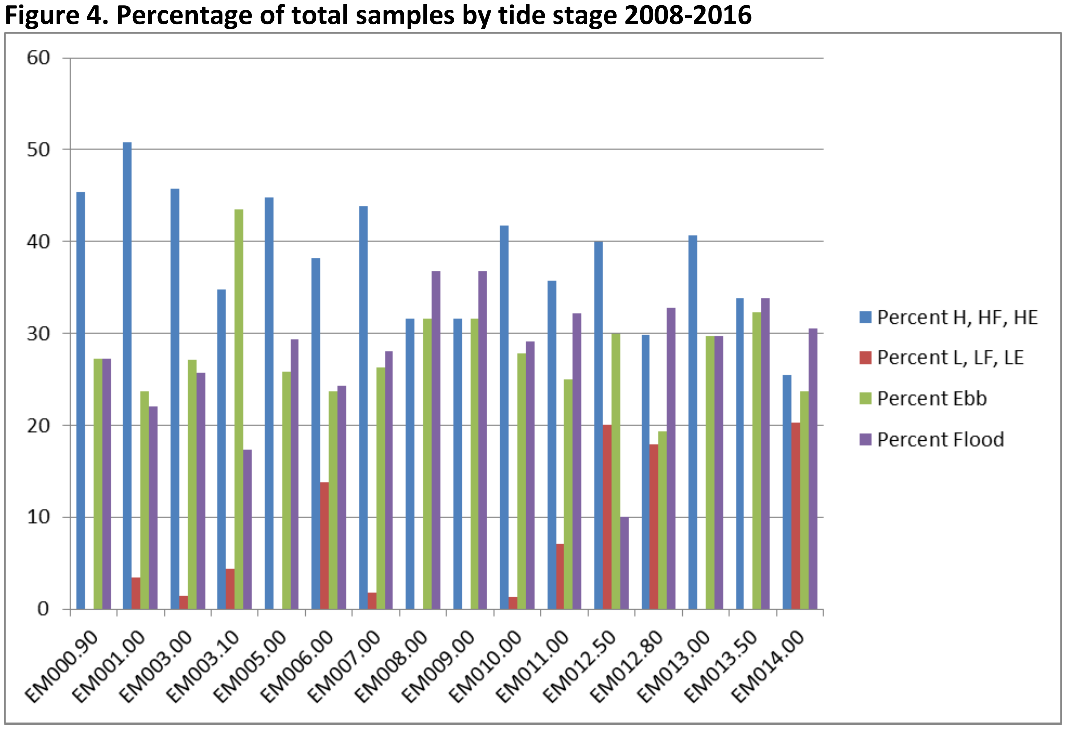
Tide stage	Minutes from Low tide
Low	(+-) 30 minutes
LF	30-90
Flood	91-270
HF	271-329
High	(+-) 30 minutes
HE	(-270) - (-330)
Ebb	(-90) - (-270)
LE	(-30) - (-90)

Table 5 shows the total number of samples taken from 2008-2016 collected by tide stage.

