APPENDIX A

Water Quality Data Review
For
Wellfleet Harbor

Prepared for

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February 17, 2012

Introduction

This report presents and summarizes water quality data collected in Wellfleet Harbor. Reviewed data sets included:

- YSI baseline water quality data collected from the inner harbor, September 1– December 9, 2011.
- Massachusetts Estuary Project (MEP) data from 12 stations, 2006 – 2010.
- Cape Cod Cooperative Extension (CCCE) data, 2009-2011 – Egg Island and the L-Pier Stations
- Provincetown Center for Coastal Studies - Wellfleet Harbor and other inshore/nearshore stations in Cape Cod Bay from 2006-2010.

Of particular interest were water quality parameters that might suggest impairment due to excess nutrients, specifically dissolved oxygen and chlorophyll *a,* as well as nutrients themselves if available.

YSI water quality data - Wellfleet Inner Harbor September 1– December 9, 2011

Environmental Partners Group deployed a YSI 6600 v2 data sonde located on the pier in Wellfleet Harbor, Massachusetts to collect baseline water quality data in the mouth of Duck Creek. Water quality data that were logged included water temperature, specific conductance, dissolved oxygen, total dissolved solids (TDS), turbidity, oxidation reduction potential (ORP), chlorophyll *a*, and blue green algae. The sonde was deployed in Wellfleet Inner Harbor from September 1 through December 9, 2011.

We examined water quality data transmitted from a YSI 6600v2 data sonde mounted in Wellfleet Harbor at the end of the marina dock (41º55’48.32N, 70º 01’ 30.01 W; Figure 1) from September 1 through December 9, 2011. The Wellfleet Harbor station was equipped with a solar powered EcoNet box which transmitted readings via cellular modem. These readings were then sent to the EcoNet website, where the data could be viewed in real-time. The sonde was fitted with the following probes:

- *Water temperature* – YSI uses the Celsius scale, in which 0°C corresponds to the freezing point of water and 100°C is its boiling point at sea level. YSI thermistors are not user adjustable but can be checked against certified thermometers.
- *Specific Conductance* - reflects the ability of water to conduct electrical current. YSI instruments measure conductivity using plates and wires across which an electrical potential is applied, and the current is measured. Conductivity, the inverse of resistivity is determined from the voltage and current values according to Ohm's law.

Since the charge on ions in solution facilitates the conductance of electrical current, the conductivity of sea water is proportional to its ion concentration. The basic unit of conductivity is the siemens (S), sometimes referred to as mho. Since cell geometry affects conductivity values, standardized measurements are expressed in specific conductivity units (mS/cm) to compensate for variations in electrode dimensions. Conductivity measurements, along with temperature allow for salinity values to be calculated through algorithms programmed into the instrument.

- *Dissolved oxygen (DO)* – The amount of oxygen dissolved in seawater that is available to sustain marine life. YSI measures DO as mg/Liter or parts per million. Dissolved oxygen below 3 ppm can present physiological problems for some species and hypoxia is generally defined as 2 ppm or less. Percent saturation, the observed dissolved oxygen level divided by the maximum amount of oxygen water can hold at a given temperature and salinity times 100, is also calculated by the instrument. Percent saturation values near 100% are associated with high quality water. Values as high as 150% or more can occur during phytoplankton and macroalgae blooms particularly during sunny periods. Nitrogen enrichment in inshore waters is typically reflected in low oxygen readings and greater variance over the course of the day.
- *pH* – pH is a measurement of hydrogen-ion concentration in the water. Values have no upper or lower limit but 7 is considered neutral, solutions below 7 are considered acidic and solutions above 7 alkaline or basic. Seawater typically ranges between 7.5 and 8.5 because it holds 50 to 60 times more carbon dioxide than the atmosphere which serves as a buffer via the carbon dioxide –carbonate system (Valiela 1995). Recent observations of seawater acidification attributable to anthropogenic increases in carbon dioxide can impair the shell calcification rate for local shellfish including oysters. Estuaries are particularly susceptible to acidification where anthropogenic nutrient enrichment may enhance the production and subsequent remineralization of organic matter leading to, or increasing hypoxia and low pH levels (Feely et al. 2010).
- *Total Dissolved Solids (TDS)* – The weight of material left behind after filtering a water sample through a 2µ glass filter. TDS is calculated in the YSI instrument using specific conductance, and is reported in grams per liter of water (g/l). In seawater most of the dissolved solids consists of salts so salinity and TDS are very similar.
- *Turbidity* – A measurement of the cloudiness or haziness of water caused by individual suspended particles that are generally invisible to the naked eye. Turbidity reduces the depth at which light can penetrate through water affecting the growth of phytoplankton and sea grasses. In general, turbidity levels above 15 NTU are considered high, and can be detrimental to the health of submerged aquatic vegetation (SAV) such as eelgrass (NOAA 2012; http://buoybay.noaa.gov/investigations/turbidity/59-investigating-turbidity-iv.html). Additionally, an increase in turbidity increases the total available surface area of solids in suspension upon which bacteria (both "good" and "bad" bacteria) can grow (ILMB 1998). The YSI measures turbidity with an optical sensor. Light from the emitter enters the sample and scatters off particles in the water. The light, scattered

at 90 degrees, enters a detector fiber and is measured. Values are expressed in nephelometric turbidity units (NTUs). Increases in turbidity are generally attributed to sediment resuspension or transport from terrestrial systems and/or water circulation patterns (Carrick et al. 1994).

- *Oxidation-Reduction Potential (ORP or Redox)* - ORP measures the tendency of a chemical species to acquire electrons and thereby be reduced. Oxidation refers to the loss of electrons, while reduction refers to the gain of electrons. High ORP values and high pH indicate oxidizing conditions while low ORP and pH values indicate reducing conditions. ORP values below 200 mV suggest reduced levels of oxygen. Denitrification occurs under anoxic conditions with ORP values in the +50 to -50 mV range.
- *Chlorophyll a* - A green pigment found in almost all plants, algae, and cyanobacteria, which allows plants to obtain energy from light. It is used as an indicator of phytoplankton abundance which is related to nutrient availability. Chlorophyll *a* can be measured by extracting the pigment from cells or in situ using a fluorometer. By extraction, a known quantity of water, such as one liter is filtered. The filter is then ground up in the laboratory using acetone. A fluorometer or spectrophotometer is used to read the light transmission at a given wavelength, which in turn is used to calculate the concentration of chlorophyll *a*. Extractive methods allow adjustment of the chlorophyll concentration for phaeophytin *a,* a degradation pigment.

  In situ measurements of living cells can also be made with a fluorometer. Chlorophyll *a* will fluoresce when exposed to a specific light source. The amount of light emitted by the chlorophyll *a* is measured and used to calculate the chlorophyll *a* concentration. Chlorophyll *a* fluorescence is influenced by species composition and light history and should be calibrated with synoptic filtered samples. It is best used for monitoring temporal and spatial trends where relative chlorophyll levels are appropriate. Chlorophyll *a* values of 10 μg/l and above are an indication of degraded water quality.
- *Blue-green algae (BGA)* – also known as cyanobacteria or blue-green bacteria are found in nearly every terrestrial and aquatic habitat. They are well studied because they can form dramatic blooms that appear like green paint. They often smell badly, are toxic, form mats that can complicate the functioning of water systems, and are of low nutritional value to zooplankton. Blue-green algae respond well to high nutrient levels, multiply to high densities and then lead to oxygen depletion when they die. Blue green algae are reported in cells/ml in the September calibration checks and Relative Fluorescence Units (RFU), or percent, in the October through December calibration checks. For calibration, both unit types have an expected reading of zero in distilled water.

The Wellfleet Harbor YSI was not equipped with a depth sensor; instead an Onset water level logger was mounted above the sonde. Since the sonde was briefly exposed to air at lower low tides, data records obtained during periods of exposure were readily identified by checking for salinity values of 1.0 ppt or lower. Once identified, those records were cross checked with tide data for Wellfleet Harbor obtained from Tide and Currents software and then with the Onset water level logger dataset. These records in addition to those taken during calibration and drift checks were omitted. To identify remaining outliers we plotted each data parameter for each month. Obvious outliers (usually a single data point vastly greater or smaller than the surrounding data points) were flagged and deleted. Following this review, fourteen days of turbidity data were deleted and represented by blank periods in the corresponding plots from both September (9/2-9/15) and October (10/5-10/19) due to negative readings since turbidity values should be within the 0-1000 NTU range.

YSI Calibration and Drift Checks

Field data checks were made on September 2 and 15, October 5 and 19, and December 13 by Environmental Partners Group (EPG) personnel. Quality assurance of the data was checked with known standards on each of these dates (with exceptions) for all parameters except temperature and salinity which is calculated internally in the sonde from the specific conductance. If the reading of a parameter in its known standard was within an acceptance range of ±5%, then a calibration (i.e. a reset of that parameter to the known standard value) was not made. However, if the reading was outside the ±5% range, then a calibration was made, and noted in the field log. On one date during the sampling period, September 15, quality assurance of the probes was checked using two methods. The probes were checked against known standards as well as a check of the following parameters against a pre-calibrated, YSI Professional Plus meter: dissolved oxygen, specific conductance, temperature, ORP, and pH. Additionally, a LaMotte turbidity meter was used to check the turbidity probe.

In our review of the time series, we flagged data within the time period for which a parameter was potentially outside the ±5% range according to the biweekly data checks above and plotted those data in red. For example, on September 2, the turbidity probe was not within the ±5% range (standard solution = 126 NTU, Wellfleet YSI reading = 157.4) and again on September 15, (EPG LaMotte turbidity meter reading used as a check for drift in the water column = 9.15 NTU, Wellfleet YSI reading = -25.5 NTU). In addition the YSI reading in distilled water should have been 0 NTU but read -29.2 NTU. These turbidity readings indicated that there was a problem with the probe between the two dates, and these data were subsequently plotted in red, indicating potentially inaccurate data. Data within the

±5% range were plotted in blue. As mentioned above, negative turbidity values were omitted for about two weeks in September and October, and correspond to blank periods in these plots. No calibration data were available for ORP on October 5; specific conductance, chlorophyll *a*, blue green algae, and ORP on October 19; and ORP on December 13.

Wellfleet Harbor YSI hydrographic data September 1– December 9, 2011

September

Data Validity

As mentioned above, data checks were made on September 2 and September 15 by reading the levels of specific conductance, pH, turbidity, chlorophyll *a*, and blue green algae in standard solutions of known concentrations (Table 1). Percent saturation was checked against an environment of saturated air or water (at a known level of 100%). According to the data check/calibration sheets for September and predetermined acceptance criteria range of ±5% supplied by EPG; pH, specific conductance, dissolved oxygen, and chlorophyll *a* were within the ±5% criteria, and therefore considered valid. The Wellfleet YSI was equipped with an optic dissolved oxygen (ODO) probe, which is considered to be very stable (compared with the older membrane-type probes). Turbidity was out of range on September 1 to 2 (plotted in red), and then again on September 15. The turbidity readings on October 5 were within the acceptance range, and these data from September 16-30 were therefore plotted in blue. Checks of the ORP probe were not available for September 2, 15, or October 5, and it is therefore difficult to evaluate the validity of this parameter. Blue-green algae levels in distilled water were above the acceptance criteria on September 2 and September 15 (12,509 and 376 cells/ml, respectively, with an expected value of zero), and were consequently plotted in red from September 1 through September 15.

Table 1. Parameters and standard solutions for Wellfleet YSI data check/calibrations in September, 2011.

	Parameter						
	Specific conductance (mS/cm)	**pH**	**Turbidity (NTU)**	**Percent saturation (%)**	**Chlorophyll *a* (µg/l)**	**Blue green algae(cells/ml)**	**ORP (mV)**
Standard Value	10.00	7.00 and 10.00	126	100	0 in distilled water	0 in distilled water	123.8
9/2	9.8	7.02 (10.00 not available)	157.4	101.1	0.3	12,509	Not checked
9/15	10.1	7.09 and 10.04	-29.2	101.3	0.2	376	Not checked

Data evaluation

According to Massachusetts Department of Environmental Protection (Mass DEP 2007) 314 CMR 4.0 Massachusetts Surface Water Quality Standards 2007, Wellfleet Harbor is considered a Class SA coastal marine habitat. The criteria for Class SA waters are as follows:

- Dissolved oxygen > 6.0 mg/l

To provide context for dissolved oxygen and percent saturation at 6.0 mg/l, the following table shows percent saturation values as a function of temperature (°C) at 30 ppt salinity and barometric pressure of 760 mm.

Temperature (°C)	Percent Saturation	Temperature (°C)	Percent Saturation
2	53.2	14	70.1
4	55.9	16	73.0
6	58.7	18	76.0
8	61.5	20	78.9
10	64.4	22	81.9
12	67.2	24	84.8
From Colt 1984			

Data were collected from the CCCE Egg Island data sonde.

- Water Temperature < 29.4 °C (85 °F)
- pH between 6.5 and 8.5.

Massachusetts Department of Public Health recommends an advisory be issued for blue-green algae levels on coastal beaches if counts exceed 70,000 cells per ml (Mass DPH 2011).

Plots for each parameter and 15-minute interval in September appear in Figure 2. The September values for temperature and pH met water quality standards for Class SA water. Water temperature ranged from 17.1°C to 24.2°C throughout the month and pH ranged from 7.1 to 8.0 (Table 2). The monthly mean dissolved oxygen level in September (5.7 mg/l) was below the water quality standard of 6.0 mg/l, with 77% (23 of 30) daily mean dissolved oxygen values below 6.0 mg/l (Table 3).

During September, the minimum 15-minute value of 1.8 mg/l was recorded on September 26. This period is indicative of a real hypoxic period because of other relatively low dissolved oxygen levels recorded within the same hour (i.e. 2.9 - 3.6 mg/l). Likewise, percent saturation ranged from 24.2 to 106.8% with the minimum value of 24.2% recorded on September 26. Throughout the entire month, 59.0% (1,604 of 2,718) of all 15-minute readings were ≤6.0 mg/l, 22.8% (619 of 2,718) were ≤5.0 mg/l, and 7.5% (203 of 2,718) were ≤4.0 mg/l.

During September, salinity ranging from 25.7 to 31.0 ppt, specific conductance ranging from 40.1 to 47.5 mS/cm, and TDS ranging from 26.1 to 30.9 g/l were within the expected range for a marine environment. Throughout the month, ORP ranged from -197 to 163 mV, consistent with low levels of dissolved oxygen. Turbidity in September ranged from 2 to 104 NTU with a mean value of 6.3 NTU. On September 30, the peak value of 104 NTU was preceded by several relatively high readings (44.6 to 97.4 NTU) recorded from 0945 to 1715 hours suggesting the data point was not anomalous. Strong southerly winds were recorded that day and likely contributed to the high value by stirring sediment.

Table 2. Minimum, maximum, and mean water quality parameters, from Wellfleet Harbor during September, 2011.

September 2011	**Wellfleet YSI**		
Parameter	**Minimum**	**Maximum**	**Mean**
Temperature °C	17.1	24.2	20.8
Salinity (ppt)	25.7	31.0	29.7
Specific Conductance (mS/cm)	40.1	47.5	45.8
TDS (g/l)	26.1	30.9	29.8
pH	7.1	8.0	7.8

ORP (mV)	-197	163	88
Dissolved Oxygen (mg/l)	1.8	8.0	5.7
Percent saturation (%)	24.2	106.8	76.4
Chlorophyll (µg/l)	3.2	54.2	8.4
BGA (cells/ml)	1,126	9,495	3,533
Turbidity (NTU)	1.9	104.0	6.3
Data logged at 15-minute intervals.			

Table 3. Daily average, maximum, and minimum dissolved oxygen levels (mg/l) based on 15-minute readings, inner Wellfleet Harbor, September, 2011.

