GROWING AREA EK

Dyer Bay, Dyer Harbor, and Pinkham Bay
Sanitary Survey Report

Report Date 4/17/18

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APPROVAL

Division Director:

__________________________ __________________________ Date: ____________
Print name signature

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Executive Summary

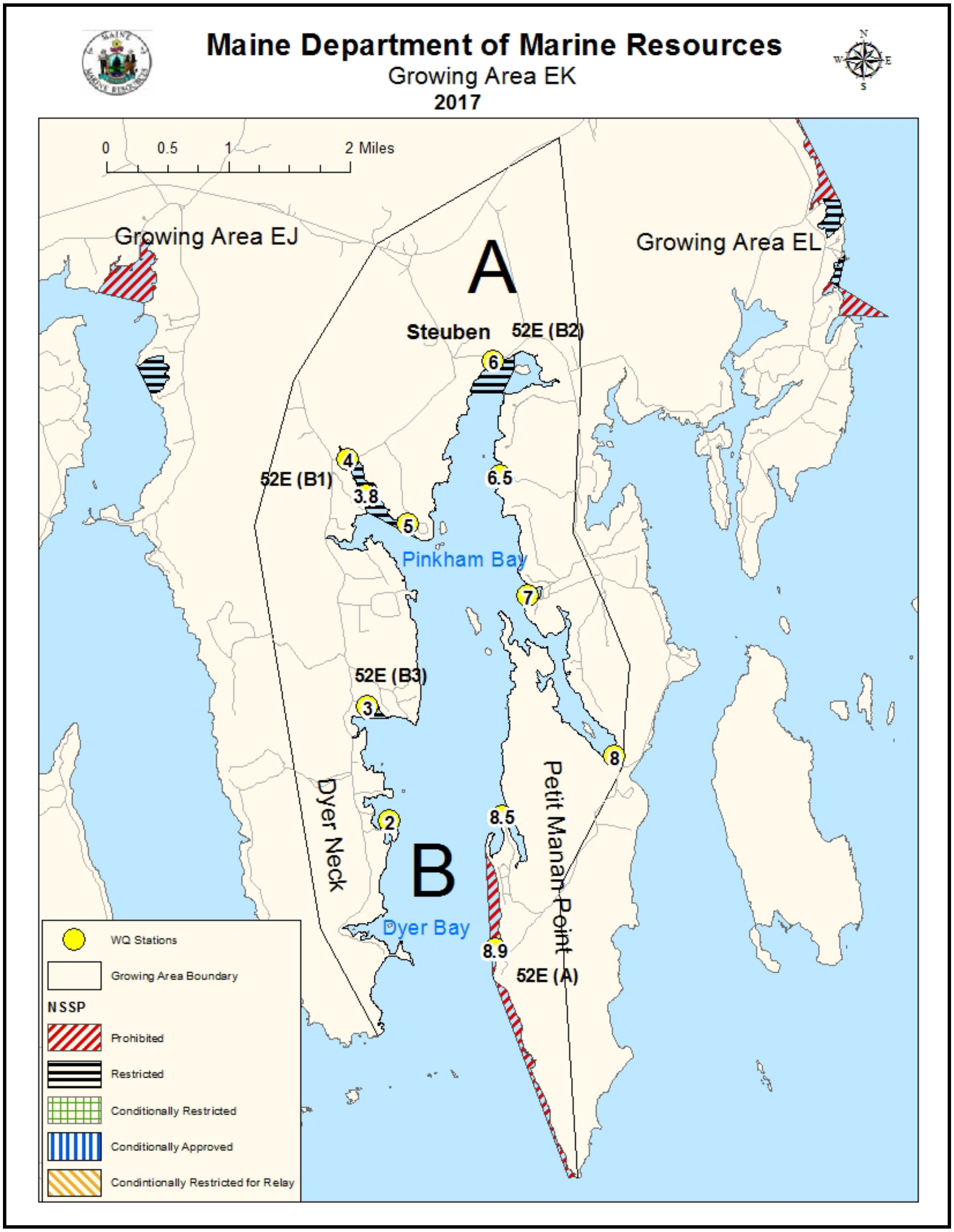
This is a Sanitary Survey report for growing area EK written in compliance with the requirements of the 2015 Model Ordinance and the National Shellfish Sanitation Program (NSSP). No changes in classification are needed now. During the last triennial period, the following changes occurred. In 2013 there was one classification change in Area EK during 2013. Pollution Area 52-E was expanded to include a Restricted area on the North Shore of Pinkham Bay. There were no new pollution sources identified during the review year. Water quality at three stations failed to meet the classification standard at the end of year review. In 2014 three new stations (EK3.1, EK5.1 and EK6.3) were added during the 2014 season. Any necessary changes will be discussed in the summary of this report. The next sanitary survey is due in 2029 and the next Triennial in 2020.

It is primarily a rural area, with no municipal services such as water or sewer. There are no municipal waste water treatment plants (WWTP) in this growing area and only one licensed OBD located in Steuben. The village of Steuben (pop. 1,131) has the highest population concentration in the area (US Census 2010). Land use is predominantly residential with some light commercial use including boat building shops and fishing piers for landing the days' catches. There are no commercial marinas but there are numerous private piers for small recreational boats and local fishing boats. The local fishing boats are mainly lobster boats. 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).