Table 5.Total Samples by Tide Stage 2008-2016

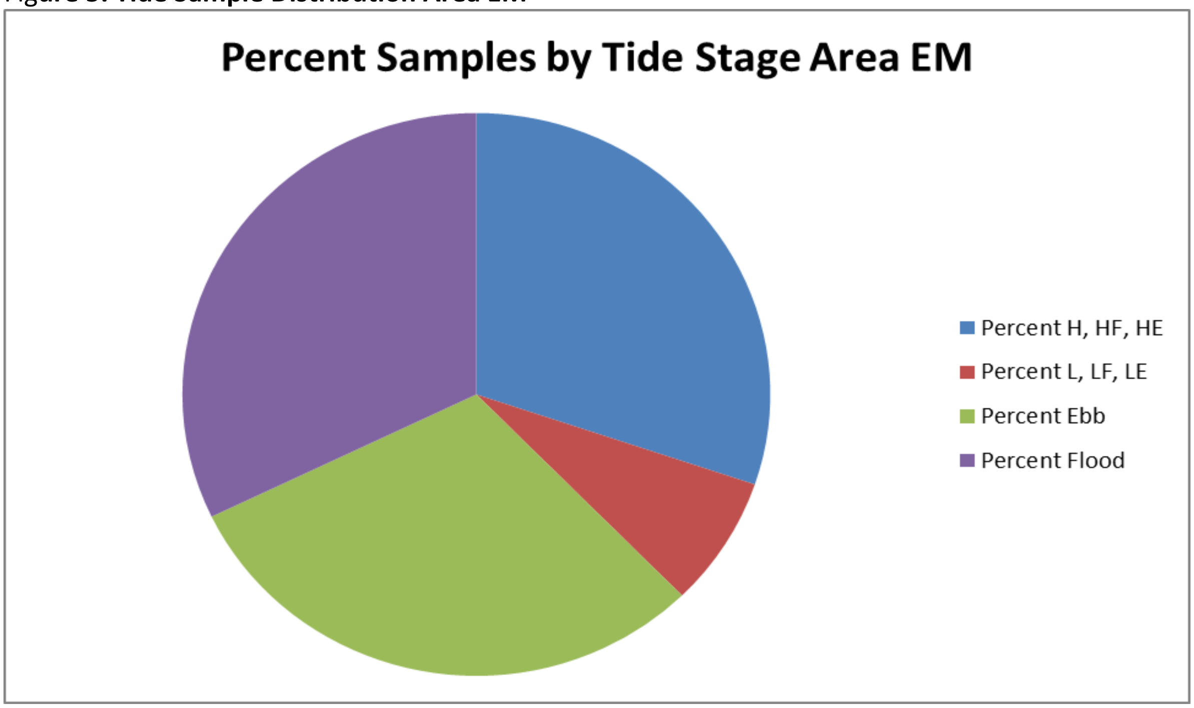
Station	Total Samples 2008-2016	Ebb total	Flood total	Total LE, L, LF	Total H.HF.HL
EM000.90	11	3	3	0	5
EM001.00	59	14	13	2	30
EM003.00	70	19	18	1	32
EM003.10	23	10	4	1	8
EM005.00	58	15	17	0	26
EM006.00	152	36	37	21	58
EM007.00	57	15	16	1	25
EM008.00	19	6	7	0	6
EM009.00	19	6	7	0	6
EM010.00	79	22	23	1	33
EM011.00	56	14	18	4	20
EM012.50	10	3	1	2	4
EM012.80	67	13	22	12	20
EM013.00	64	19	19	0	26
EM013.50	65	21	22	0	22
EM014.00	59	14	18	12	15

Figure 4. Percentage of total samples by tide stage 2008-2016



As shown in the graph in figure 4 there are only 4 stations that have over 10 percent of their samples collected during the low; LE; or LF tide stage. Since much of this growing area is tidal river drainage with a tide height range of 14' it should be expected that at the lower tide stages some stations will be missed due to lack of water. Figure 5 shows the percent of samples collected by tide stage for the growing area. This shows equal distribution except for the Low, Low Ebb, and Low Flood tide stages. This just reinforces the fact that because this growing area is a tidal river system with large areas of intertidal habitat samples cannot be collected at the lower tide stages. The remaining tide stages show an equal distribution of samples indicates that out systematic sampling system is working for this growing area.

Figure 5. Tide Sample Distribution Area EM



Rainfall

The mean annual precipitation in growing area EM is approximately 44 inches. The precipitation is not evenly distributed throughout the year. The wettest months are November and April. August is typically the driest month. Much of the precipitation in the winter comes as snow and may affect runoff rates in spring upon melting. It is likely that after prolonged periods of dry weather, significant rainfall (>1" over 24 hours) will cause some pollution from non-point runoff. It is unclear how much of an effect major rainfall events have on water quality due to variability of ground water saturation, history of recent significant rainfall that may have washed non-point pollution sources away, hard ground or ledge or wildlife or agriculture activity.

To analyze rain and its effects on the growing area, 72 hour rain data for each station from 2008-2016 was binned into dry data; rain between 0.01-0.50"; 0.51-1.00"; and >1.00". The geomean score for each binned rain amount can be found in Table 6. Please note that adverse flood data was not included in this analysis and each station needed a minimum of 4 samples before a geomean was calculated. The geomean for the dry data was used as a baseline for each station. The geomean for the different rain amounts was compared to the dry geomean scores. Those stations that showed an increase in the geomean of 50 percent or more were considered adversely affected by that rain amount. Please note that stations EM 3.1, 8, 9, and 12.5 are new stations or newly reactivated stations and did not meet the minimum sample count requirements for this analysis and were not included.