	Average Dissolved Oxygen	Maximum Dissolved Oxygen	Minimum Dissolved Oxygen
9/1/2011	5.6	7.7	2.8
9/2/2011	5.5	7.7	2.4
9/3/2011	5.8	7.5	2.9
9/4/2011	5.6	7.2	3.5
9/5/2011	5.7	7.5	3.8
9/6/2011	4.9	6.2	3.3
9/7/2011	4.6	6.5	2.3
9/8/2011	4.8	6.9	2.4
9/9/2011	5.6	7.7	3.0
9/10/2011	6.0	7.8	3.7
9/11/2011	6.0	7.6	3.9
9/12/2011	5.9	7.3	3.5
9/13/2011	6.1	7.2	3.8
9/14/2011	6.0	7.4	4.0
9/15/2011	5.9	7.5	4.0
9/16/2011	6.1	7.6	4.7
9/17/2011	5.9	7.5	4.6
9/18/2011	6.1	7.5	4.6

9/19/2011	6.4	7.8	5.2
9/20/2011	6.6	7.8	5.0
9/21/2011	6.3	8.0	4.7
9/22/2011	6.3	7.9	4.5
9/23/2011	5.9	7.6	4.1
9/24/2011	5.9	7.7	3.1
9/25/2011	5.7	7.3	2.2
9/26/2011	5.5	7.0	1.8
9/27/2011	5.1	6.8	1.9
9/28/2011	5.2	6.5	2.6
9/29/2011	5.3	6.2	3.5
9/30/2011	5.5	6.8	3.8

The 15-minute YSI data from September indicated elevated levels of chlorophyll *a* with a maximum value of 54.2 µg/l recorded on September 10, and a second peak on September 25 (37.8 µg/l; Figure 3). These levels were substantially greater than the 10 µg/l acceptance level, which according to EPA (2007) "should be adequately protective for both public health and water quality". Daily mean chlorophyll *a* levels were above 10 µg/l on seven days during September (Table 4;), with 15-minute readings of chlorophyll *a* levels at least once per day above 10 µg/l occurring on 27 of the 30 days in September. Blue-green algae levels were below the advisory level of 70,000 cells/ml throughout the month.

Table 4. Daily average, maximum, and minimum chlorophyll *a* levels (µg/l based on 15-minute readings, inner Wellfleet Harbor, September, 2011.

Date	Average Chlorophyll *a*	Maximum Chlorophyll *a*	Minimum Chlorophyll *a*
9/1/2011	11.5	21.3	6.9
9/2/2011	10.7	27.3	6.8
9/3/2011	9.8	15.1	5.0
9/4/2011	9.8	13.8	5.6
9/5/2011	8.6	12.5	5.4
9/6/2011	8.1	30.4	4.5
9/7/2011	6.6	14.2	4.1
9/8/2011	6.2	11.6	3.9
9/9/2011	7.1	20.8	4.0
9/10/2011	8.5	54.2	4.7

9/11/2011	6.7	10.3	4.1
9/12/2011	6.3	22.3	3.5
9/13/2011	8.3	35.6	4.5
9/14/2011	11.1	21.2	5.5
9/15/2011	11.5	19.3	7.5
9/16/2011	9.0	15.6	6.0
9/17/2011	6.7	10.0	4.3
9/18/2011	6.2	9.8	3.7
9/19/2011	5.2	7.0	3.2
9/20/2011	6.0	10.4	3.4
9/21/2011	6.5	9.8	3.7
9/22/2011	7.6	11.8	4.6
9/23/2011	10.4	17.1	5.3
9/24/2011	10.8	17.6	6.1
9/25/2011	10.4	37.7	5.8
9/26/2011	9.7	22.3	6.0
9/27/2011	9.1	16.7	5.7
9/28/2011	8.0	12.9	5.4
9/29/2011	8.0	13.5	5.0
9/30/2011	8.3	17.3	6.2

October

Data Validity

According to the data check/calibration sheets; pH, turbidity, and percent saturation were within the ±5% criteria on October 5, October 19, and December 13. From October 5 through the 19, a majority of turbidity levels recorded were negative. Since the turbidity range on the YSI unit is 0 to 1000 NTU, all negative values were deleted from the database. The turbidity probe was within the 5% range on both data checks before and after this time period, and therefore the remainder of values was considered to be accurate.

Table 4. Parameters and standard solutions for Wellfleet YSI data check/calibrations in October, 2011.

	Parameter						
	Specific conductance (mS/cm)	**pH**	**Turbidity (NTU)**	**Percent saturation (%)**	**Chlorophyll a (µg/l)**	**Blue green algae(cells/ml)**	**ORP (mV)**
Standard Value	10.00	4.00, 7.00, and 10.00	126	100	0 in distilled water	0 in distilled water	123.8
10/5	9.8	3.96, 7.0 (10.0 not checked)	133.6	101.9	0.3 in distilled water	0.1RFU** in distilled water	Not checked
10/19	Not checked	7.0, 10.1 (4.0 not checked)	127.6	100.3	Not checked	Not checked	Not checked
12/13	9.7	*4.3, 7.1, 10.1	130.9	100.9	0.3 in distilled water	0.2 RFU** in distilled water	Not checked

*4.3 was not within the acceptance range, possibly due to faulty standard
**RFU = Relative Fluorescence Units (%)

Data evaluation

As with the September data, the temperature and pH values were within the specified water quality criteria for Class SA water. Water temperature ranged from 7.9 to 20.9 °C and pH ranged from 7.4 to 8.1 throughout October (Table 5). The mean dissolved oxygen level in October (7.0 mg/l) was above the water quality standard of 6.0 mg/l, but the minimum monthly mean value (3.2 mg/l) was not. Dissolved oxygen levels dropped below 6.0 mg/l for at least one 15-minute reading on 25 of 31 days (Figure 4). On October 1, multiple low readings, ranging from 3.1 to 4.3 mg/l, were recorded on either side of the low tide (at 0901 hours). We believe these readings are accurate, and not due to exposed probes because the water level logger data indicated that the probes were beneath the surface at the times corresponding to the relatively low dissolved oxygen levels. However, daily mean dissolved oxygen levels were below 6.0 mg/l on four days, October 1-4 (5.3, 5.4, 5.6, and 5.9 mg/l respectively; Table 6).

During October, salinity levels ranging from 25.4 – 30.5 ppt, specific conductance from 40.0 to 46.8 mS/cm, and TDS levels from 26.0 to 30.4 g/l were within expected levels. ORP levels in October were comparable to those in September (-133 to 131 mV). The monthly mean level of chlorophyll *a* during October was 5.5 µg/L, with no daily mean values above 10 µg/l (Table 7). However, peak chlorophyll *a* levels were above 10 µg/L at least once per day on 13 of 31 days, with a maximum of 35.2 µg/l on October 29, and a second peak of 27.8 µg/l on

October 15. These spikes, when chlorophyll *a* levels were above 10.0 µg/l for multiple reading, occurred within time frames of about 4 hours and 1.25 hours, respectively. Throughout the month, turbidity levels ranged from 0 NTU to a maximum value of 95.0 NTU, with a mean value of 5.8 NTU. Blue-green algae levels were below 70,000 cells/ml, ranging from 849 to 24,210 cells/ml throughout the month.

Table 5. Minimum, maximum, and mean water quality parameters, from Wellfleet Harbor during October, 2011.

October 2011	Wellfleet YSI		
Parameter	**Minimum**	**Maximum**	**Mean**
Temperature °C	7.9	20.9	15.9
Salinity (ppt)	25.4	30.5	29.4
Specific Conductance (mS/cm)	40.0	46.8	45.4
TDS (g/l)	26.0	30.4	29.5
pH	7.4	8.1	7.9
ORP (mV)	-133	131	76
Dissolved Oxygen (mg/l)	3.2	8.8	7.0
Percent saturation (%)	41.1	105.2	84.0
Chlorophyll (µg/L)	1.9	35.2	5.51
BGA (cells/ml)	849	24,210	2,959
Turbidity (NTU)	0	95	5.8
Data logged at 15-minute intervals.			

Table 6. Daily average, maximum, and minimum dissolved oxygen levels (mg/l) based on 15-minute readings, inner Wellfleet Harbor, October, 2011.

	Average Dissolved Oxygen	Maximum Dissolved Oxygen	Minimum Dissolved Oxygen
10/1/2011	5.3	6.4	3.2
10/2/2011	5.4	6.5	4.1
10/3/2011	5.6	7.2	3.9
10/4/2011	5.9	7.4	4.0
10/5/2011	6.4	7.5	5.4
10/6/2011	6.7	8.0	4.8
10/7/2011	7.0	8.2	5.5
10/8/2011	7.2	8.2	5.7
10/9/2011	7.2	8.3	5.3
10/10/2011	7.2	8.1	4.8
10/11/2011	6.9	8.2	5.4
10/12/2011	6.7	7.9	4.2
10/13/2011	6.5	7.4	5.0
10/14/2011	6.3	7.2	4.6
10/15/2011	7.0	7.8	6.2
10/16/2011	7.5	8.4	6.5
10/17/2011	7.6	8.4	6.4
10/18/2011	7.5	8.5	5.8
10/19/2011	6.9	7.8	5.6
10/20/2011	7.2	8.4	5.8
10/21/2011	7.4	8.2	6.5
10/22/2011	7.5	8.6	5.9
10/23/2011	7.4	8.5	6.0
10/24/2011	7.6	8.8	5.7
10/25/2011	7.4	8.2	5.3
10/26/2011	7.2	8.0	5.3
10/27/2011	6.9	7.6	5.1
10/28/2011	7.3	8.1	5.8
10/29/2011	7.5	8.1	5.6
10/30/2011	8.3	8.7	6.8
10/31/2011	8.1	8.8	7.1

Table 7. Daily average, maximum, and minimum chlorophyll *a* levels (µg/l) based on 15-minute readings, inner Wellfleet Harbor, October, 2011.

Date	Average Chlorophyll *a*	Maximum Chlorophyll *a*	Minimum Chlorophyll *a*
10/1/2011	7.9	11.5	5.2
10/2/2011	7.9	11.5	5.4
10/3/2011	7.5	11.2	4.7
10/4/2011	7.0	10.8	4.4
10/5/2011	6.3	9.4	4.1
10/6/2011	4.5	6.8	2.7
10/7/2011	3.8	5.6	1.9
10/8/2011	4.5	6.5	2.9
10/9/2011	4.8	8.0	2.6
10/10/2011	5.3	8.8	3.0
10/11/2011	5.6	8.9	3.7
10/12/2011	5.3	8.5	3.3
10/13/2011	4.7	7.3	3.0
10/14/2011	4.4	8.2	2.8
10/15/2011	6.8	27.8	4.1
10/16/2011	5.9	9.1	3.9
10/17/2011	5.1	6.9	3.4
10/18/2011	4.5	6.7	2.9
10/19/2011	4.0	6.1	2.4
10/20/2011	5.6	11.4	3.1
10/21/2011	5.8	14.2	3.5
10/22/2011	4.9	15.1	3.1
10/23/2011	4.5	8.4	3.1
10/24/2011	5.4	13.0	3.3
10/25/2011	5.8	9.1	3.7
10/26/2011	6.5	9.3	4.4
10/27/2011	6.5	14.1	3.9
10/28/2011	4.9	10.1	3.1
10/29/2011	5.9	35.2	2.7
10/30/2011	6.2	16.0	3.4
10/31/2011	3.7	7.2	2.4

November - December

Data Validity

As mentioned above, according to the data check/calibration sheet on December 13 (Table 3), specific conductance, pH, turbidity, and dissolved oxygen, chlorophyll *a*, and blue-green algae were within the ±5% criteria, and ORP was not checked. Aside from the data recorded when the probes were exposed to the air during low tides, no other data were omitted.

Data evaluation

Temperature, pH, and dissolved oxygen recorded during November through December 9 were within state water quality standards. Throughout this sampling period, the temperature was somewhat lower than the preceding two months, as expected and ranged from 6.7 to 12.3°C (Table 8). Values recorded for pH ranged from 7.6 to 8.2, and dissolved oxygen levels ranging from 6.3 to 10.3 mg/l were above the 6.0 mg/l criteria for the entire 39-day period (Table 9; Figure 5). The increase in dissolved oxygen can be attributed to colder water temperatures and lower utilization. Salinity levels in Wellfleet Harbor ranged from 24.2 to 30.0 ppt, specific conductance from 39.8 to 46.6 mS/cm, and TDS ranged from 24.9 to 30.3 g/l. The monthly mean chlorophyll *a* level for November through December 9 (6.1 µg/l) was below 10 µg/l, and no daily mean chlorophyll *a* levels were above 10 µg/l (Table ,10). Based on individual 15-minute readings, chlorophyll *a* levels above 10 µg/l were recorded on 24 of 39 days (November 1-December 9), with a maximum value of 34.1 µg/l. Blue-green algae levels were below the recommended level of 70,000 cells/ml throughout November to December 9. Although the mean turbidity level for this sampling period was relatively low (4.0 NTU), levels throughout the sampling period were variable, with multiple peaks between 50 and 60 NTU recorded on five occasions and a maximum of 77.8 NTU on November 9.

Table 8. Minimum, maximum, and mean water quality parameters, from Wellfleet Harbor during November-December 9, 2011.

November-December 9, 2011	**Wellfleet YSI**		
Parameter	**Minimum**	**Maximum**	**Mean**
Temperature °C	6.7	12.3	9.5
Salinity (ppt)	24.2	30.0	29.2

Specific Conductance (mS/cm)	39.8	46.6	45.4
TDS (g/l)	24.9	30.3	29.5
pH	7.6	8.2	8.0
ORP (mV)	-59	129	88
Dissolved Oxygen (mg/l)	6.3	10.3	8.7
Percent saturation (%)	67.8	108.1	91.8
Chlorophyll (µg/l)	1.4	34.1	6.1
BGA (cells/ml)	404	25,512	2,555
Turbidity (NTU)	0	77.8	4.0
Data logged at 15-minute intervals.			

Table 9. Daily average, maximum, and minimum dissolved oxygen levels (mg/l) based on 15-minute readings, inner Wellfleet Harbor, November-December 9, 2011.

Date	Average Dissolved Oxygen	Maximum Dissolved Oxygen	Minimum Dissolved Oxygen
11/1/2011	8.1	9.0	6.7
11/2/2011	8.3	9.0	6.7
11/3/2011	8.4	9.3	7.2
11/4/2011	8.4	9.0	7.2
11/5/2011	8.7	9.5	7.4
11/6/2011	8.9	9.9	7.6
11/7/2011	9.0	9.6	7.3
11/8/2011	8.7	9.5	7.6
11/9/2011	8.7	9.8	7.3
11/10/2011	8.5	9.5	7.4
11/11/2011	8.3	9.0	7.0
11/12/2011	8.8	9.7	7.9
11/13/2011	8.7	9.4	6.6
11/14/2011	8.7	9.4	7.5

11/15/2011	8.3	9.1	6.7
11/16/2011	7.7	8.5	6.4
11/17/2011	7.6	8.5	6.3
11/18/2011	8.7	9.8	7.0
11/19/2011	9.1	9.9	7.8
11/20/2011	8.9	9.7	7.2
11/21/2011	8.4	9.5	7.2
11/22/2011	8.6	9.6	7.1
11/23/2011	9.1	9.5	8.2
11/24/2011	8.9	9.4	7.7
11/25/2011	9.1	9.8	7.7
11/26/2011	9.1	9.7	6.9
11/27/2011	9.0	9.7	7.3
11/28/2011	8.9	9.8	6.8
11/29/2011	8.7	9.8	6.9
11/30/2011	8.8	9.4	7.5
12/1/2011	8.6	9.6	7.6
12/2/2011	8.8	10.0	6.8
12/3/2011	9.1	10.0	7.4
12/4/2011	9.1	10.3	6.6
12/5/2011	9.3	10.3	7.0
12/6/2011	9.3	10.0	7.6
12/7/2011	8.6	9.5	7.1
12/8/2011	9.0	9.7	8.1
12/9/2011	9.0	9.6	8.2

Table 10. Daily average, maximum, and minimum chlorophyll *a* readings (µg/l) based on 15-minute readings, inner Wellfleet Harbor, November-December 9, 2011.