Growing area EK 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: Shoreward of a line that starts at Dyer Point, then going north through the center of the Dyer Neck peninsula the intersection of Steven's Drive and Route 1 in East Steuben, then eastward along Route 1 to the Steuben/Milbridge town line, then south to Pigeon Hill and continuing south through the center of the Petit Manan peninsula to the end at Petit Manan Point. This is a rural area with sparse population. Land use is predominantly residential with some light commercial use including boat building shops and fishing piers for landing the days catch.

The upland land cover is predominately evergreen, deciduous and wetland forest with minimal development. Much of upland Stueben and Gouldsboro are wetland and sandy glacial till. Blueberry fields are scattered throughout the upland. Fresh water influence along these shores is the major source and transport mechanism for pollution in this growing area. There are no major rivers draining into this area. Numerous brooks and small streams can be found throughout the growing area. These have been evaluated microbiologically.

Figure 1: Area EK Overview



History of Growing Area Classification

2006: 52E (B.2) reclassified Upper Pinkham's bay from Prohibited to Restricted.

2007: This new rule administratively combines the areas previously described in Closed Areas 52-D, 52-E, and 52-J; and reclassifies the Dyer Harbor 52E (B.2) area from Prohibited to Restricted, as well as making that area smaller.

2008: None

2009: 52E (B.2) Upper Pinkham Bay was reclassified to approved

2010: None

2011: None

2012: None

2013: 52E (B.2) Upper Pinkham Bay reclassified Approved to Restricted

2014: 52E (B.1) Restricted area in Dyer Bay was expanded. 52E (B.3) A Restricted area Northwest of Parker head was created. 52E (B.4) A Restricted area in Pigeon Hill Bay was created.

2015: None

2016: 52E (B.4) Restricted area in Pigeon Hill Bay reclassified to Approved.

2017: 52E (B.2) A portion of the Restricted area in Pinkham Bay reclassified to Approved.

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 2017 review year, shellfish growing area EK had areas classified as:

Restricted:
52E (B1) Dyer Harbor (Steuben) NP
52E (B2) Pinkham Bay (Steuben) NP
52E (B3) Parker Head (Steuben) NP

Prohibited:

52E (A) Petit Manan (Steuben) OBD

Activity during Review Period

2006: 52E (B.2) reclassified Upper Pinkham's bay from Prohibited to Restricted.

2007: Pollution Area No. 52E (May 16, 2007) combined and modified closures 52D, 52E, 52J. The portion of Dyer Harbor outside of Station 3.8 was reclassified upward from Prohibited to Approved due to water quality meeting approved standard and inside of Station 3.8 was reclassified upward from Prohibited to Restricted due to water quality meeting restricted standard (Area No. 52E Part A).

2008: None

2009: Area No. 52E (March 12, 2009) reclassified Area No. 52E Part B (Station EK006.00) from Restricted to Approved due to water quality meeting approved standard and renamed Area No. 52E Part C to Area No. 52E Part B.

2010: None

2011: None

2012: 11/26/2012 – 14 stream samples were collected.

2013: Pollution Area No. 52-E. The legal notice was administratively reformatted, renumbered and re-establishes the Restricted area in northern Pinkham Bay. A complete addendum for these changes may be found in DMR's central files.

2014: 52E (B.1) Restricted area in Dyer Bay was expanded. 52E (B.3) A Restricted area Northwest of Parker head was created. 52E (B.4) A Restricted area in Pigeon Hill Bay was created.

2016: 52E (B.4) Restricted area in Pigeon Hill Bay reclassified to Approved.

2017: 52E (B.2) A portion of the Restricted area in Pinkham Bay reclassified to Approved.

Pollution Source Survey

The following sections include information on pollution sources which do or may impact water quality in growing area EK. 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 EK Pollution Sources

Town	GASS ID	Pollution Area	Major PS	PS Type	Problem	Impact
Steuben	EK015	52E (A)	NPDES	OB	Y	AD
Steuben	EK008	52E (B.2)	seaweed	Wrack	Y	AD
Steuben	EK006	52E (B.1)	stream	stream	Y	AI
Steuben	EK004	52E (B.3)	stream	stream	Y	AI
Steuben	EK004	52E (B.3)	stream	stream	Y	AI