Table 6. Area EM Geomean by 72H rain amount

Station	Geo. Dry	Dry Count	Geo. .01-.5	Count .01-.5	Geo. .51-1	Count .51-1	Geo >1	Count >1
EM 1	3.05	15	4.37	30	1.90	6	10.39	4
EM3	3.67	20	3.76	35	3.21	8	4.38	6
EM5	3.89	13	3.71	30	1.94	5	4.46	6
EM6	4.06	15	3.32	29	5.63	6	9.70	5
EM7	4.32	15	4.23	30	3.91	6	20.98	4
EM10	3.99	16	9.42	29	13.40	5	24.62	5
EM11	4.41	16	10.37	28	8.42	5	8.49	5
EM12.8	3.86	17	5.25	35	3.98	6	9.13	5
EM13	4.12	18	6.46	30	3.95	8	12.20	5
EM13.5	4.28	18	6.81	31	3.69	8	14.98	5
EM14	3.86	15	3.90	27	2.89	6	4.26	6

Table 7 shows the percentage change in geomean from dry for each station. Those stations that showed a 50 percent change from dry for a particular rain amount were considered adversely effected by rain.

Table 7. Percent change in geomean area EM 2008-2016

Station	%change from dry .01-.5	% change from dry .51-1	%change from dry >1
EM 1	43%	-38%	241%
EM3	2%	-12%	19%
EM5	-5%	-50%	14%
EM6	-18%	39%	139%
EM7	-2%	-10%	386%
EM10	136%	236%	516%
EM11	135%	91%	93%
EM12.8	36%	3%	136%
EM13	57%	-4%	196%
EM13.5	59%	-14%	250%
EM14	1%	-25%	10%

Stations EM 7, 10, 11, 13, and 13.5 are all located adjacent to streams. Station EM 1 is located adjacent to a small intermittent stream that only runs during larger rain events. They are currently located in either prohibited or restricted areas. Station EM 12.8 is the only station that is not in a current closed area and has a P90 score that meets approved standards. Based on this information the Pleasant River drainage should be looked at for a possible 1” rainfall conditional area in the upper portion of the drainage near stations 7-11 and the Marsh Harbor area near stations 12.8-13.5.

Winds

Migratory weather systems cause winds that frequently change in strength and direction. Gulf of Maine winds are generally westerly, but often take on a northerly component in winter and a southerly one in summer. Strongest winds are generated by lows and cold fronts in fall and winter and by fronts and thunderstorms during spring and summer. Extreme winds are usually associated with a hurricane or severe northeaster and can reach 125 knots. Sustained winds of 100 knots occur about every 50 years on average; gusts are usually about 30 percent higher.

Coastal winds are complex since they are influenced by the topography. Over land speeds are reduced, however, channels and headlands can redirect the wind and even increase the speed by funneling the wind. In general, winds have southerly components in summer and northerly ones in winter. In sheltered waters near Rockland, Portland, and Brunswick, there are a large percentage of calms, particularly during the morning hours. When the existing circulation is weak and there is a difference between land and water temperatures, a land-sea breeze circulation may be set up. As the land heats faster than the water, a sea breeze is established during the day; this onshore flow may reach 15 knots or more. At night, the land cools more rapidly, often resulting in a weak breeze off the land. In many locations, the sea breeze serves to reinforce the prevailing summer wind. Analysis of GOMOOS data (2001-2006) show winter winds along coastal Maine are typically from the west-northwest during clear periods and from the northeast during storms. In the spring, summer and fall, predominant winds are from the south-southwest. West, northwest and north winds are common during fall and winter. Although less frequent, winds from the northeast, north and northwest directions are typically stronger than winds from the south. In the summer, winds tend to be on shore due to heated, rising air over land and cooler ocean air flowing into the void.