Date	Average Chlorophyll *a*	Maximum Chlorophyll *a*	Minimum Chlorophyll *a*
11/1/2011	3.8	11.0	2.5
11/2/2011	3.4	6.0	1.5
11/3/2011	3.9	8.4	1.4
11/4/2011	5.1	8.5	3.3
11/5/2011	5.0	7.1	2.5
11/6/2011	5.2	10.0	2.4
11/7/2011	7.0	10.7	3.5
11/8/2011	5.2	21.6	2.7

11/9/2011	4.8	12.0	3.3
11/10/2011	4.9	7.2	2.9
11/11/2011	6.5	20.9	3.1
11/12/2011	9.3	16.3	5.8
11/13/2011	7.3	11.5	4.5
11/14/2011	7.3	12.3	4.5
11/15/2011	7.1	12.2	4.2
11/16/2011	5.6	10.2	3.6
11/17/2011	5.1	8.6	3.3
11/18/2011	5.6	8.4	3.2
11/19/2011	7.0	24.9	3.4
11/20/2011	7.5	15.3	4.6
11/21/2011	6.3	15.1	3.8
11/22/2011	5.4	8.4	3.5
11/23/2011	8.5	34.1	4.0
11/24/2011	6.3	10.4	3.9
11/25/2011	6.0	11.2	3.9
11/26/2011	5.7	10.1	4.0
11/27/2011	5.4	8.8	3.7
11/28/2011	6.4	15.5	4.1
11/29/2011	5.9	8.6	3.7
11/30/2011	7.0	12.5	4.2
12/1/2011	6.9	10.1	4.6
12/2/2011	6.3	23.2	4.0
12/3/2011	6.3	9.8	4.0
12/4/2011	6.1	9.3	4.2
12/5/2011	5.8	12.3	3.3
12/6/2011	6.0	8.8	3.6
12/7/2011	6.2	10.3	4.2
12/8/2011	7.5	16.3	4.7
12/9/2011	6.8	10.0	4.9

Wellfleet Harbor water quality data from other sources

Massachusetts Estuary Project (MEP)

MEP data were collected at 12 stations within Wellfleet Harbor during a 5-year period (Figure 6). Data were collected on six occasions from June through September in 2006, and two times per month during July and August in 2007, 2008, 2009, and 2010, all during ebb tides. Data readings were made at the surface, mid- and bottom depths when water depth allowed, otherwise readings were made at the surface and bottom depths. The complete data set consists of 15 parameters: Depth, dissolved oxygen, temperature, salinity, conductivity, phosphate (PO_4), ammonium (NH_4), nitrogen oxides (NO_x), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total organic nitrogen (TON), particulate organic nitrogen (PON), total nitrogen (TN), particulate organic carbon (POC), chlorophyll *a*, phaeophytin, and turbidity using secchi disappearance/appearance depths. For this summary the focus is on dissolved oxygen, total nitrogen, and chlorophyll *a* because they are the most relevant parameters to this study. Dissolved oxygen was recorded with a YSI 55 dissolved oxygen meter, in which the data output for dissolved oxygen was not corrected for salinity. These dissolved oxygen levels were subsequently corrected for salinity by MEP personnel, included in the dataset, and used for this analysis. Chlorophyll *a* and nutrients were analyzed in the laboratory from grab samples taken at station locations.

Dissolved Oxygen – In order to analyze for spatial trends in dissolved oxygen over time within Wellfleet Harbor, all dissolved oxygen readings were plotted by station (Figure 7). Dissolved oxygen levels recorded at all 12 stations within Wellfleet Harbor from 2006 to 2010 were often low relative to water quality standards, with levels ≤6.0 mg/l during 33 of 63 (52%) sampling occasions in 2006, 38 of 72 (53%) in 2007, 44 of 45 (98%) in 2008, 53 of 56 (95%) in 2009, and 51 of 54 (94%) in 2010 (Figure 7). In general, the plotted data suggested that dissolved oxygen decreased as sampling stations progressed northward and inshore. The highest values were recorded at Stations 1 and 2 (maximum value of 8.4 mg/l in 2006 at Station 1), and the lowest recorded at Stations 9 through 12 (minimum value of 2.7 mg/l at Stations 9 and 11 in 2010). Averaging all data available for each station and running a nonparametric Mann-Kendall trend test indicated a significant downward trend in dissolved oxygen ($p = 0.000014$) moving from Station 1 to Station 12.

Annual mean dissolved oxygen values were equal to or above 6.0 mg/l during 2006 and/or 2007 at Stations 1 through 10, and during 2008 at Station 1 (Figure 8). All mean dissolved oxygen levels for 2008 (excluding the above exception) through 2010 at Stations 1 through 12 were below 6.0 mg/l. Mean dissolved oxygen values for all five years were below 6.0 mg/l at Stations 9, 11, and 12, and all but one mean value, 6.3mg/l in 2007, were below 6.0 mg/l at Station 10.

Visually there also appears to be a decreasing trend over time, with a majority of the highest dissolved oxygen readings appearing in 2006 and a majority of the lowest levels recorded in 2010 at each station. This pattern is apparent in a closer look at the stations in the Wellfleet Inner Harbor (MEP Stations 10 – 12), where a decreasing trend in dissolved oxygen levels is apparent at Stations 10, 11, and 12 from 2006 to 2010 (Figure 9). At Station 10, four of ten readings were below 6.0 mg/l in 2006 and 2007, and all readings were below 6.0 mg/l during 2008 through 2010 (one, three, and two readings per year respectively). At Stations 11 and 12, all but one reading (four of five) were below 6.0 mg/l in 2006 and 2007, while all readings were below 6.0 mg/l from 2008 to 2010 (two, four and four readings per year taken at Station 11, and two, four, and three readings per year at Station 12). These data suggest a decline in the inner harbor water quality environment over the past five years.

In order to provide information regarding dissolved oxygen levels at the EP Station during the summer months, when dissolved oxygen is expected to be at minimum levels, data collected from Duck Creek (MEP Station 12; Figure 6) from June 19 through September 14 (2006 – 2010) were plotted with the EPG dissolved oxygen data. Figure 10 indicates that daily mean dissolved oxygen levels were the lowest from June through September, started to improve in the beginning of October, and remained above 6.0 mg/l from October through December 7.

Total Nitrogen – Figure 11 displays total nitrogen measurements for all 12 MEP stations and all dates between 2006 and 2010. Total nitrogen consists of all organic and inorganic forms of nitrogen. Total nitrogen values greater than 0.7 mg/l (= 50 µmols) are considered high and indicative of impaired waters and values under 0.32 mg/l (= 23 µmols) are consistent with high water quality (Howes et al. 2005). Outer Station 1 and 2 values were all less than 50 µmols compared to inner-harbor Station 12 where 79% (19 of 24) of the readings were greater than 50 µmols, with a maximum value of 90.9 µM at Station 12 in 2009. The total nitrogen data showed a spatial trend consistent with the dissolved oxygen data in that lower levels were measured at the more offshore stations and higher levels were measured at the inshore stations. A temporal trend was also apparent for total nitrogen at the 3 inner-most stations (10, 11, 12) over the five years sampled (Figure 12). Total nitrogen levels increased from 2006 to 2010 at Stations 10 and 12, and from 2008 to 2010 at Station 11 (Figure 12). Total nitrogen levels did not appear to follow this trend in 2007 at Stations 10 and 12, with the highest reading two times higher (123.0 µmols) than the other readings at Station 10, and substantially lower readings (maximum value of 57.9 µmols) while maximum values for the other years ranged from 77.5 to 90.9 µmols.

Chlorophyll a - Similar to total nitrogen, chlorophyll *a* levels increased as sampling location moved northward and inshore although the majority of values were well below 10 µg/l. Readings at Station 1 (ranged from 0.6 to 5.6 µg/l), while those at Station 12 (ranged from 1.4 to 11.8 µg/l), with the highest value (13.4 µg/l) recorded at Station 11 in 2009 (Figure 13). Maximum levels of chlorophyll *a* were recorded in 2009 and 2010 at all stations except Station 1, where the maximum level of chlorophyll *a* was recorded in 2008 (5.6 µg/l).

A majority of chlorophyll *a* levels recorded from 2006 to 2010 at the three inner harbor stations were below the alarm level, 10 µg/l, with elevated levels occurring only in 2009 at Stations 7, 8, 10, 11, and 12 (Figure 13). Chlorophyll *a* levels at Stations 10, 11, and 12 were relatively similar among the five years, except for the elevation during 2009, with no trend detected (Figure 14).

Cape Cod Cooperative Extension (CCCE) dataset – Egg Island and the L-Pier Stations

Water quality data were collected at the Egg Island Station, located in the northern portion of Wellfleet Harbor (between MEP Stations 8 and 10) and at the L-Pier, located at the mouth of the inner harbor (near MEP Station 10; Figure 1). The Egg Island data set consisted of nine parameters: Depth, temperature, salinity, dissolved oxygen, specific conductivity, total dissolved solids, pH, chlorophyll *a*, and turbidity. The L-Pier data set consisted of ten parameters, the same nine as at Egg Island plus ORP. For this report we focused on dissolved oxygen, chlorophyll *a*, turbidity, and pH considered the most relevant parameters to this study. Negative depth and turbidity values were omitted from both datasets before analysis and plotting. Data were recorded at 15-minute intervals from moored YSI data sondes. These data collections were made possible with funding from Barnstable County, Woods Hole Sea Grant, and the Southeastern Massachusetts Aquaculture Center (SEMAC). Data at Egg Island were collected from June 16 through November 22, 2011, and at the L-Pier from July 24 through December 11 in 2009, March 19 through June 15, July 29 through August 5, and October 22 through December 9 in 2010, and April 28 (May 20 for dissolved oxygen) through June 21 in 2011.

Dissolved Oxygen –

Egg Island - From mid-June to mid-November 2011, the majority of daily mean dissolved oxygen readings at Egg Island were above 6.0 mg/l (144 of 158 records = 91%). The daily mean dissolved oxygen readings that were below or equal to 6.0 mg/l occurred periodically between July 8 and August 15, when the lowest daily mean value of dissolved oxygen (4.7 mg/l) was observed (Figure 15). The 15-minute dissolved oxygen levels were below 6.0 mg/l throughout the entire day on August 15, with readings dropping below 6.0 mg/l from 20:01 on August 14 to 04:46 on August 16. Throughout the time series, dissolved oxygen was lowest during the warm, biologically active summer months and then increased in the fall.

L-Pier - Water quality data collected at the L-Pier located in the inner harbor illustrate a similar seasonal trend where daily mean dissolved oxygen levels were highest and above 6.0 mg/l in the early spring (March through mid-May 2010), and decreased to below 6.0 mg/l from mid-May through mid-September (2009 – 2011; Figure 16). Pooled together, the three years of data collected spanned from March 19 through December 11, but none of the three years' data included all of these months and so will be described separately. During 2009, daily mean dissolved oxygen values were consistently below 6.0 mg/l from the beginning of the data set on July 24 until August 31 (Figure 16). From the data collected during March 19 through June 15, 2010, daily mean dissolved oxygen values exceeded 6.0 mg/l until May 20 when it began to vary above and below 6.0 mg/l. Dissolved oxygen was consistently below or equal to 6.0 mg/l during the summer, July 29 through August 5. During the data set from May 20 through June 21, 2011, 25 of 33 (76%) daily mean dissolved oxygen values were below 6.0 mg/l.

At the L-Pier Station, 15-minute dissolved oxygen readings dropped below 6.0 mg/l for at least one reading, and frequently for hours each day over a period of time for each of the three years: from July 24 through October 10, 2009; from May 15 through November 23, 2010; and from May 20 through June 21, 2011 (Figure 17). Minimum 15-minute dissolved oxygen readings for each year were recorded on August 1, 2009 (0.8 mg/l), on May 30, 2010 (1.6 mg/l) and on June 10, 2011 (1.2 mg/l).

Overall, daily mean dissolved oxygen levels collected in 2011 at Egg Island were higher than those recorded near the mouth of the Wellfleet Inner Harbor at the L-Pier Station during 2009 and 2010. Although the datasets for 2011 do not overlap, the data do suggest higher dissolved oxygen levels at Egg Island due at least in part to the greater water exchange expected at the more offshore location.

Chlorophyll a –

Egg Island **-** At Egg Island, daily mean chlorophyll *a* levels from early summer through late fall ranged from 3.6 µg/l (June 16, October 31, and November 2) to 31.7 µg/l (August 28, 2011; Figure 18). Overall, 43 of 160 (27%) daily mean values of chlorophyll *a* were above 10.0 µg/l, with the top four daily mean values occurring in July and August (19.1 µg/l on July 26, 20.1 µg/L on August 29, 22.3 µg/l on August 7, and 31.7 µg/l on August 28).

L-Pier – A majority (26 of 36, 72%) of the daily mean chlorophyll *a* levels at the L-Pier Station were above 10 µg/l from July 26 to August 28 during 2009, for 18 of 136 days (during late July to early August, and November 14 through November 24) during 2010, and for two days between May and June (June 11 and June 12) in 2011 (Figure 19). The 15-minute-interval chlorophyll *a* plots show that recorded peak values were above the 10 µg/l level periodically throughout the time series during 2009, 2010, and 2011 (Figure 20). An algal bloom appears to have occurred in mid-November when the 15-minute and daily mean chlorophyll *a* levels remained above 20 µg/l. The bloom lasted for nine days (November 13 through November 22) and chlorophyll a levels reached as high as 85.7 µg/l

Although the data for Egg Island and the L-Pier Station for 2011 do not overlap temporally, daily mean chlorophyll *a* levels recorded at the L-Pier Station during 2009 through 2011 were comparable to those collected at Egg Island in 2011 with values occurring above and below 10 µg/l during each year at both stations.

Turbidity-

Egg Island –Daily mean values of turbidity at Egg Island from mid-June to mid-November varied between 0.2 NTU on July 14 and 55.2 on August 28, 2011 with multiple peaks ranging from 20 to 40 NTU (Figure 21). From mid-June to mid-November 2011, 10.6% (17 of 160) of daily mean turbidity levels were above 15.0 NTU, and turbidity levels above 15.0 NTU were recorded at least once per day during 91 of 160 (56%) days.

L-Pier - Mean daily turbidity levels recorded at the L-Pier remained below 15 NTU for 2009, 2010, and 2011 (Figure 22). During 2009, 22.9% (32 of 140) of days sampled, at least one 15-minute reading was above 15.0 NTU; 27.2% (37 of 136) of days during 2010; and only one reading above 15 NTU was recorded in 2011 (17.7 NTU on April 28, 2011 (Figure 23). The plots of turbidity readings at 15-minute intervals indicate that periodic peaks well above the daily mean values were seen in 2009 and 2010, with the highest recorded level 199 NTU on November 11, 2009. These relatively short elevated turbidity levels may be due to wind, tide, and boating activities near the L-Pier.

pH

Egg Island – Both the fifteen-minute readings and daily mean pH levels recorded at the Egg Island Station from June 16 through November 22, 2011 were within the water quality criteria for Class SA waters (6.5 to 8.5) and ranged from 7.4 to 8.3 (Figure 24).

L-Pier - Daily mean pH values at the L-Pier Station from 2009 through 2011 were within the water quality criteria. There were a few occasions during 2009 where the pH dropped below water quality criteria for brief periods (Figure 25). The low pH values corresponded to low dissolved oxygen readings ranging from 2.9 to 3.4 mg/l. During 2010, there were 92 occasions when 15-minute pH readings were above water quality criteria, and ranged from 8.5 to 9.5 (Figure 26). pH readings were above 8.5 for approximately seven hours on each day, on April 28, (from 05:45 to 13:30) , April 29 (from 06:30 to 13:30), and April 30 (from 08:30 to 1500); and from one reading on May 15 (pH = 8.7). Daily mean pH levels ranged from 8.0 to 8.5, and were within the specified criteria for all days in 2010. Elevated pH values can reflect photosynthesis during an algal bloom, however, there is no evidence of any blooms occurring with no spikes in dissolved oxygen or chlorophyll *a* levels during these periods. All 15-minute (ranging from 7.5 to 8.3) and daily mean (7.7 to 8.1) pH levels during May and June, 2011 were within water quality criteria.