Figure 2. Pollution Source Map A

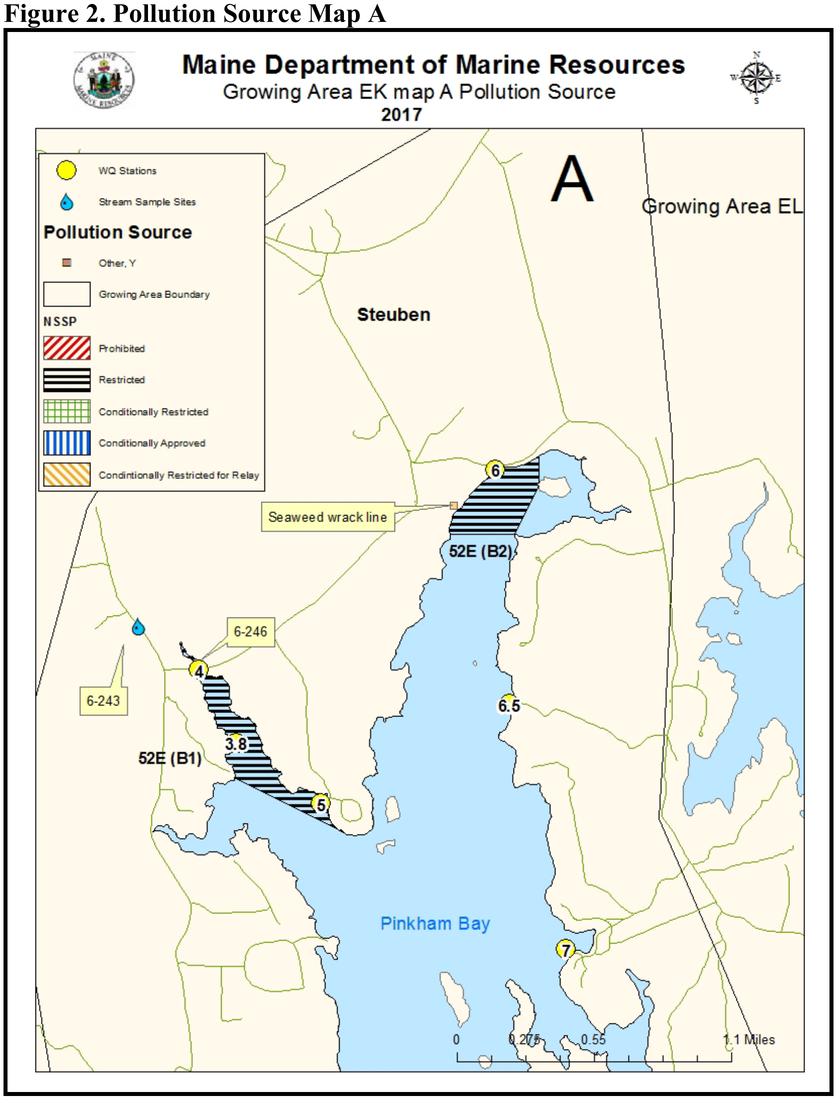


Figure 3. Pollution Source Map B


Maine Department of Marine Resources
Growing Area EK map B Pollution Source
2017
Steuben
52E (B3)
4-238
4-239
3
8
Dyer Bay
8.5
2
52E (A)
8.9
WQ Stations
Stream Sample Sites
Growing Area Boundary
NSSP
Prohibited
Restricted
Conditionally Restricted
Conditionally Approved
Condintionally Restricted for Relay
0
0.275
0.55
1.1 Miles

Domestic Waste *(IG Systems and OBDs)*

Growing area EK consists of 16 two-mile segments (GASSIDs) all within the town of Steuben. The growing area consists of 95 residential in ground systems. All domestic waste systems were visited in 2017 during the sanitary survey.

There is one over board discharges (OBDs) that discharges its treated effluent into the waters of Area EK (Figure 3). 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.

Growing area EK has one pollution area based on the presence of licensed OBD’s. It is a sand processor with end-stage chlorination and discharge the water to the ocean. A dilution calculation was completed for the OBD to determine the zone of impact in the event of an ODB malfunction (loss of chlorination). These calculations considered the depth of receiving water at mid-tide, the licensed flow rates and effluent bacterial concentrations of 140,000 fecal coliform/100 ml (worse case-loss of disinfection). The dilution zone is the minimum area required to dilute the effluent to 14 FC/100 ml’s. OBD closure areas are frequently larger that the calculated dilution zones due to other pollution issues in the immediate area or because of the need for defendable enforcement lines.

Pollution Area 52 E (A 1.): (Pinkham Bay; Steuben) this area is classified as Prohibited based the presence of one OBD.

Table 2. Active Licensed Overboard Discharges

Closure	Town	Waterbody	Mid Tide Depth	FLOW	Dilution in Acres Needed	Current Closure Size
52E A	Steuben	DYER BAY	10	300	0.92	88

Municipal Treatment

There are no municipal Waste Water Treatment Facilities in Shellfish Growing Area EK.

Industry

There are no industrial activities on the shores of the survey area.

Marinas

Yeaton Cove and an unnamed cove half a mile north of Yeaton Cove each serve as a mooring area for 6 to 12 day-use lobster fishing boats. These fishing boats are generally unoccupied while anchored. Sample stations EK002.00 and EK003.00 are located within 300 to 500 meters of the moorings. There are no boats with heads or overnight boats and so a conditional area based on marina presence is not necessary.

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).

There are no municipal storm water systems in this growing area.

Non-Point Pollution Sources

Non-point source (NPS) pollution is water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into a river, or wind-borne debris blowing out to sea. Nonpoint source pollution can be contrasted with point source pollution, where discharges occur to a body of water at a single location, such as discharges from a chemical factory, urban runoff from a roadway storm drain or from ships at sea. NPS may derive from many different sources with no specific solution to rectify the problem, making it difficult to regulate.

Streams and Drainages: Freshwater streams, drainages and tidal creeks are the major source of non-point discharge into Growing Area EK. 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. The stream samples taken during this review period can be seen in the table below.

Table 3. Stream Samples EK

Town	Date	Stream ID	P source Type	CFU/100ml	Closure
Steuben	15-Jun-09	EK006-242	Stream	28	NA
Steuben	15-Jun-09	EK006-246	Stream	92	52E (B.1)
Steuben	08-Dec-09	EK004-236	Stream	1.9	NA
Steuben	15-Jun-09	EK008-248	Stream	50	NA
Steuben	08-Dec-09	EK008-248	Stream	2	NA
Steuben	15-Jun-09	EK004-237	Stream	10	NA
Steuben	26-Nov-12	EK004-236	Stream	50	NA
Steuben	26-Nov-12	EK004-239	Stream	1.9	52E (B.3)
Steuben	26-Nov-12	EK006-244	Stream	16	52E (B.1)
Steuben	08-Dec-09	EK004-237	Stream	1.9	NA
Steuben	20-Jun-07	EK008-248	Stream	1.9	NA