River Discharge

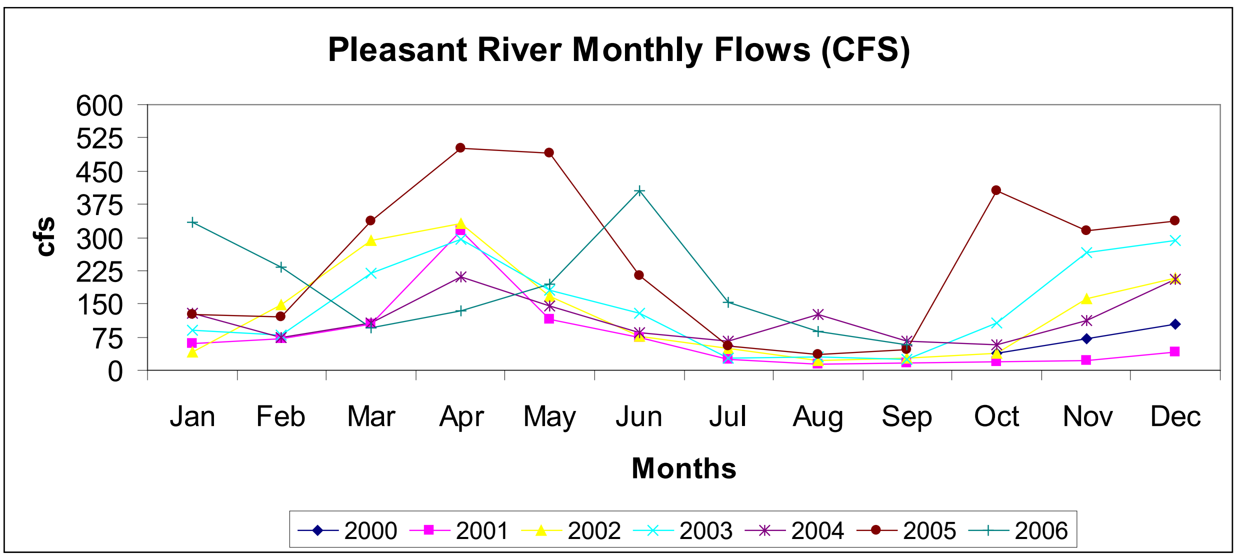
Stream flow in mid-coast Maine exhibits seasonal variation, with the highest flows occurring in the spring and the mid-to late fall. To illustrate the seasonality of stream flow in Maine, the mean monthly flow for the Pleasant River near Epping, Maine with a drainage area 60.60 square miles is shown in the following table. (USGS 01022260 Pleasant River near Epping, Maine) Unfortunately due to lack of funding this site was discontinued in October of 2006 so no current data exist from this point on.

Table 8. Monthly Flows in CFS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000										38	70	105
2001	59	70	104	315	116	75	25	15	18	19	23	42
2002	42	149	295	331	167	75	50	21	28	38	160	209
2003	91	79	219	296	180	130	28	30	24	107	267	294
2004	128	75	106	212	146	84	66	126	65	58	113	206
2005	127	120	337	500	489	213	56	37	46	406	314	338
2006	334	232	97	134	196	405	153	88	57			

As illustrated by table 8 above, March through May and October through December are the months with the heaviest flows. This corresponds to the snowmelt for the spring of the year and to the wetter months encountered in the fall of the year. Figure 6 below shows a graphical representation of the data.

Figure 6. Monthly Flows in CFS



Salinity

Salinity generally tends to be lowest in the spring, due to spring rains and snowmelt/runoff and in late fall from rainfall. Summer and early autumn show the highest values of salinity, due to the relatively low stream flows at this time of year. Salinity data, taken from routine (random/prescheduled) ambient monitoring data from sites near the mouths of rivers or streams approximate the stream flow patterns and influence of fresh water inputs on the growing area. However, partial salinity stratification can occur during times of heavy rainfall and runoff. It is well recognized that freshwater influence from runoff can contribute to elevated bacterial loading near shore. Queries of the sample data in Area EM for average salinity by month (2008-2016) shows sample sites with their average salinities broken down by month.

Table 9. Average Salinity by Month Area EM 2008-2016

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EM1	31	30	29	25	31	30	32	33	30	33	31	30
EM3	29	22	29	24	28	28	29	31	31	33	28	27
EM5	30	29	23	23	27	28	29	30	30	30	29	30
EM6	28	27	23	23	27	26	26	28	28	28	25	25
EM7	30	22	24	14	28	28	28	27	30	31	24	24
EM8	21	12	27	9	30	21	32	27	30	28	15	28
EM9	18	12	4	5	15	24	31	29	36	28	30	24
EM10	20	25	15	16	21	22	20	26	24	26	26	25
EM11	25	26	20	13	26	18	29	26	23	25	21	22
EM12.80	30	29	29	28	27	30	25	31	32	31	31	27
EM13	30	30	32	28	28	26	30	31	26	24	19	24
EM13.50	30	30	26	29	28	29	28	31	31	31	30	28
EM14	30	32	31	15	30	31	29	33	30	34	31	31

Stations EM 5, 7, 8, 9, 10, 11, and 13 are located adjacent to freshwater streams.