Provincetown Center for Coastal Studies - Wellfleet Harbor and other inshore/nearshore stations in Cape Cod Bay from 2006-2010

In order to examine water quality in Wellfleet Harbor relative to other nearby waters we examined data collected by the Provincetown Center for Coastal Studies (PCCS). Data were available from inner Wellfleet Harbor (Station 28, Figure 26) and 28 comparable inshore and near shore stations throughout Cape Cod Bay from May through October, 2006 through 2009. The Wellfleet Harbor sampling location was on the southwest end of the pier in Wellfleet Harbor (near MEP Station 10 and CCCE L-Pier Station). The other inshore station locations ranged from Duxbury Harbor on the West side of Cape Cod Bay to Provincetown on the East (Figure 27). Inshore/near shore sites were sampled on ebb tides usually two to five times per month from May through October each year. The dataset for 2006 included five parameters measured from May through October, water temperature, salinity, dissolved oxygen, nitrite/nitrate, and ortho-phosphate. The datasets for 2007-2009 included ten parameters, the same five recorded in 2006 plus nitrogen, phosphorous, chlorophyll *a*, phaeophytin, and turbidity. Measurements of chlorophyll *a* and phaeophytin were conducted with a fluorometer following laboratory extraction. Phaeophytin measurements were used to correct chlorophyll *a* measurements. High concentrations of phaeophytin are not often reported in the open ocean, but can be encountered in relatively high concentrations in highly productive coastal waters.

Non-nutrient parameters

The following data from 2006-2009 were obtained from the PCCS website (PCCS 2011, http://www.coastalstudies.org/what-we-do/cc-bay-watch/monitoringdata.htm) and arranged in tabular form. Water temperature at the Wellfleet Harbor station was slightly higher than those measured at the other inshore/near shore stations in Cape Cod Bay for each year from 2006 to 2009 (Table 9). The slightly elevated temperatures at the Wellfleet station were likely due to its location well up in the Harbor inshore of the extensive tidal flats that absorbed radiant energy during daylight hours (Figure 26). Mean salinity levels at the Wellfleet Harbor station were only slightly higher than the other inshore stations for each year from 2006 to 2009, while the maximum salinity values were lower at Wellfleet compared to the other inshore stations during the same years. Mean dissolved oxygen levels at the Wellfleet station were lower than all other inshore stations from 2006 to 2009, and the lowest overall value for 2009 (4.6 mg/l was at Wellfleet) compared to the minimum for the other inshore stations (4.9 mg/l). The mean turbidity at the Wellfleet station was slightly higher (ranging from 1.4 – 1.9 NTU) than the other inshore stations (ranging from 1.2 – 1.3 NTU), but the maximum values for each year were lower (ranging from 2.3 – 4.6 NTU) than the other stations (ranging from 7.2 – 21.8 NTU).

Table 9. Comparison of annual water quality parameters from Wellfleet Harbor and 28 inshore/near shore stations May – October throughout Cape Cod Bay, 2006-2009.

	Temperature (C)		Salinity (ppt)		Dissolved Oxygen (mg/L)		Turbidity (NTU)	
	Wellfleet Harbor	Cape Cod Bay Inshore Stations	Wellfleet Harbor	Cape Cod Bay Inshore Stations	Wellfleet Harbor	Cape Cod Bay Inshore Stations	Wellfleet Harbor	Cape Cod Bay Inshore Stations
2009								
Mean	19.92	18.52	30.05	29.37	7.78	9.26	1.43	1.23
Min	14.69	9.22	28.80	4.40	4.63	4.92	0.67	0.17
Max	25.82	26.74	31.00	32.96	9.51	20.53	2.33	21.83
2008								
Mean	21.45	19.54	30.48	30.07	6.33	7.64	1.72	1.34
Min	12.80	10.10	29.40	14.14	3.86	3.81	0.61	0.16
Max	25.70	26.30	31.52	32.03	8.55	11.33	3.58	7.17
2007								
Mean	21.41	18.90	30.42	29.81	6.74	7.87	1.91	1.31
Min	15.10	12.20	28.60	8.70	5.20	4.80	0.00	0.00
Max	26.30	27.00	31.80	32.10	8.31	11.51	4.64	12.44
2006								
Mean	19.85	18.19	29.88	29.81	7.25	8.22		
Min	10.70	10.00	27.40	8.00	4.72	4.52		
Max	27.50	28.20	31.50	32.28	10.02	12.97		

PCCS 2011 http://www.coastalstudies.org/what-we-do/cc-bay-watch/monitoringdata.htm

Nutrients

Nitrogen-based and phosphorous-based nutrients were reported in micro molar (µMols) units (PCCS 2011), and converted to mg/l here. Mean and maximum nitrate levels at the Wellfleet station were lower than all other inshore stations for each year from 2006 to 2009 (Table 10). Mean total nitrogen was higher in Wellfleet Harbor than at the other inshore stations from 2007 to 2009 and the highest reading among all inshore stations occurred in Wellfleet in 2008 (248 µMols = 3.48 mg/l).

Table 10. Comparison of nitrogen water quality parameters from Wellfleet Harbor and 28 inshore/near shore stations May through October throughout Cape Cod Bay, 2006-2009.

	Nitrate				Total Nitrogen			
	Wellfleet Harbor		Cape Cod Bay Inshore Stations		Wellfleet Harbor		Cape Cod Bay Inshore Stations	
	(uM)	mg/l	(uM)	mg/l	(uM)	mg/l	(uM)	mg/l
2009								
Mean	0.07	0.004	0.39	0.024	11.42	0.16	6.67	0.093
Min	0.00	0.000	0.00	0.000	1.23	0.017	0.00	0.000
Max	0.25	0.016	10.81	0.67	32.47	0.455	60.00	0.840
2008								
Mean	0.05	0.003	0.39	0.024	24.79	0.347	14.59	0.204
Min	0.00	0.000	0.00	0.000	7.53	0.105	0.00	0.000
Max	0.16	0.01	43.43	2.693	248.40	3.479	248.40	3.479
2007								
Mean	0.17	0.011	0.54	0.033	22.47	0.315	14.43	0.202
Min	0.00	0.000	0.00	0.000	5.21	0.073	0.00	0.000
Max	2.04	0.126	23.19	1.438	81.76	1.145	200.00	2.801
2006								
Mean	0.17	0.011	0.68	0.042				
Min	0.00	0.000	0.00	0.000				
Max	2.13	0.132	33.85	2.099				

http://www.coastalstudies.org/what-we-do/cc-bay-watch/monitoringdata.htm

Although phosphorous levels are typically referred to in discussions of freshwater nutrient loading, we will present the phosphorous-related data collected in Cape Cod Bay because the information is available with context to other inshore stations in the same body of water, and may be useful for this study. Mean ortho-phosphate levels were slightly higher at the Wellfleet Harbor station (0.5 – 1.0 µM; 0.05 – 0.10 mg/l) compared to the other inshore stations (0.2 – 0.5 µM; 0.02 – 0.05 mg/l) for all years from 2006 to 2009 (Table 11). Overall, the highest maximum ortho-phosphate was recorded at the other inshore stations in 2006 (8.9 µM and 0.8 mg/l). The highest maximum ortho-phosphate value at Wellfleet Harbor (4.1 µM and 0.4 mg/l) occurred in 2007, while the value from the other Cape Cod Bay inshore stations was 3.7 µM and 0.4 mg/l. Within Wellfleet Harbor, the maximum values occurred on August 1, 2006 and July 10, 2007; and in the inshore stations on July 6 2006, and June 26, 2007. Mean total phosphorous levels were slightly higher at Wellfleet Harbor (ranging from 2.5 – 2.9 µM; 0.08 – 0.09 mg/l) than at the other inshore stations (ranging from 1.3-1.6 µM; 0.04 – 0.05 mg/l) from 2007 to 2009.

Table 11. Comparison of phosphorous-related nutrient water quality parameters from Wellfleet Harbor and 28 inshore/near shore stations May through October throughout Cape Cod Bay, 2006-2009.

	Ortho-Phosphate				Total Phosphorous			
	Wellfleet Harbor		Cape Cod Bay Inshore Stations		Wellfleet Harbor		Cape Cod Bay Inshore Stations	
	(uM)	mg/l	(uM)	mg/l	(uM)	mg/l	(uM)	mg/l
2009								
Mean	0.52	0.049	0.19	0.018	2.52	0.078	1.32	0.041
Min	0.07	0.007	0.00	0.00	1.18	0.037	0.34	0.011
Max	2.07	0.197	0.93	0.088	5.70	0.177	5.76	0.178
2008								
Mean	0.56	0.053	0.39	0.037	2.90	0.090	1.61	0.050
Min	0.20	0.019	0.00	0.00	0.78	0.024	0.41	0.013
Max	2.03	0.193	2.66	0.253	13.51	0.418	13.51	0.418
2007								
Mean	1.04	0.099	0.51	0.048	2.73	0.085	1.56	0.048
Min	0.15	0.014	0.01	0.001	1.04	0.032	0.34	0.011
Max	4.05	0.385	3.71	0.352	8.35	0.259	13.55	0.420
2006								
Mean	0.64	0.050	0.48	0.046				
Min	0.03	0.003	0.00	0.00				
Max	2.38	0.226	8.89	0.844				

http://www.coastalstudies.org/what-we-do/cc-bay-watch/monitoringdata.htm

Mean chlorophyll *a* levels were also higher at the Wellfleet station (ranging from 4.3 – 6.0 µg/L) compared with the other inshore stations (2.1 – 2.5 µg/l) from 2007 to 2009 (Table 12). However, maximum observed chlorophyll *a* values in Wellfleet were lower (9.3 – 12.1 µg/l) than all the other inshore station maxima (10.9 – 13.2 µg/l) for the same time period.

Table 12. Comparison of nutrient-related water quality parameters from Wellfleet Harbor and 28 inshore/near shore stations May through October throughout Cape Cod Bay, 2006-2009.

	Chlorophyll *a*		Pheophytin	
	Wellfleet Harbor	Cape Cod Bay Inshore Stations	Wellfleet Harbor	Cape Cod Bay Inshore Stations
	ug/L	ug/L	ug/L	ug/L
2009				
Mean	4.31	2.07	3.65	2.08
Min	0.91	0.16	0.75	0.32
Max	9.57	11.42	8.25	10.20
2008				
Mean	5.10	2.52	1.77	1.06
Min	1.37	0.34	0.39	0.11
Max	9.28	10.93	3.15	4.09
2007				
Mean	5.96	2.53	1.09	0.70
Min	2.17	0.41	0.20	0.00
Max	12.07	13.2	2.09	3.92
2006				
Mean				
Min				
Max				

http://www.coastalstudies.org/what-we-do/cc-bay-watch/monitoringdata.htm

Conclusions

Environmental Partners YSI Data: Inner Wellfleet Harbor September – November, 2011

The September water quality data recorded in Wellfleet Harbor near the mouth of Duck Creek indicate that eutrophication is occurring. Relatively low dissolved oxygen coupled with some high chlorophyll *a* readings suggest that nutrient enrichment is degrading water quality there. Peak chlorophyll *a* levels remained high through October and November although daily means did not. Minimum dissolved oxygen levels remained low (below 6.0 mg/l and ranged from 41 to 78 percent saturation) periodically through October, also suggesting continued eutrophication, but increased to levels above 6.0 mg/l throughout November as waters cooled. Dissolved oxygen levels are expected to remain above 6.0 mg/l throughout the winter months due to the combination of low cold-water biological oxygen demand and the high solubility of oxygen in cold water.

MEP Data: Inner Wellfleet Harbor June –September, 2006-2010

Among the twelve MEP stations located throughout Wellfleet Harbor, data indicated a relative decrease in water quality at the innermost stations (MEP Stations 10-12) compared to those stations more offshore (Stations 1-9). Relatively low dissolved oxygen, high total nitrogen, and somewhat higher chlorophyll a levels inshore compared to offshore are indicative of nutrient impaired waters.

CCCE Egg Island and L-Pier Data: Wellfleet Harbor March –December, 2009-2011

The two CCCE stations in Wellfleet Harbor, Egg Island and the L-Pier Station are only 0.6 miles apart but water quality readings reflect clear differences. The Egg Island station is further from shore with greater tidal exchange while the L-Pier Station is in closer proximity to the inner Harbor and Duck Creek. A difference in dissolved oxygen levels was detected between the two stations, with a majority of daily mean dissolved oxygen levels at or above 6.0 mg/l from June through September at Egg Island, and a majority of readings below 6.0 mg/l at the L-Pier Station during the same period of time.

Provincetown Center for Coastal Studies Data: Cape Cod Bay/Wellfleet Harbor May – October, 2006-2009

The Provincetown Center for Coastal Studies data is consistent with the 2011 YSI dataset suggesting that innermost Wellfleet Harbor is experiencing eutrophication which is consistent with other inshore/near shore locations in Cape Cod Bay. Mean dissolved oxygen levels in Wellfleet Harbor were lower than those in all other inshore/nearshore stations for all four years sampled. The highest level of total nitrogen among all inshore stations was recorded in Wellfleet Harbor in 2008. These decreased water quality parameters could be due to the more inshore location of Wellfleet Harbor compared to the other inshore/near shore locations.

Recommendations:

We suggest the following:

- Observe the Duck Creek cultch site this winter to the extent possible for signs of sea bird predation and freeze damage.
- In the spring of 2012 check the site for cultch integrity, particularly sediment depth around the shell, oyster density and oyster growth. Add shell to the site to enhance settlement surface area and build vertical relief.
- Return the YSI instrument to the water as soon as possible in the late winter-early spring. If possible we recommend that the unit be calibrated biweekly from date of installation through June and weekly during July and August when nutrient loading to

the Harbor peaks during the vacation season. If that is impractical the data stream should be monitored regularly for signs of drift.

- Measure nitrate, dissolved oxygen, total dissolved solids, and chlorophyll at a series of points in and around the Duck Creek reef site and perhaps other locations in the Harbor during the July and August 2012 high season. Can a difference in these parameters be detected that correlates with shellfish density? Perhaps target flood and ebb tide on one or two days in each of those two months. A YSI data sonde can be used to measure dissolved oxygen, total dissolved solids, and chlorophyll (along with water temperature and salinity) but nitrate samples will require grab samples analyzed at a laboratory.
- If not already available in one place compile a list of shellfish grants/sites, species associated with each, and approximate standing stock of animals at each site in Wellfleet Harbor. With that database rough numbers of nutrients utilized by the shellfish population in Wellfleet Harbor can be calculated.
- Begin to establish shellfish population targets that would be consistent with continuously acceptable water quality.

Objectives:

- To utilize as much of Wellfleet Harbor shellfish habitat as possible for the benefit of water quality, shellfishing, and tourism. Water quality benefits will moderate the need for wastewater treatment infrastructure. To do so, shellfish populations must be maintained.
- Work with regulatory agencies to permit development of oyster sanctuaries so that permanent reefs can become established. Permanent reefs have higher profiles with reduced sedimentation and provide a source of spat.