Town	Date	Stream ID	P source Type	CFU/100ml	Closure
Steuben	08-Dec-09	EK002-235	Stream	1.9	NA
Steuben	29-Aug-11	EK006-246	Stream	180	52E (B.1)
Steuben	08-Dec-09	EK006-246	Stream	1.9	52E (B.1)
Steuben	20-Jun-07	EK004-236	Stream	2	NA
Steuben	26-Nov-12	EK006-245	Stream	16	
Steuben	20-Jun-07	EK005-240	Stream	1.9	NA
Steuben	20-Jun-07	EK008-247	Stream	2	NA
Steuben	23-May-11	EK006-246	Stream	14	52E (B.1)
Steuben	15-Jun-17	EK008-247	Stream	8	NA
Steuben	15-Jun-09	EK009-249	Stream	1.9	NA
Steuben	15-Jun-09	EK004-239	Stream	25	52E (B.3)
Steuben	15-Jun-09	EK008-247	Stream	46	NA
Steuben	08-Dec-09	EK008-247	Stream	1.9	NA
Steuben	26-Nov-12	EK004-237	Stream	1.9	NA
Steuben	15-Jun-17	EK005-240	Stream	2	NA
Steuben	15-Jun-17	EK004-236	Stream	10	NA
Steuben	12-Sep-17	EK008-247	Stream	6	NA
Steuben	15-Jun-09	EK002-235	Stream	2	NA
Steuben	20-Jun-07	EK005-241	Stream	10	NA
Steuben	20-Jun-07	EK006-246	Stream	24	52E (B.1)
Steuben	08-Dec-09	EK004-239	Stream	1.9	52E (B.3)
Steuben	26-Nov-12	EK004-238	Stream	1.9	52E (B.3)
Steuben	20-Jun-07	EK004-239	Stream	1.9	52E (B.3)
Steuben	08-Dec-09	EK009-249	Stream	1.9	NA
Steuben	15-Jun-09	EK004-236	Stream	6	NA
Steuben	26-Nov-12	EK002-235	Stream	1.9	NA
Steuben	26-Nov-12	EK005-240	Stream	1.9	NA
Steuben	26-Nov-12	EK005-241	Stream	1.9	NA
Steuben	26-Nov-12	EK006-246	Stream	2	52E (B.1)
Steuben	26-Nov-12	EK008-248	Stream	1.9	NA
Steuben	15-Jun-09	EK005-240	Stream	5.4	NA

Town	Date	Stream ID	P source Type	CFU/100ml	Closure
Steuben	08-Dec-09	EK005-240	Stream	6	NA
Steuben	15-Jun-17	EK006-246	Stream	150	52E (B.1)
Steuben	15-Jun-17	EK005-241	Stream	24	NA
Steuben	12-Sep-17	EK006-246	Stream	40	52E (B.1)
Steuben	08-Dec-09	EK006-242	Stream	1.9	NA
Steuben	08-Dec-09	EK005-241	Stream	4	NA
Steuben	26-Nov-12	EK006-243	Stream	2	52E (B.1)
Steuben	20-Jun-07	EK004-238	Stream	1.9	52E (B.3)
Steuben	08-Dec-09	EK004-238	Stream	1.9	52E (B.3)
Steuben	15-Jun-17	EK009-249	Stream	1.9	NA
Steuben	20-Jun-07	EK002-235	Stream	34	NA
Steuben	20-Jun-07	EK006-242	Stream	70	NA
Steuben	15-Jun-09	EK005-241	Stream	10	NA
Steuben	29-Aug-11	EK008-247	Stream	460	NA
Steuben	26-Nov-12	EK006-242	Stream	1.9	NA
Steuben	26-Nov-12	EK009-249	Stream	1.9	NA
Steuben	15-Jun-09	EK004-238	Stream	6	52E (B.3)

Area EK has three areas that are Restricted based on non-point pollution.

1. Pollution Area 52 E (B1.) “Pinkham Bay (Steuben), Restricted due to non-point source pollution; Monitored by EK 6 (P90 = 28.7) and a new Z station EK 6.3.

2. Pollution Area 52 E (B2.) “Dyer Harbor” (Steuben) classified as restricted based on non-point runoff from nearby upland areas. This area is monitored by EK 3.8 (P90= 23.7), 4 (P90= 153.8), and 5 (P90=42.5 with a new Z station EK 5.1.

3. Pollution Area 52 E (B3.) “Parker Head” (Steuben) classified as restricted based on suspected non- point issues. Stations EK 3(P90= 47.7) and a new Z station EK 3.1 monitor this area.

Agricultural Activities

There are no commercial livestock activities in the growing area (MDAFRR 2005, MOFGA 2011) in proximity to seawater.

Domestic Animals and Wildlife Activity

When domestic animal waste is improperly disposed of it can have an adverse impact on water quality. There are no records indicating potential pollution from companion animals in area EK.

In addition to domestic animals, wildlife can also have an adverse impact on water quality. Thousands of migrating waterfowl rest at the refuge (US FWS MCINWR 2010) during the fall migration. Most the refuges freshwater flowage drains into the adjacent growing area (EL).

Hydrographic and Meteorological Characteristics

Tides and Currents

This area is subject to a semi-diurnal tidal cycle which presents two high tides and two low tides per lunar day. The mean range of tide is 10.9 feet. Tidal currents are strong in the entrance of Dyer Bay but follow the general direction of the channel except near Dyer Point, on the west side of the entrance, where they set in and out of Gouldsboro Bay. Because of the large tidal range, some sampling stations are dry at low tide. Thus, these stations will not have sample data during the low or lower tide stages, simply because there is no water there to sample.