Seasonal Effects on FC Concentrations

To examine the effects that seasons may have on fecal coliform levels in Growing Area EM the historical fecal coliform data of the ambient sites were grouped according to season:

Winter was defined as December, January, and February
Spring was defined as March, April, and May
Summer was defined as June, July, and August
Fall was defined as September, October, and November

This analysis includes fecal coliform results collected from 2008 to 2016. The collection dates were queried to conform to the seasonal groupings discussed above. Any adverse flood data was excluded. Next the geomean for each station per season was calculated and then graphed. Each station needed a minimum of 3 samples for each season before a geomean was calculated. Stations with geomean scores > 14 were considered adversely affected during that seasonal period. The results can be seen in figure 7. The graph clearly shows that the summer and fall period have the highest geomean scores with every station showing elevated geomean scores for this time period. Next the sample count for each station by seasonal period was calculated. This can be seen in figure 8.

Figure 7. Seasonal Geomean 2008-2016

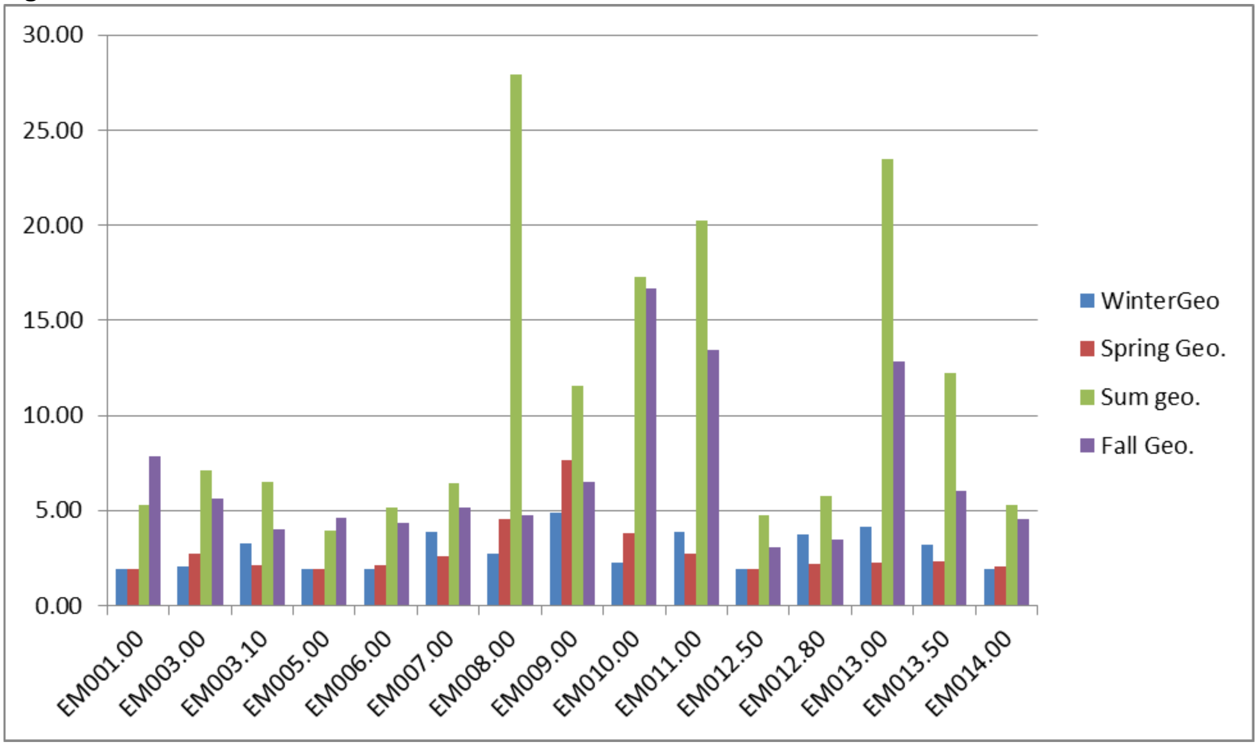


Figure 8. Area EM percent samples by season

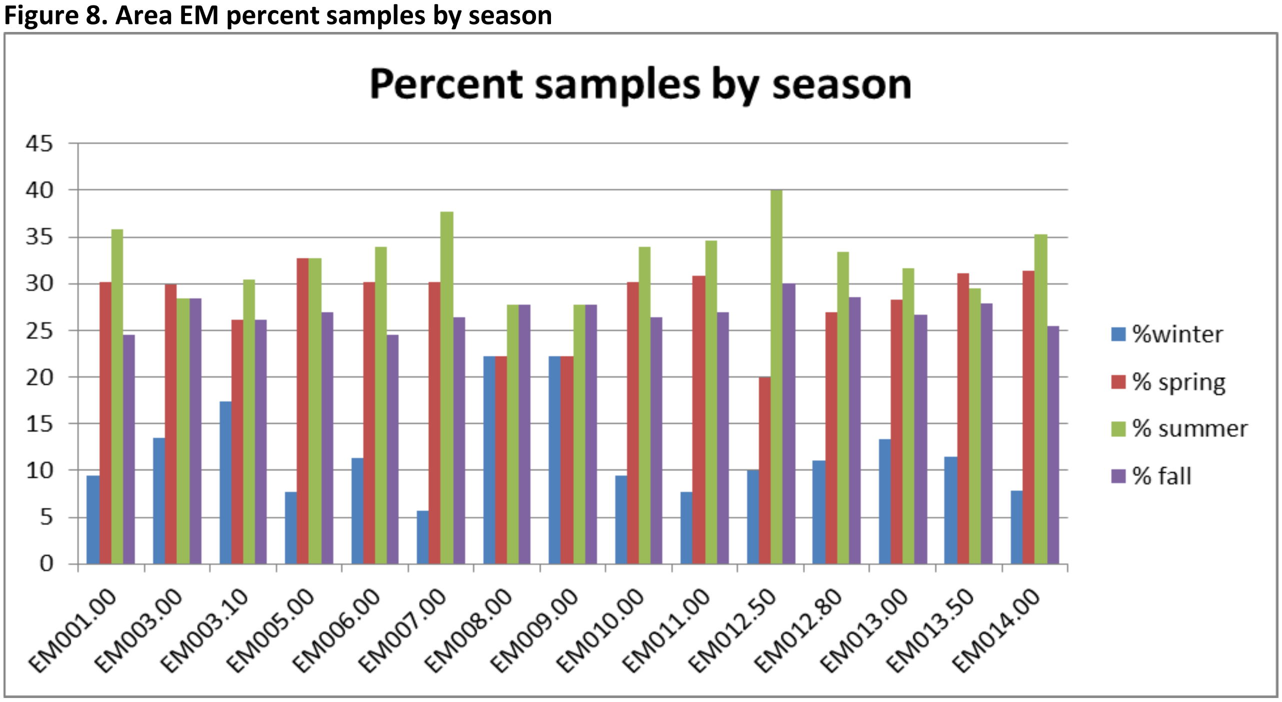


Figure 8 shows that about 60% of all the samples collected for this growing area occur during the fall and summer period which is the period with the highest geomean scores. There are eight stations that have 10% or more of their samples taken in the winter and these are sample stations that have purposely been put on a year-round sampling strategy. To better represent what is occurring in the watershed this area should be sampled more frequently in the winter. Although It is unlikely that an equal number of samples per season will occur because of ice and snow conditions a percentage of more than 10% can be achieved. If this is accomplished the data set will better represent actual year-round conditions for this Growing Area.