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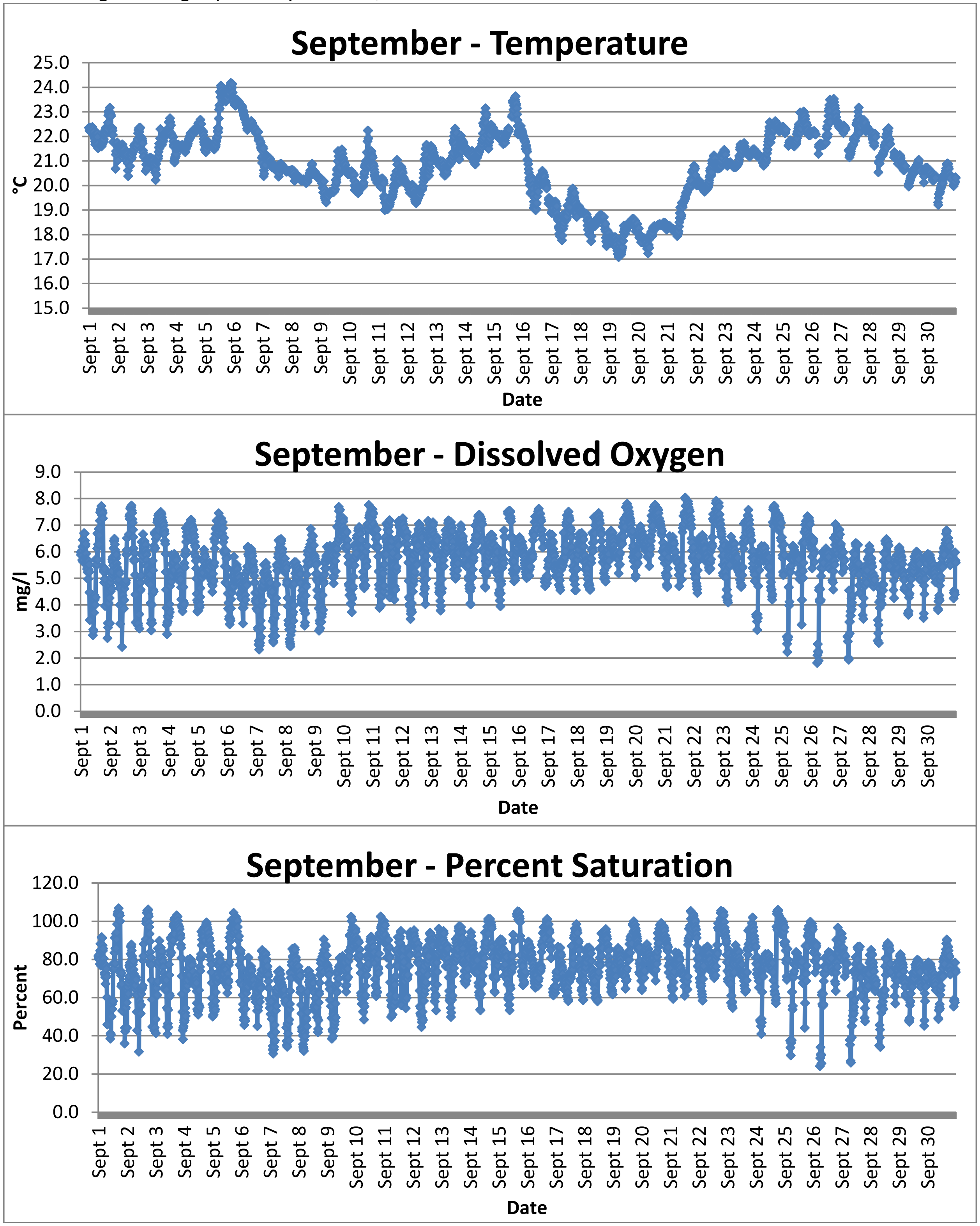
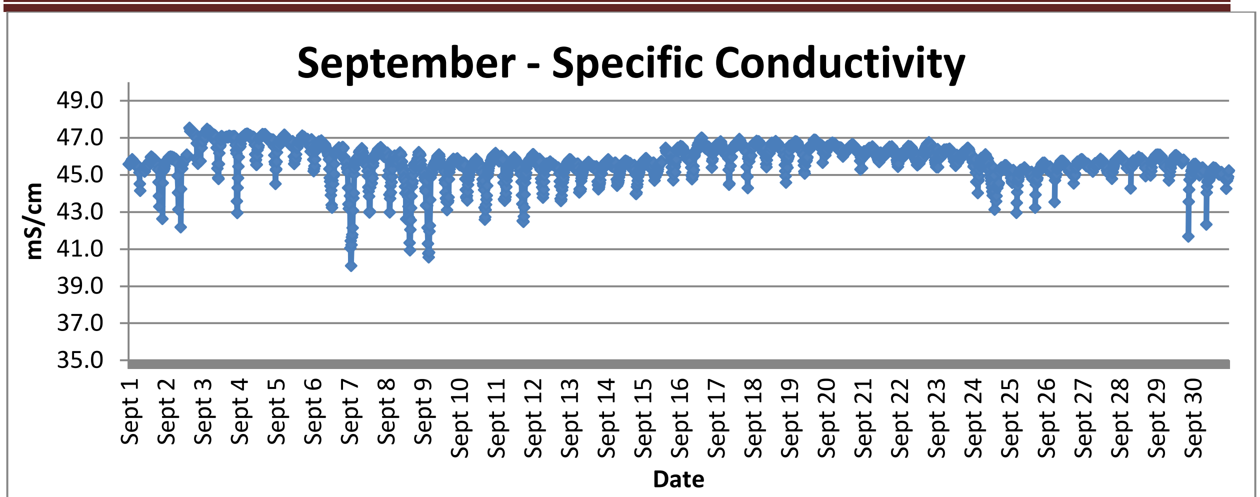
Figure 1. Location of Environmental Partners YSI, CCCE stations (Egg Island and L-Pier Station), and the culch site in the mouth of Duck Creek in Wellfleet Harbor.

Figure 2. Wellfleet Harbor Water quality parameters (temperature, dissolved oxygen, percent saturation, specific conductance, salinity, total dissolved solids pH, ORP, turbidity chlorophyll, and blue green algae) for September, 2011.




September - Specific Conductivity
mS/cm
49.0
47.0
45.0
43.0
41.0
39.0
37.0
35.0
Sept 1
Sept 2
Sept 3
Sept 4
Sept 5
Sept 6
Sept 7
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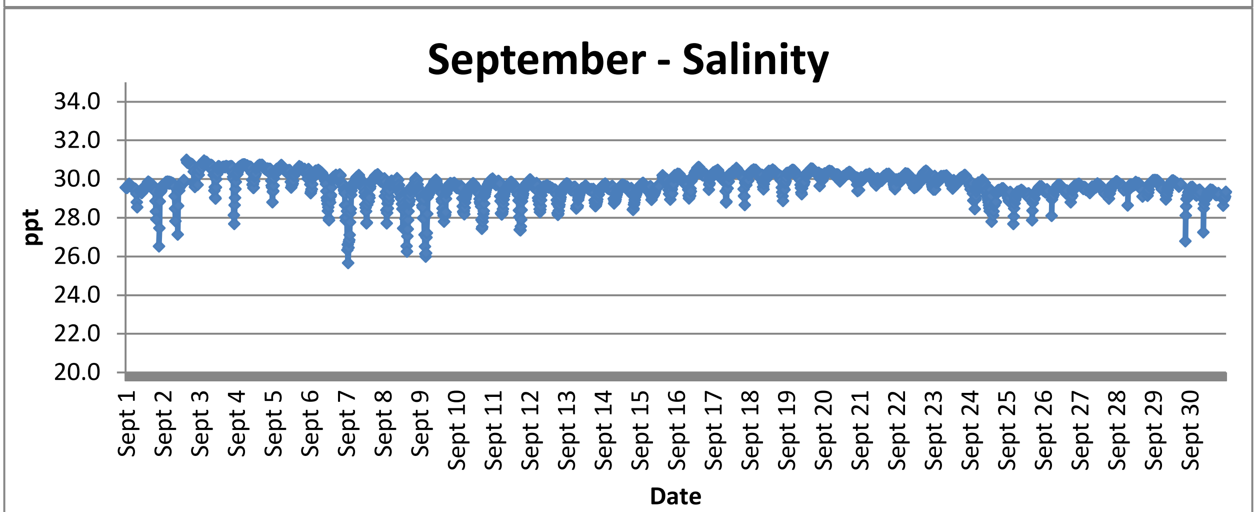
Date


September - Salinity
ppt
34.0
32.0
30.0
28.0
26.0
24.0
22.0
20.0
Sept 1
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Sept 3
Sept 4
Sept 5
Sept 6
Sept 7
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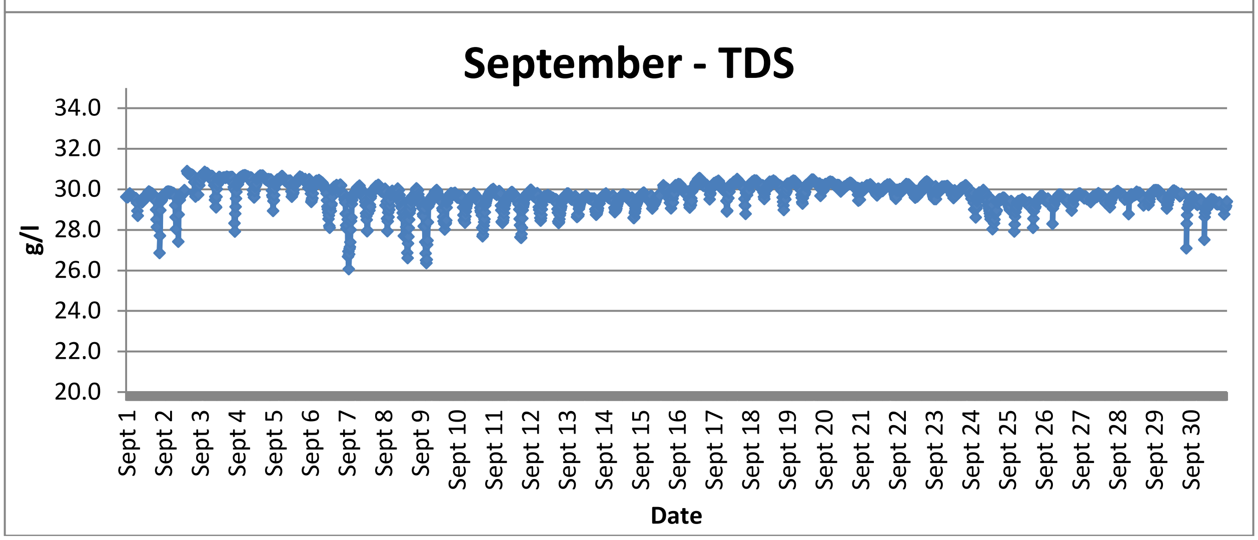
Date


September - TDS
g/l
34.0
32.0
30.0
28.0
26.0
24.0
22.0
20.0
Sept 1
Sept 2
Sept 3
Sept 4
Sept 5
Sept 6
Sept 7
Sept 8
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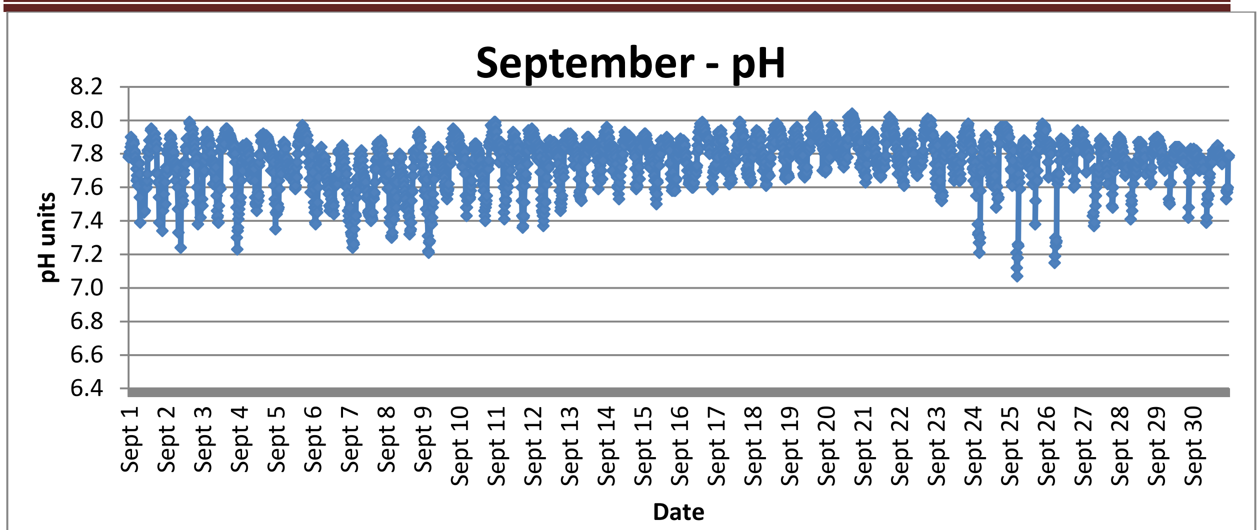
September - pH
pH units
8.2
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
Sept 1
Sept 2
Sept 3
Sept 4
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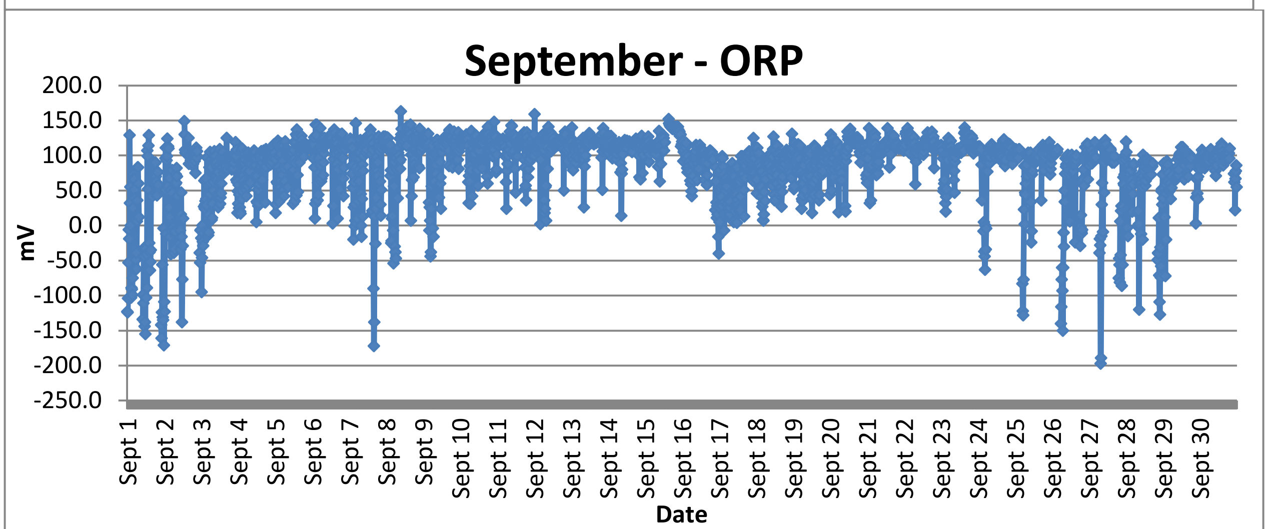
Date