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 was 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 was 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)

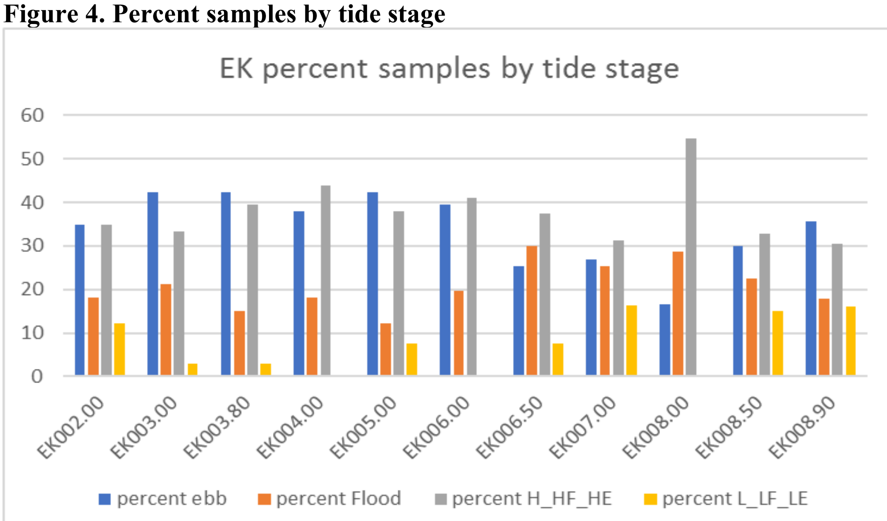
Table 5 shows the total number of samples taken from 2007-2017 collected by tide stage.

Table 5. Total Samples by Tide Stage 2007-2017

Station	E	F	H	HE	HF	L	LE	LF	Total Samples 2007-2017
EK002.00	23	12	8	9	6	5		3	66
EK003.00	28	14	6	10	6		1	1	66
EK003.80	28	10	7	10	9		1	1	66
EK004.00	25	12	8	10	11				66
EK005.00	28	8	7	9	9	1	1	3	66
EK006.00	26	13	6	13	8				66
EK006.50	17	20	8	8	9	1	2	2	67
EK007.00	18	17	7	7	7	2	6	3	67
EK008.00	11	19	16	11	9				66
EK008.50	20	15	8	7	7	3	4	3	67
EK008.90	20	10	7	4	6	3	4	2	56

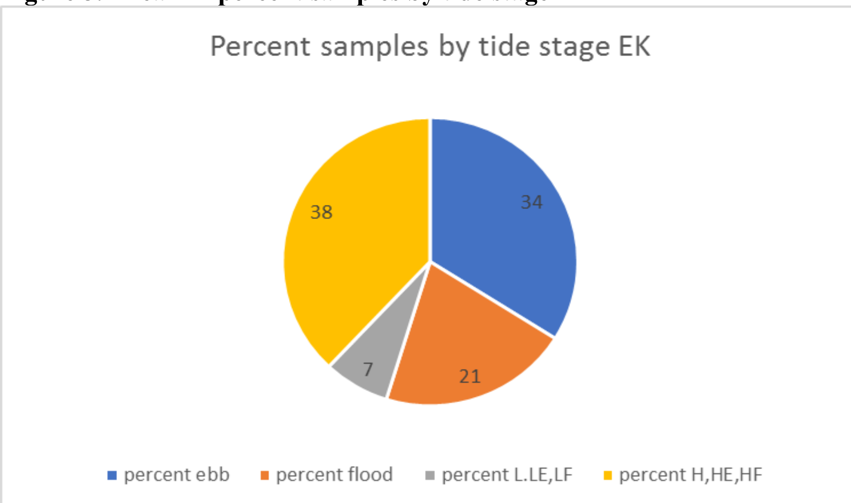
To better show sample collection as it relates to tide stage the H, HE, HF were combined into one category along with L, LE, and LF. The ebb and flood stage were left alone. The percentage of samples collected for each tide stage was than calculated and can be seen in the figure below.

Figure 4. Percent samples by tide stage



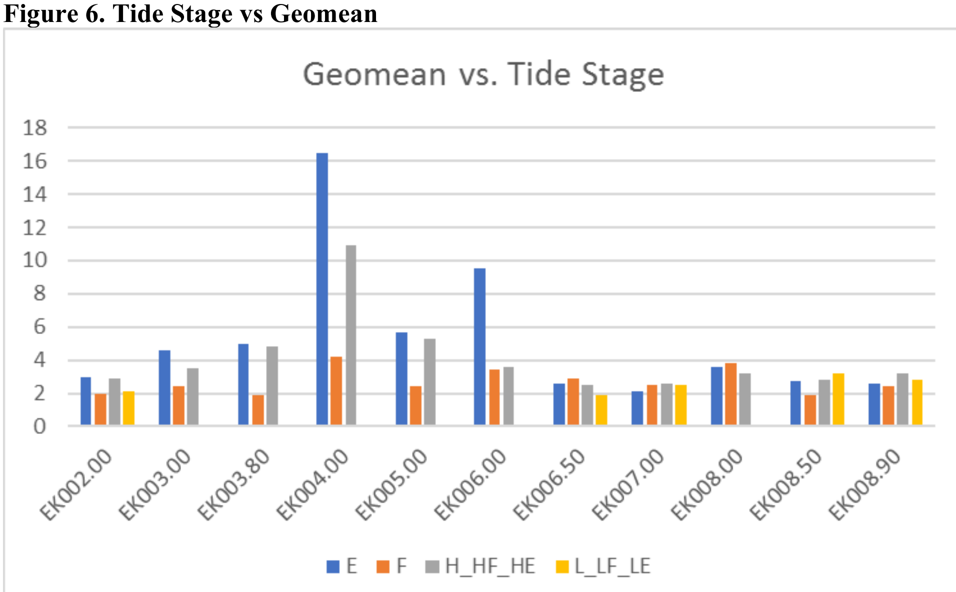
As shown in the graph in Figure 4 there are 4 stations that have over 10 percent of their samples collected during the low; LE; or LF tide stage. The other 7 stations have less than 10 percent of their samples collected at the lower tide stages. Figure 5 shows the percent of samples collected by tide stage for the growing area. This shows that the Low, Low Ebb, Low Flood, and Flood tide stages are not equally distributed even at the stations that can be collected at all tides and an effort should be made to sample these tide stages.