Figure 9. Area EM geomean by season

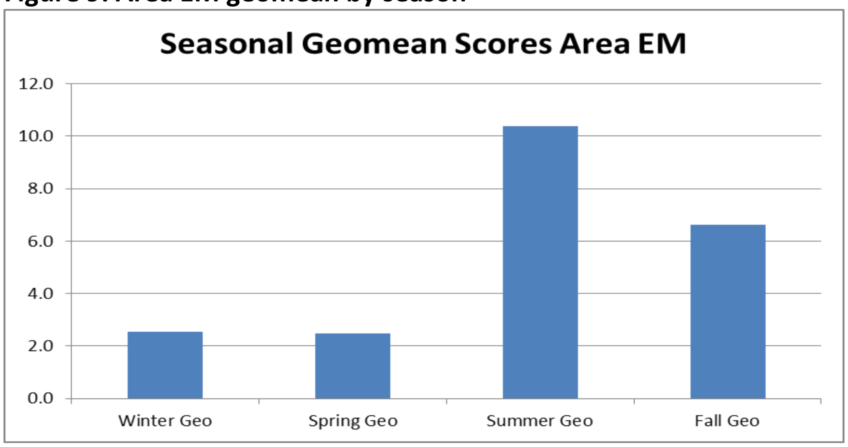
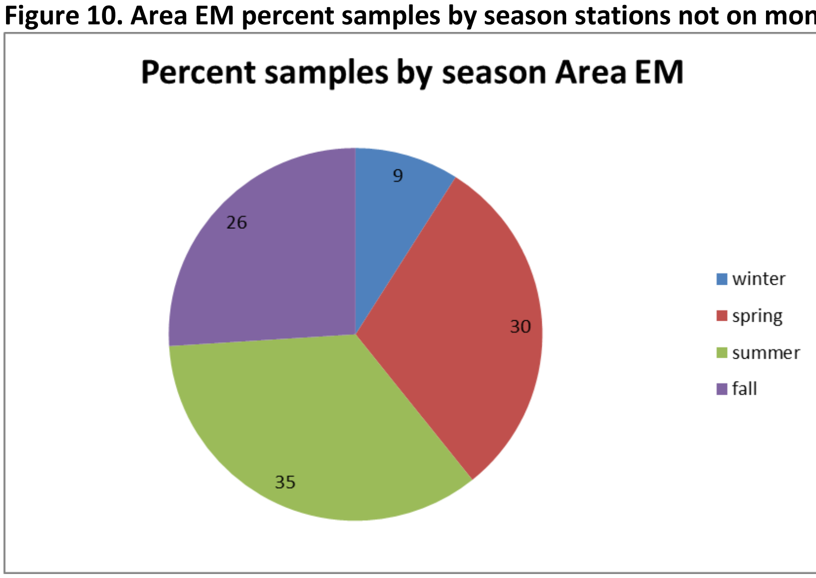
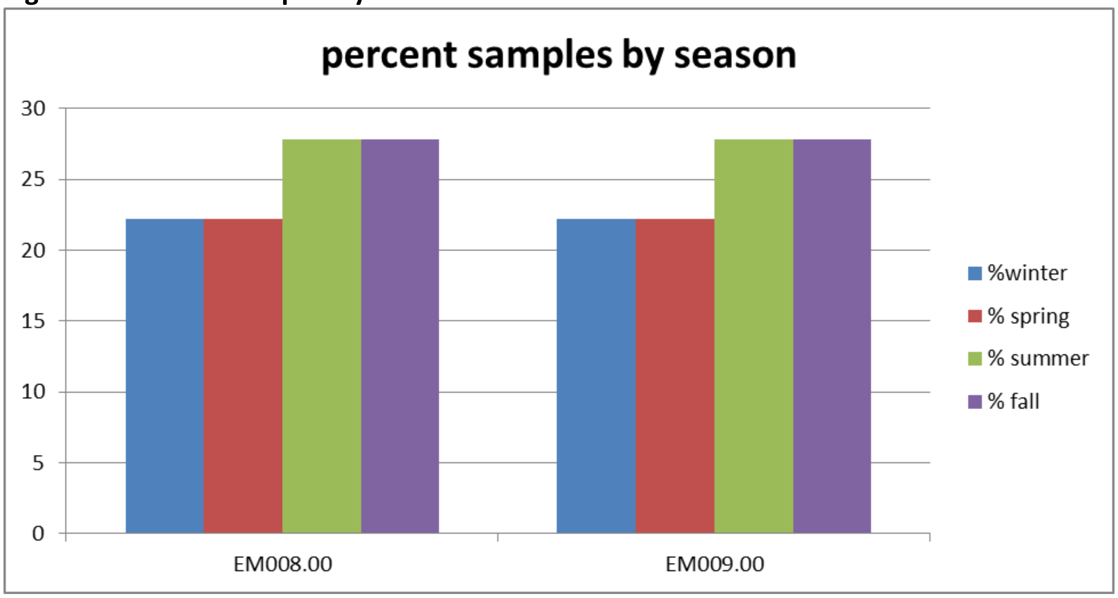


Figure 10. Area EM percent samples by season stations not on monthly sampling



Stations EM 8 and EM 9 were put on monthly sampling in 2015 and Figure 11 below represents the seasonal sample collection distribution.

Figure 11. Percent samples by season



Water Quality Review

Including two new Z stations (Class X below) there are 15 active water sampling sites in Growing Area EM. They are collected from near-shore sites on Sample runs 14 and CA 3. Sample sites are established to monitor known or potential pollution sources and on the margins of established closures. It is recognized that access, icing and safety considerations prevent some stations being sampled on scheduled dates. Currently all stations in Growing Area EM meet their current NSSP classification standard.