September - ORP
mV
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
-200.0
-250.0
Sept 1
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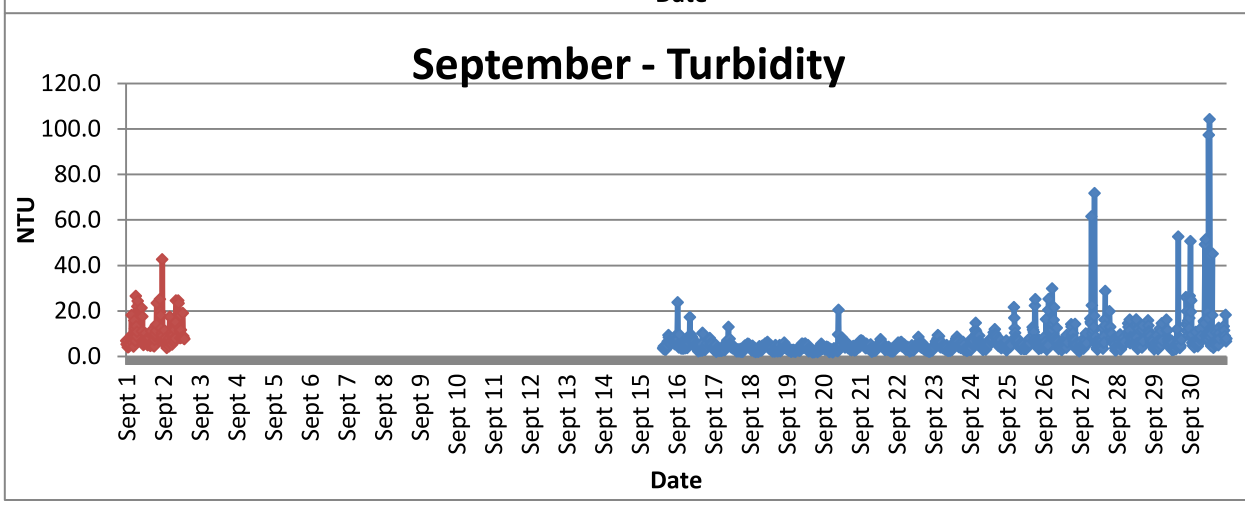
September - Turbidity
NTU
120.0
100.0
80.0
60.0
40.0
20.0
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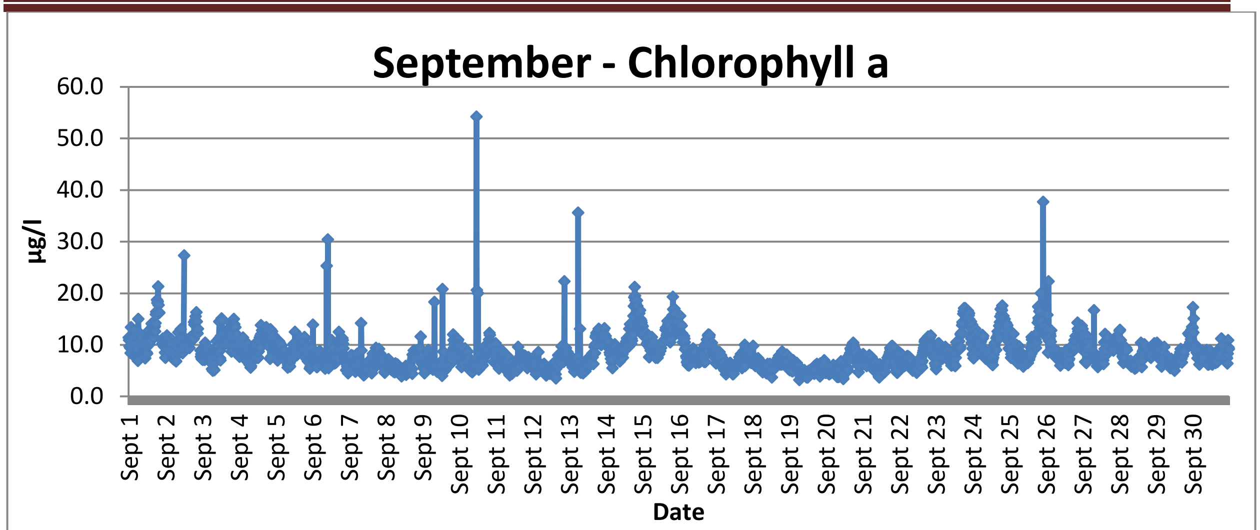
September - Chlorophyll a
µg/l
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sept 1
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Sept 7
Sept 8
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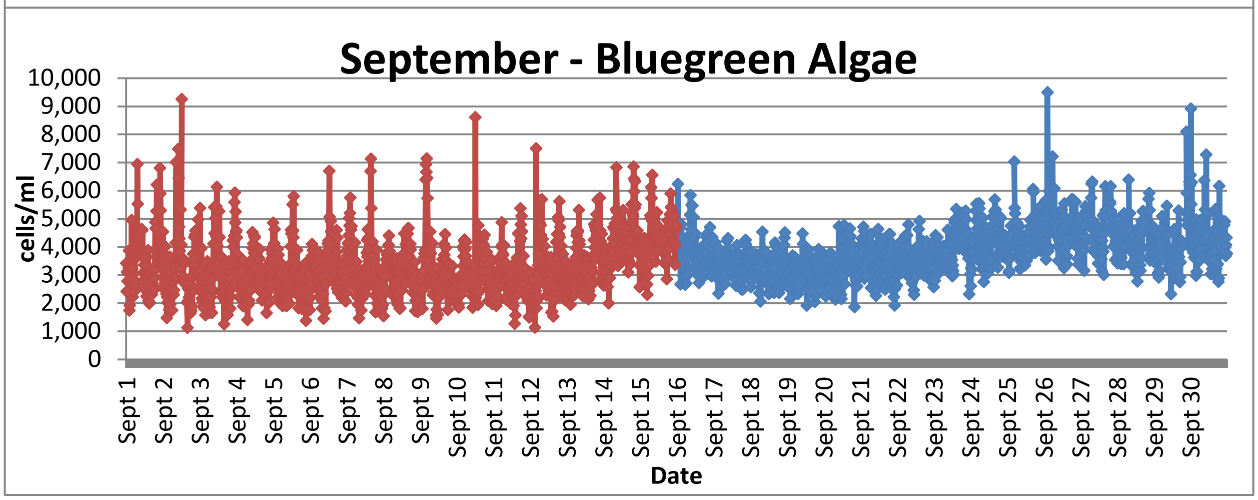
September - Bluegreen Algae
cells/ml
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Sept 1
Sept 2
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Date

Figure 3. Daily mean chlorophyll a levels recorded in Wellfleet Harbor, September-November, 2011.

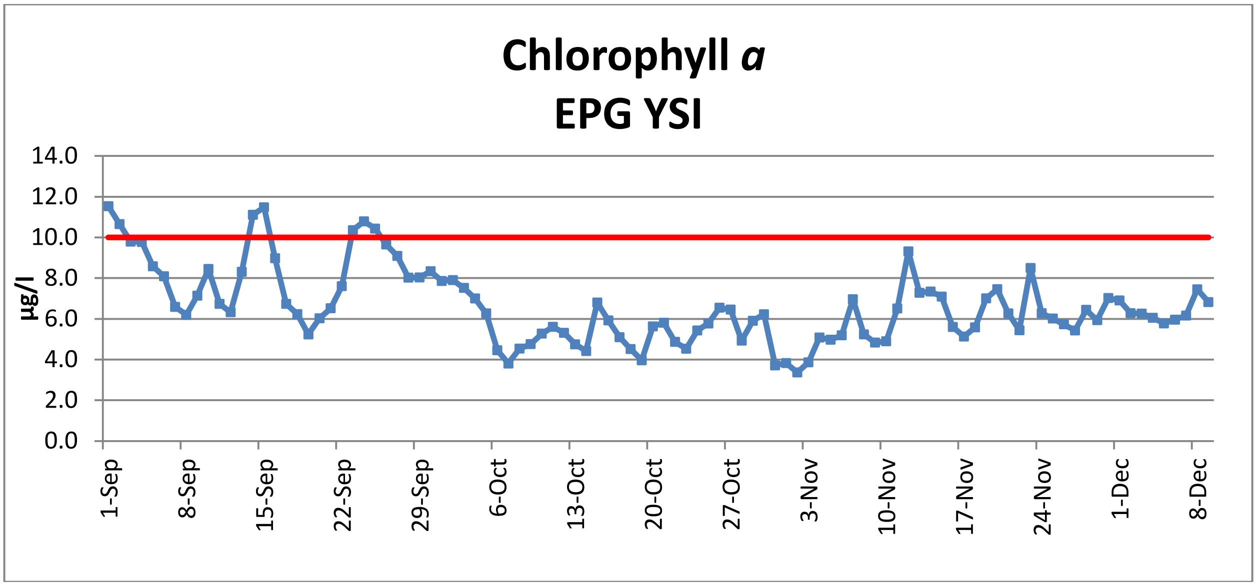
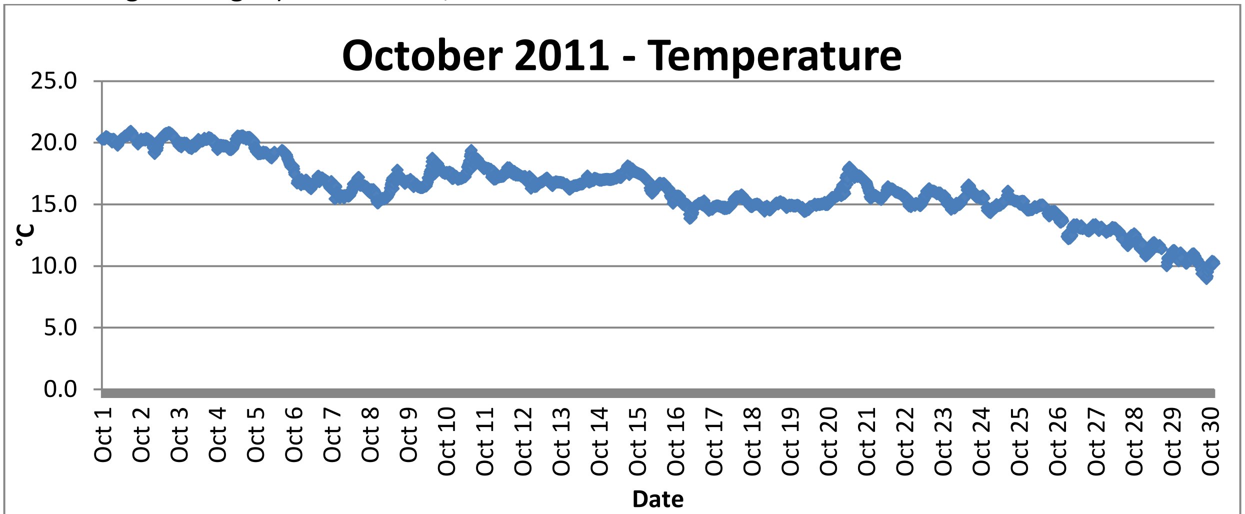
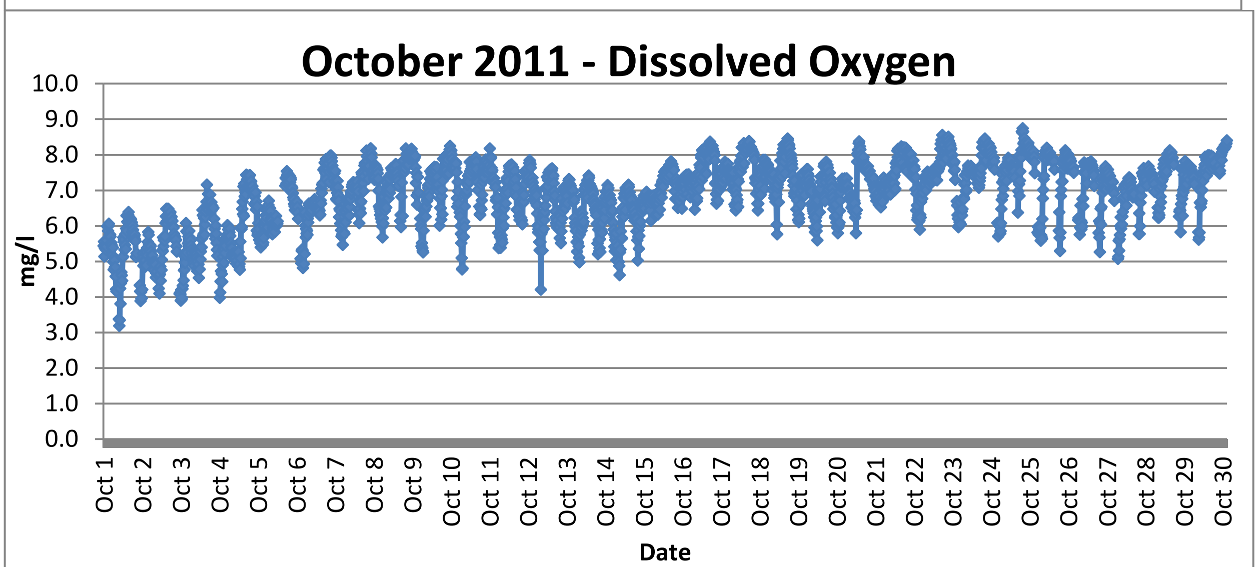
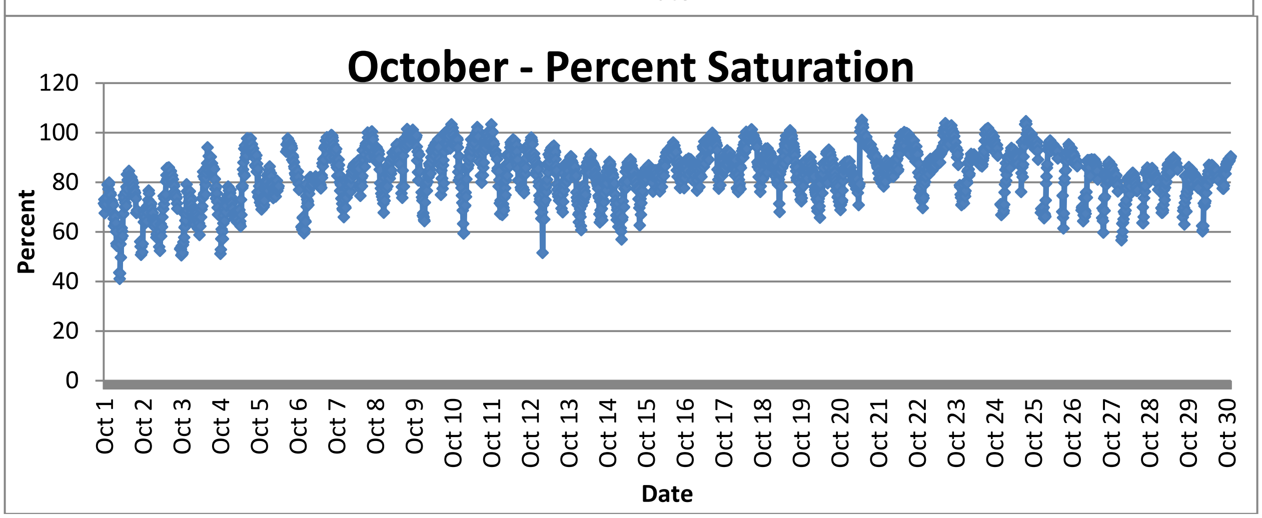
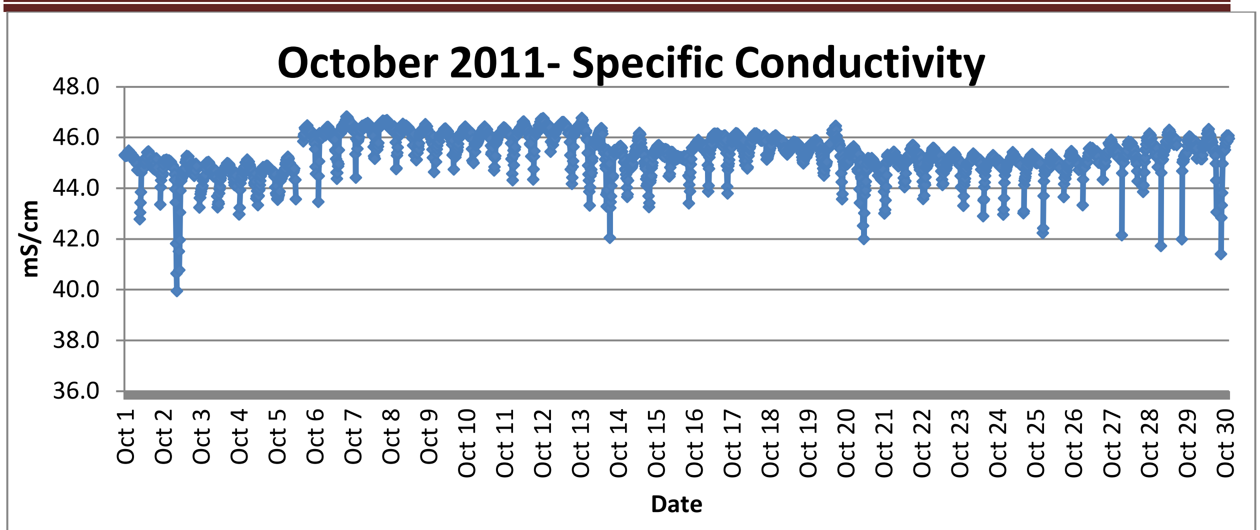


Figure 4. Wellfleet Harbor Water quality parameters (temperature, dissolved oxygen, percent saturation, specific conductance, salinity, total dissolved solids pH, ORP, turbidity chlorophyll, and blue green algae) for October, 2011.