Figure 5. Area EK percent samples by tide stage



To examine if tide has any effect on water quality the geomean for each station at each tide stage was calculated and can be seen in the figure below. A minimum of 5 samples for each tide stage was required for a geomean to be calculated.

Figure 6. Tide Stage vs Geomean



Stations EK 2, 3, 3.8, 4, 5 and 6 show elevated geomeans during the ebb and higher tide stages. These elevated geomeans point to near shore pollution impacts that are being pulled out on the ebbing tide as well as being present during the higher tide stages at the shore and waterline interface.

Rainfall

The mean annual precipitation in growing area EK 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 2007-2017 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 5 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.

Table 6. Geomean vs Rain

Station	dry	.01-.5	.51-1	>1	%change .01-.5	%change .5-1	%change >1
EK002.00	1.9	3.2	1.9	3.1	68.4	0.0	63.2
EK003.00	4	4	1.9	2.9	0.0	-52.5	-27.5
EK003.80	2.9	3.9	7.4	7.2	34.5	155.2	148.3
EK004.00	7.3	9.6	10	63	31.5	37.0	763.0
EK005.00	2.9	4.3	4.2	15	48.3	44.8	417.2
EK006.00	4.1	5.2	3.1	14.2	26.8	-24.4	246.3
EK006.50	2.1	2.5	4.2	2.8	19.0	100.0	33.3
EK007.00	1.9	2.6	0	2.2	36.8	0.0	15.8
EK008.00	3.7	3.1	5.7	3.5	-16.2	54.1	-5.4
EK008.50	2.1	2.5	2.3	6.2	19.0	9.5	195.2
EK008.90	1.9	3	2.1	5	57.9	10.5	163.2

Only stations EK 4, 5, and 6 had their geomeans exceed the standard of 14 CFU/100ml for rain amounts greater than 1" in 72 hours. All three stations are located near the mouths of streams and are in restricted areas. The other stations that had percent changes greater than 50% are still well below the geomean standard of 14.

Winds

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. 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 Discharges

Growing Area EK has no significant rivers but does have 15 streams that are sampled. Of these fifteen, the one most significant in terms of flow rates is; Asa Dyer Brook (6-246) which discharges into the head of Dyer Harbor. Water quality station EK 4 is at the mouth of the Asa Dyer Brook and is classified as Restricted. Although streams are not inherently considered problems in themselves, they do have a high potential to be conduits of pollutants carried to the shellfish beds. Because of this high potential, they are listed here in this section of pollution sources with sample results detailed in Table 7 below. Sample results indicate low background fecal contamination.

Table 7. Stream Sample Results

Town	Date	Stream ID	P source Type	CFU/100ml	Closure
Steuben	15-Jun-09	EK006-246	Stream	92	52E (B.1)
Steuben	29-Aug-11	EK006-246	Stream	180	52E (B.1)
Steuben	08-Dec-09	EK006-246	Stream	1.9	52E (B.1)
Steuben	23-May-11	EK006-246	Stream	14	52E (B.1)
Steuben	20-Jun-07	EK006-246	Stream	24	52E (B.1)

Town	Date	Stream ID	P source Type	CFU/100ml	Closure
Steuben	26-Nov-12	EK006-246	Stream	2	52E (B.1)
Steuben	15-Jun-17	EK006-246	Stream	150	52E (B.1)
Steuben	12-Sep-17	EK006-246	Stream	40	52E (B.1)

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 EK for average salinity by month (2009-2017) shows sample sites with their average salinities broken down by month.