Table 10. Area EM 2016 P90 (Conditionally Approved stations (CA) are based on results from the open status)

Station	Class	Count	MFCount	GM	SDV	MAX	P90	Appd_Std	Restr_Std
EM001.00	R	30	30	4.1	0.72	1700	35.2	31	163
EM003.00	CA	30	30	2.8	0.38	56	8.8	31	163
EM003.10	X	23	23	3.8	0.39	31	12.3	31	163
EM005.00	A	30	30	2.5	0.41	300	8.8	31	163
EM006.00	A	30	30	4.1	0.62	1700	26	31	163
EM007.00	R	30	30	6.8	0.69	1700	54	31	163

Station	Class	Count	MFCount	GM	SDV	MAX	P90	Appd_Std	Restr_Std
EM008.00	P	18	18	6.7	0.49	80	29.7	31	163
EM009.00	P	18	18	7.4	0.49	56	32	31	163
EM010.00	P	30	30	11	0.69	1700	85.6	31	163
EM011.00	R	30	30	7.9	0.82	1700	89.8	31	163
EM012.50	X	10	10	3.1	0.52	76	15.3	31	163
EM012.80	A	30	30	3.9	0.64	440	26.7	31	163
EM013.00	P	30	30	7.1	0.81	1700	78.2	31	163
EM013.50	R	30	30	4.1	0.66	1220	29	31	163
EM014.00	R	30	30	2.9	0.45	240	11.5	31	163

Water Quality Discussion and Classification Determination

P90 trending for all active stations with a minimum of 30 samples is shown in Table 11. The percent change in P90 from 2015 to 2016 was calculated and only 4 stations showed an increase in P90 scores. Positive percent change indicates a decline in water quality equals and a negative percent change shows an improvement in water quality. The three stations highlighted in yellow are stations that were placed on a year-round sampling schedule and all show a significant improvement in their P90 scores.

Table 11. P90 trend EM stations with 30 samples

Station	Class	2014 P90	2015 P90	2016 P90	%change 2015-2016
EM001.00	R	55.9	31.1	35.2	11.6%
EM003.00	CA	7.4	7.1	8.8	19.3%
EM005.00	A	25.2	12.3	8.8	-39.8%
EM006.00	A	29.3	25.6	26	1.5%
EM007.00	R	44	43	54	20.4%
EM010.00	P	83.9	87	85.6	-1.6%
EM011.00	R	164.7	91.3	89.8	-1.7%
EM012.80	A	27.4	31	26.7	-16.1%
EM013.00	P	185.6	106.8	78.2	-36.6%
EM013.50	R	83.9	67.3	28.5	-136.1%
EM014.00	R	32.9	17.2	11.5	-49.6%

Growing area EM has shown an overall improvement in water quality over the last three years.

Recommendation for Future Work

Area EM is lacking winter and fall data with the greatest sampling effort occurring during the spring and summer time. Recent year-round sampling effort of stations in this area has shown a marked improvement in p90 scores. It is the recommendation to keep these stations on the year-round sampling schedule to see if this trend continues. Based on the results of this study will determine if the entire growing area should go to a monthly sampling strategy. The entire growing area remains on the adverse rain sampling schedule and once again attempts to sample the day of 1" rain events as well as three days after the event will be made. This will depend on staff availability and lab capabilities at the time of such rain events. There are no changes to classification required in Growing Area EM at this time.

References

National Shellfish Sanitation Program: Guide for the Control of Molluscan Shellfish, 2015 Revision;

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Town information, 2007-2008 Maine Municipal Directory, Maine Municipal Association, Augusta, Maine 04330

Licensed discharge information, Maine Department of Environmental Protection, Augusta, Maine

Data Layers, Maine Office of GIS, Augusta, Maine

Rainfall data, National Weather Service, Caribou, Maine

APPENDIX A - Key to water quality table headers.

STATION = water quality monitoring station

CLASS = classification assigned to the station; prohibited (P), restricted (R), conditionally restricted (CR), conditionally approved (CA), approved (A), experimental (X).

COUNT = the number of samples evaluated for classification, must be a minimum of 30.

MFCNT = the number of samples evaluated with the MTec method (included in the total Count column)

GEO_MEAN = means the antilog (base 10) of the arithmetic mean of the sample result logarithm (base 10).

SDV = standard deviation

MAX = maximum score of the 30 data points in the count column

P90 = 90th percentile

APPD_STD = the 90th percentile, at or below which the station would meet approved criteria in the absence of pollution sources or poisonous and deleterious substances.

RESTR_STD = the 90th percentile, at or below which the station would meet restricted criteria.