October 2011- Specific Conductivity
mS/cm
48.0
46.0
44.0
42.0
40.0
38.0
36.0
Oct 1
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Oct 3
Oct 4
Oct 5
Oct 6
Oct 7
Oct 8
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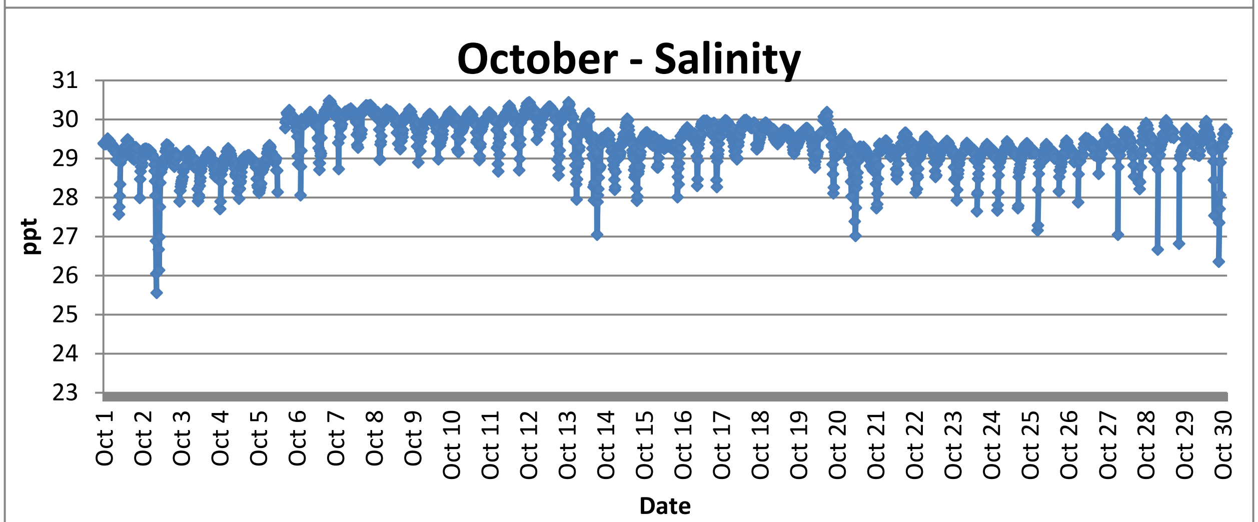
October - Salinity
ppt
31
30
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28
27
26
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Oct 6
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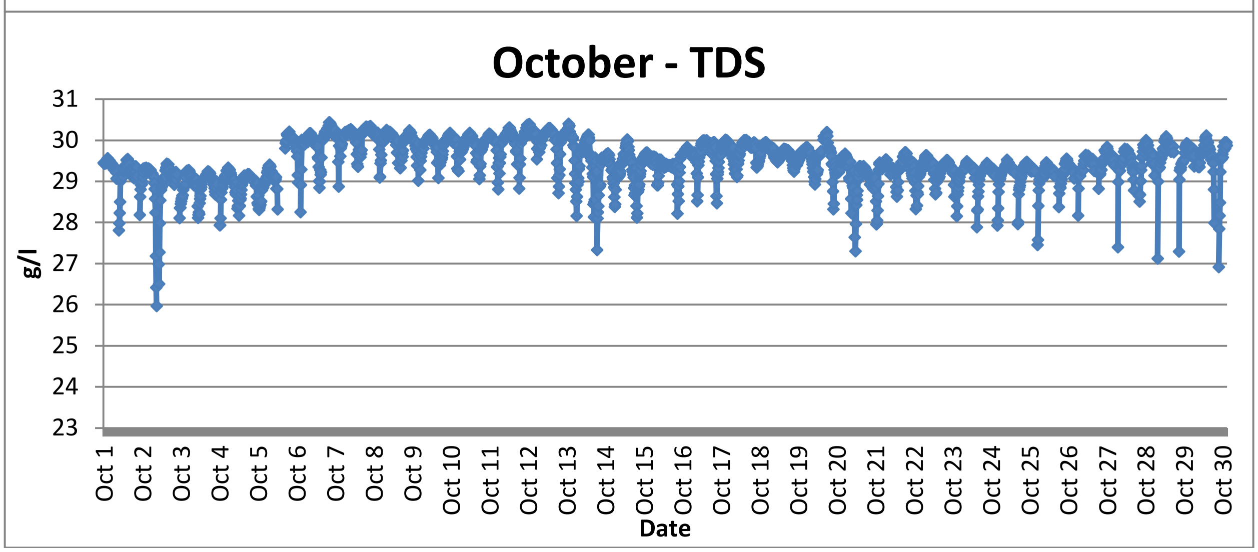
October - TDS
g/l
31
30
29
28
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26
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23
Oct 1
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Oct 7
Oct 8
Oct 9
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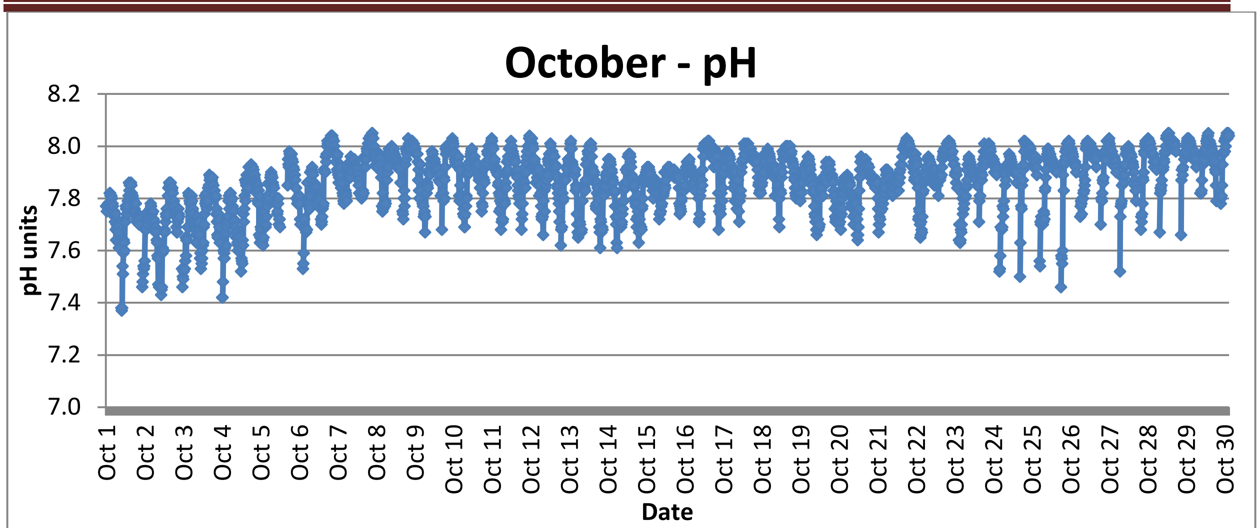
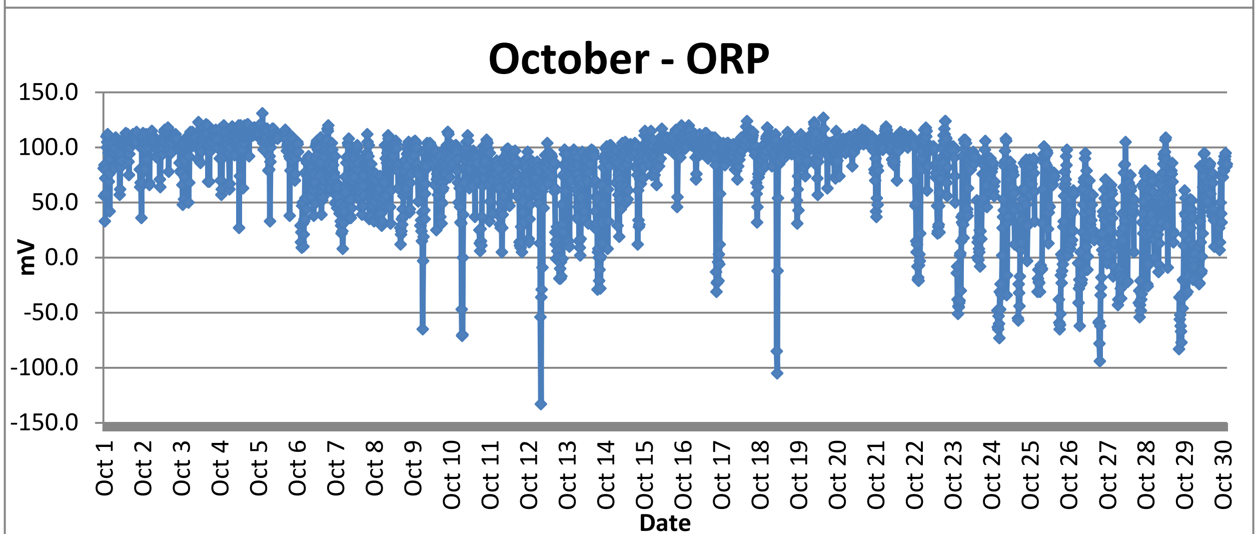
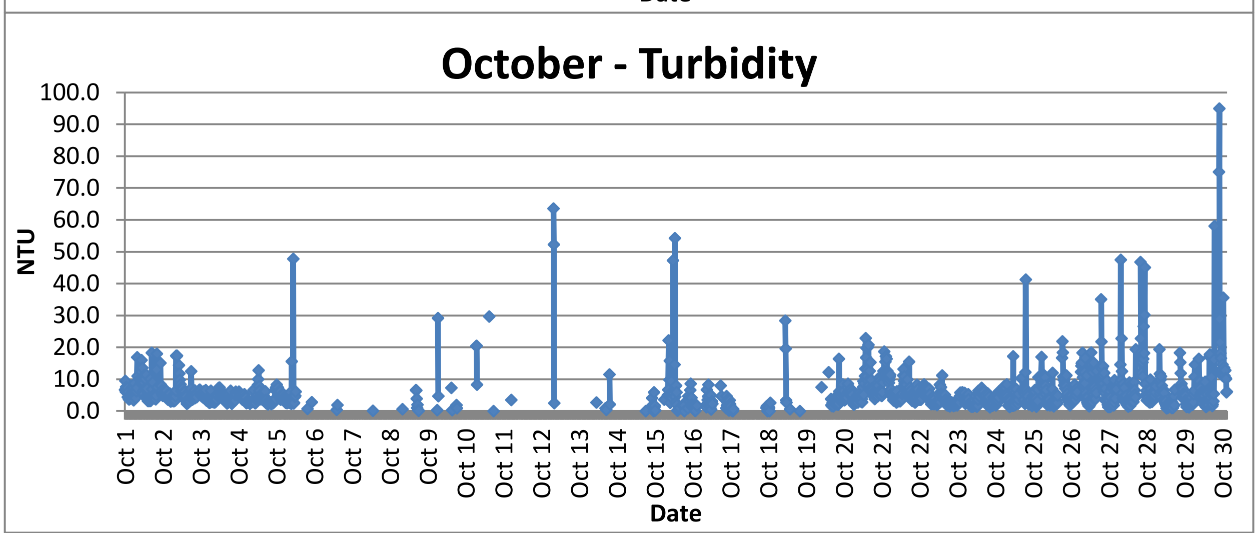
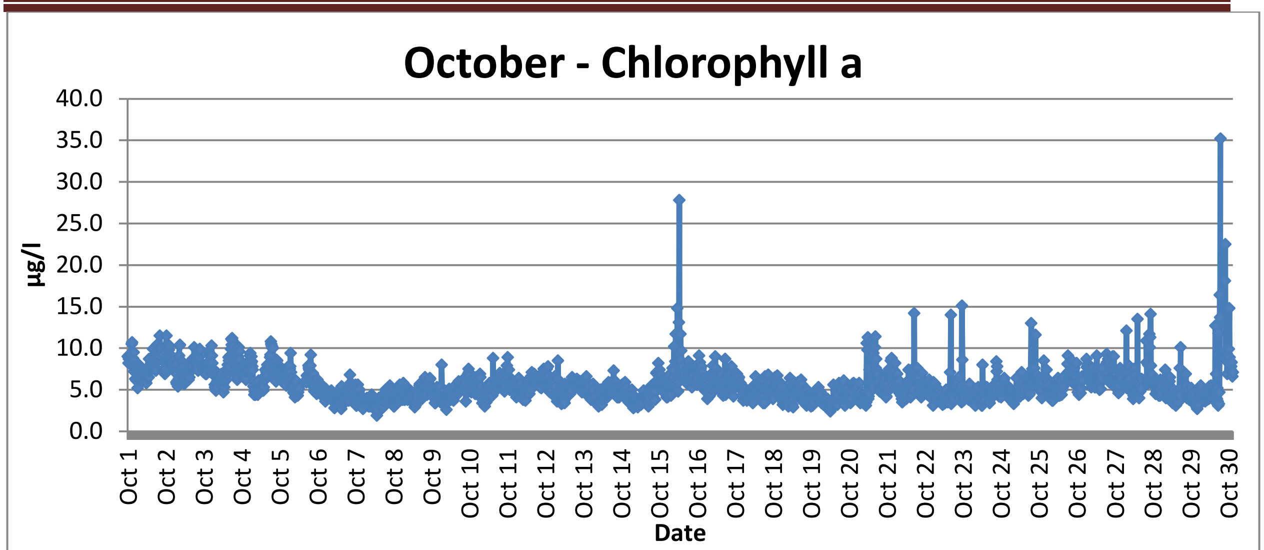
Date


October - pH
pH units
8.2
8.0
7.8
7.6
7.4
7.2
7.0
Oct 1 Oct 2 Oct 3 Oct 4 Oct 5 Oct 6 Oct 7 Oct 8 Oct 9 Oct 10 Oct 11 Oct 12 Oct 13 Oct 14 Oct 15 Oct 16 Oct 17 Oct 18 Oct 19 Oct 20 Oct 21 Oct 22 Oct 23 Oct 24 Oct 25 Oct 26 Oct 27 Oct 28 Oct 29 Oct 30
Date


October - ORP
mV
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
Oct 1 Oct 2 Oct 3 Oct 4 Oct 5 Oct 6 Oct 7 Oct 8 Oct 9 Oct 10 Oct 11 Oct 12 Oct 13 Oct 14 Oct 15 Oct 16 Oct 17 Oct 18 Oct 19 Oct 20 Oct 21 Oct 22 Oct 23 Oct 24 Oct 25 Oct 26 Oct 27 Oct 28 Oct 29 Oct 30
Date


October - Turbidity
NTU
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct 1 Oct 2 Oct 3 Oct 4 Oct 5 Oct 6 Oct 7 Oct 8 Oct 9 Oct 10 Oct 11 Oct 12 Oct 13 Oct 14 Oct 15 Oct 16 Oct 17 Oct 18 Oct 19 Oct 20 Oct 21 Oct 22 Oct 23 Oct 24 Oct 25 Oct 26 Oct 27 Oct 28 Oct 29 Oct 30
Date