Table 8. Average Salinity by Month 2009-2017

Station	February	March	April	May	June	July	August	September	October	November	December
EK002.00	32	31	31	31	32	31	31	32	32	32	
EK003.00	31	30	28	30	32	31	31	32	32	32	
EK003.80	31	29	26	29	32	30	30	32	32	30	
EK004.00	26	27	24	19	30	30	28	32	31	23	
EK005.00	30	26	25	30	31	30	30	28	29	29	28
EK006.00	28	24	29	28	32	29	31	32	29	31	
EK006.50	27	28	31	30	32	31	31	30	31	29	33
EK007.00	31	32	31	31	32	32	31	32	32	32	
EK008.00	30	25	31	31	32	32	31	32	32	31	
EK008.50	30	29	32	31	32	32	31	32	32	32	
EK008.90	32	31	31	31	32	31	32	32	32	32	

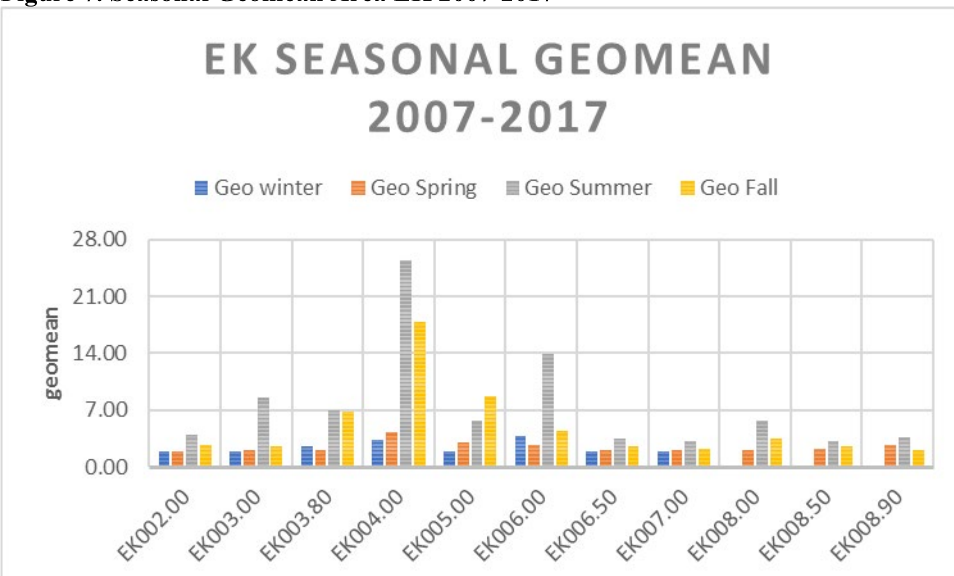
Seasonal Effects on FC Concentrations

To examine the effects that seasons may have on fecal coliform levels in Growing Area EK 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 2007 to 2017. 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 5 samples for each season before a geomean was calculated. Stations with geomean scores > 14 were considered adversely affected during that seasonal period.

Figure 7. Seasonal Geomean Area EK 2007-2017



Station EK 4 showed geomeans greater than 14 CFU/100ml for the summer and fall period and station EK 6 showed an elevated geomean during the summer period. Both stations are located near streams. The summer period showed increased geomeans for almost all stations in this growing area. Next the sample count for each station by seasonal period was calculated.

Figure 8. Percent Samples by season

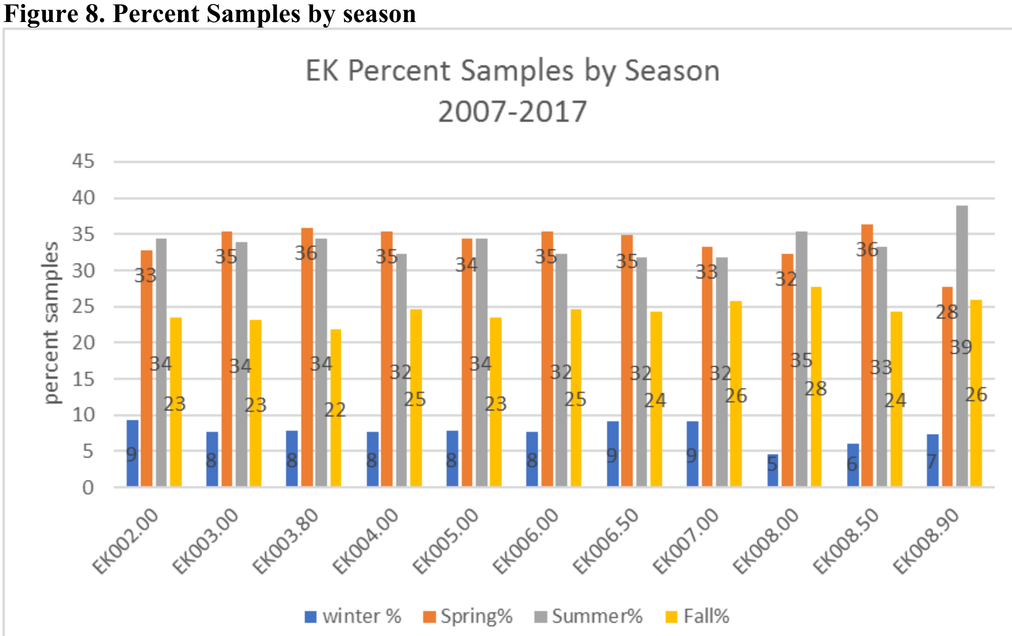
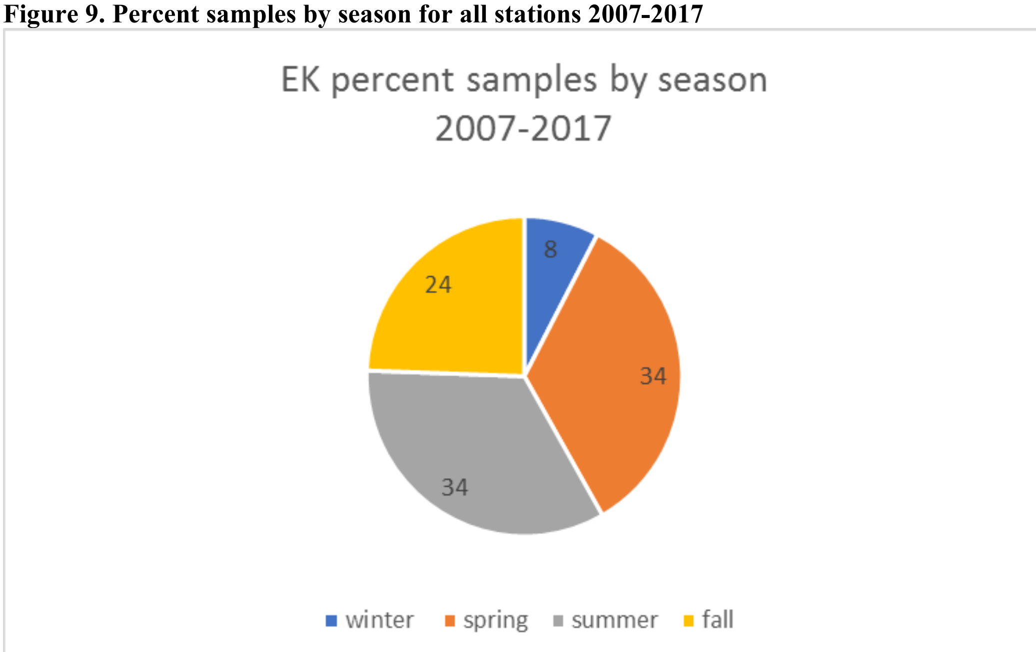


Figure 9 shows the percent samples by season broken down by individual station. The data shows that just over 1/3 of all the samples collected for this growing area occur during the summer which is the period with the highest geomean scores. For a systematic random sampling strategy where only the minimum of six samples a year are collected this means that 2 out of the six samples occur during the time when water quality is the worst. To better represent what is occurring in the watershed this area should be sampled more frequently in the winter and fall. Although it is unlikely that an equal breakdown of samples per season will occur because of ice and snow conditions a percentage of more than 10% could easily be achieved. If this is accomplished the data set will better represent actual year-round conditions for this Growing Area. The pie chart below shows percent samples by season for the entire growing area from 2007-2017.

Figure 9. Percent samples by season for all stations 2007-2017



Water Quality Review

There are presently 11 active water sampling sites in Growing Area EK along with three new Z stations. They are collected from near-shore sites on sample run 12. 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 station in Growing Area EK meet their current NSSP classification standard.

Table 9. Area EK 2017 P90

Station	Class	Count	MFCount	GM	SDV	MAX	P90	Appd_Std	Restr_Std
EK002.00	A	30	30	2.6	0.36	36	7.7	31	163
EK003.00	R	30	30	4.5	0.79	1700	47.7	31	163
EK003.10	X	24	24	3.3	0.52	154	15.9	31	163
EK003.80	R	30	30	4.3	0.58	90	23.7	31	163
EK004.00	R	30	30	13.5	0.82	1060	153.8	31	163
EK005.00	R	30	30	5.2	0.71	460	42.5	31	163
EK005.10	X	24	24	3.4	0.54	220	17.5	31	163
EK006.00	R	30	30	5.3	0.56	300	28.7	31	163
EK006.30	X	27	27	3.8	0.4	48	12.6	31	163
EK006.50	A	30	30	2.8	0.31	28	7	31	163
EK007.00	A	30	30	2.4	0.22	12	4.7	31	163
EK008.00	A	30	30	4.7	0.54	340	23.7	31	163
EK008.50	A	30	30	3	0.41	66	10.4	31	163
EK008.90	P	30	30	2.7	0.4	66	9	31	163

Water Quality Discussion and Classification Determination

P90 trending for all active stations with a minimum of 30 samples is shown in table 10. The percent change in P90 from 2016 to 2017 was calculated and 6 stations showed an increase in P90 scores. Positive percent change indicates a decline in water quality and a negative percent change shows an improvement in water quality. Those stations that exhibited a decrease of 20% or more are highlighted in red.

Table 10. P90 Trend Area EK 2015-2017

Station	Class	2017	2016	2015	%Change 2016-2017
EK002.00	A	7.7	6	4.3	28
EK003.00	R	47.7	52.7	33.8	-9
EK003.80	R	23.7	22.3	26.5	6
EK004.00	R	153.8	137.5	139.4	12
EK005.00	R	42.5	42.8	46	-1
EK006.00	R	28.7	33.4	54.8	-14

Station	Class	2017	2016	2015	%Change 2016-2017
EK006.50	A	7	7	7.6	0
EK007.00	A	4.7	4	4.5	18
EK008.00	A	23.7	21.1	22.5	12
EK008.50	A	10.4	9.5	5.2	9
EK008.90	P	9	11.7	8.7	-23

Growing area EK has shown a slight decline in water quality over the last three years with six out of 11 stations showing an increase in score between 2016 and 2017. However, of those that increased only one station EK 2, showed an increase of 20 percent or more and that was from a 6 to a 7.7.

Recommendation for Future Work

Area EK 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 adjacent growing areas has shown a marked improvement in p90 scores when an effort is made to collect data year-round. It is the recommendation to put this area on the year-round sampling schedule to see if this trend continues. There are no changes to classification required in Growing Area EK.

References

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

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Climatic and hydrographic information, US Coast Guard Coastal Pilot, 2005 edition

U.S. Food and Drug Administration (2001). Applied Concepts in Sanitation Surveys of Shellfish Growing Areas: Course #FD2042 (Training Manual), Volumes I and II.

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) and approved (A).

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.