October - Chlorophyll a
µg/l
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct 1
Oct 2
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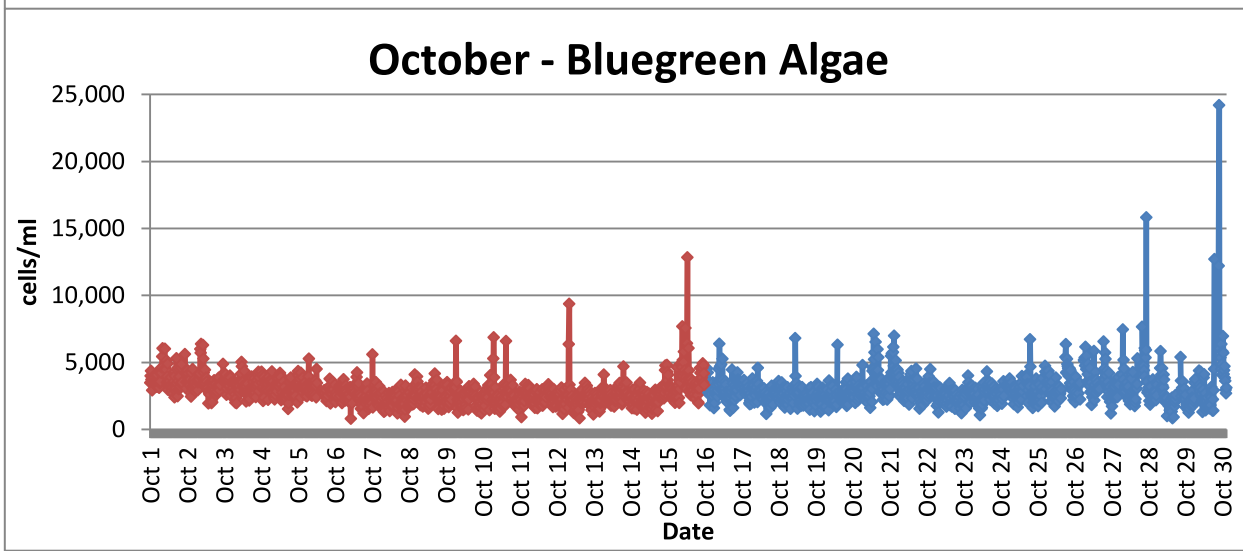
October - Bluegreen Algae
cells/ml
25,000
20,000
15,000
10,000
5,000
0
Oct 1
Oct 2
Oct 3
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Oct 5
Oct 6
Oct 7
Oct 8
Oct 9
Oct 10
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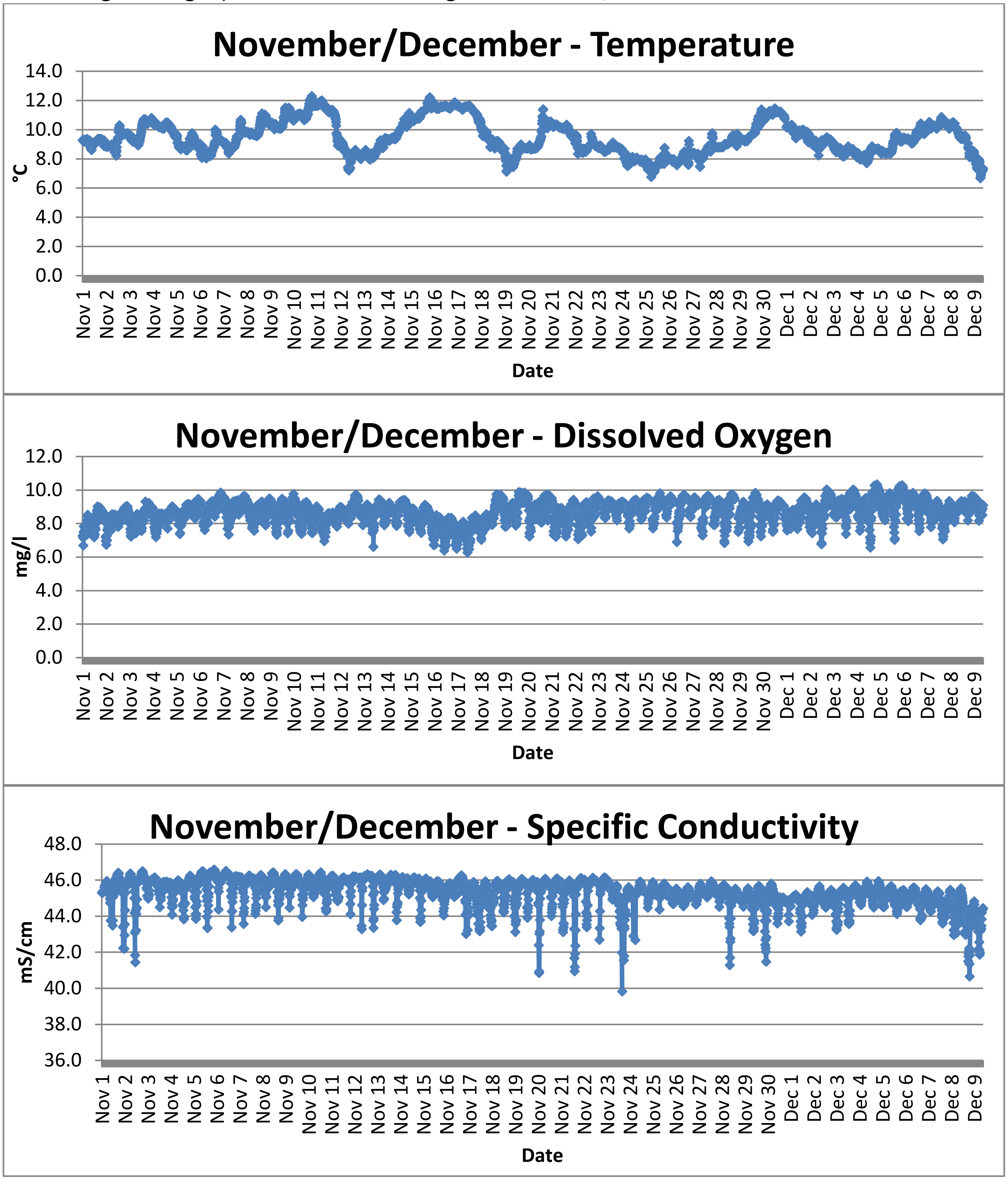
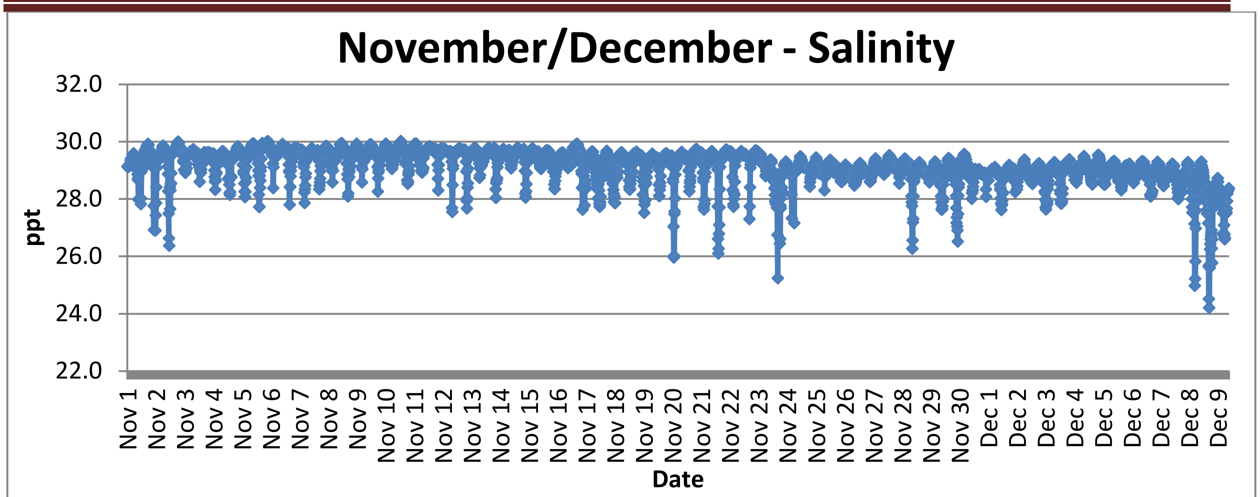
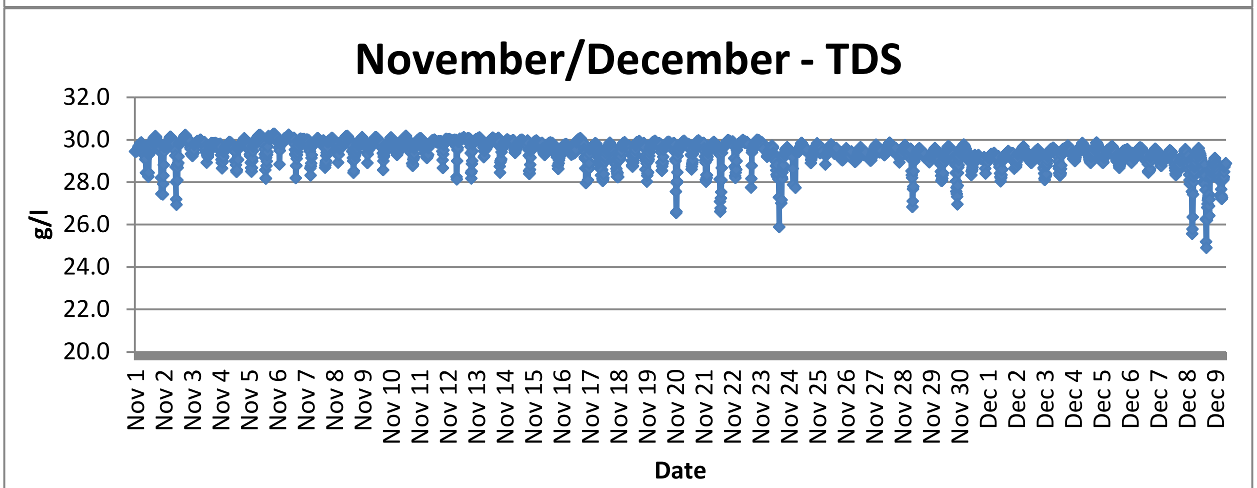
Oct 30
Date

Figure 5. Wellfleet Harbor Water quality parameters (temperature, dissolved oxygen, percent saturation, specific conductance, salinity, total dissolved solids pH, ORP, turbidity chlorophyll, and blue green algae) for November through December 9, 2011.




November/December - Salinity
ppt
32.0
30.0
28.0
26.0
24.0
22.0
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
Nov 26
Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - TDS
g/l
32.0
30.0
28.0
26.0
24.0
22.0
20.0
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
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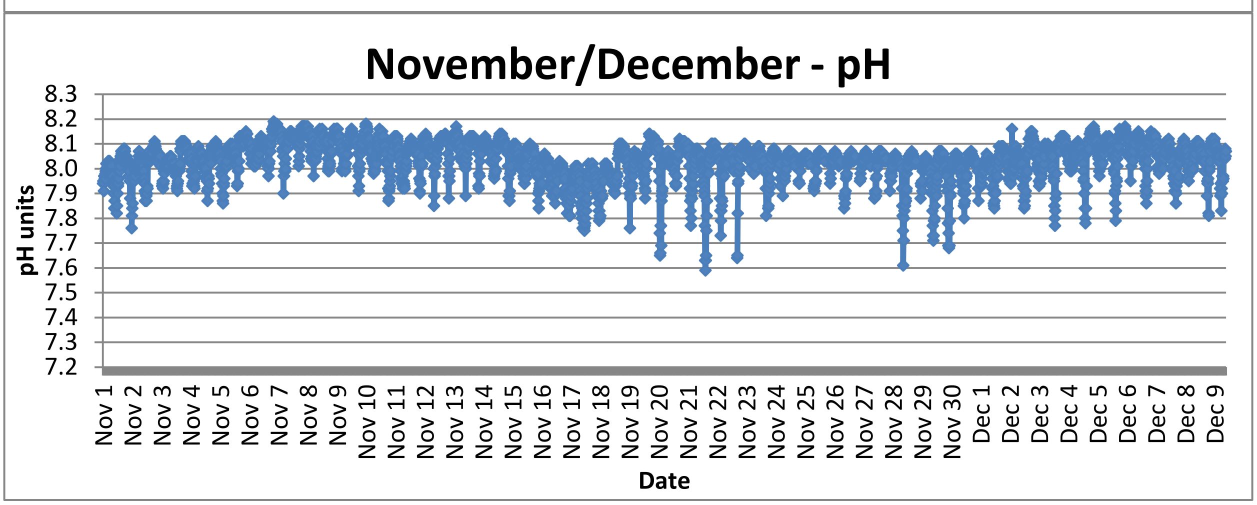
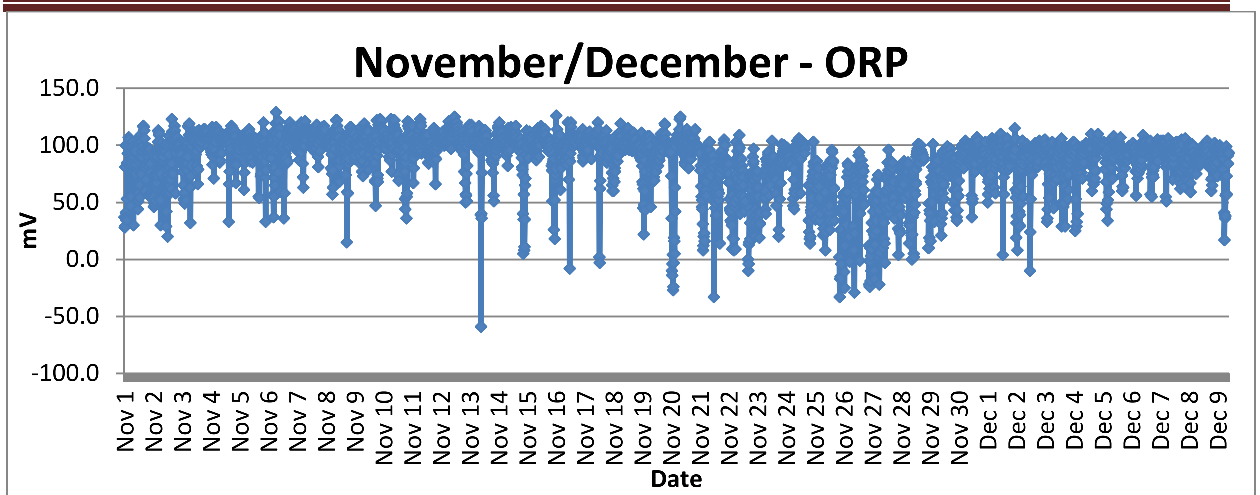
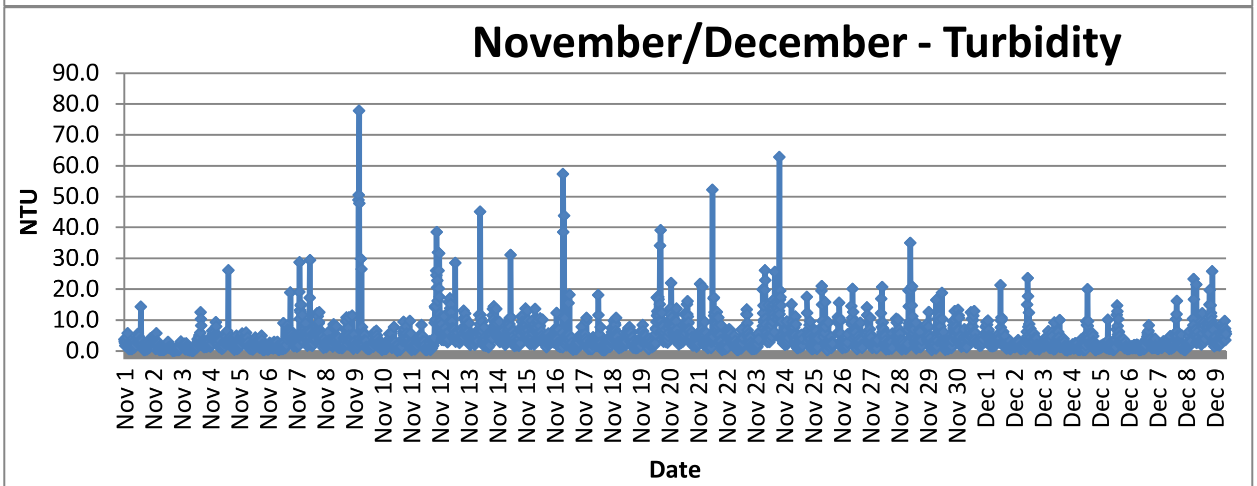
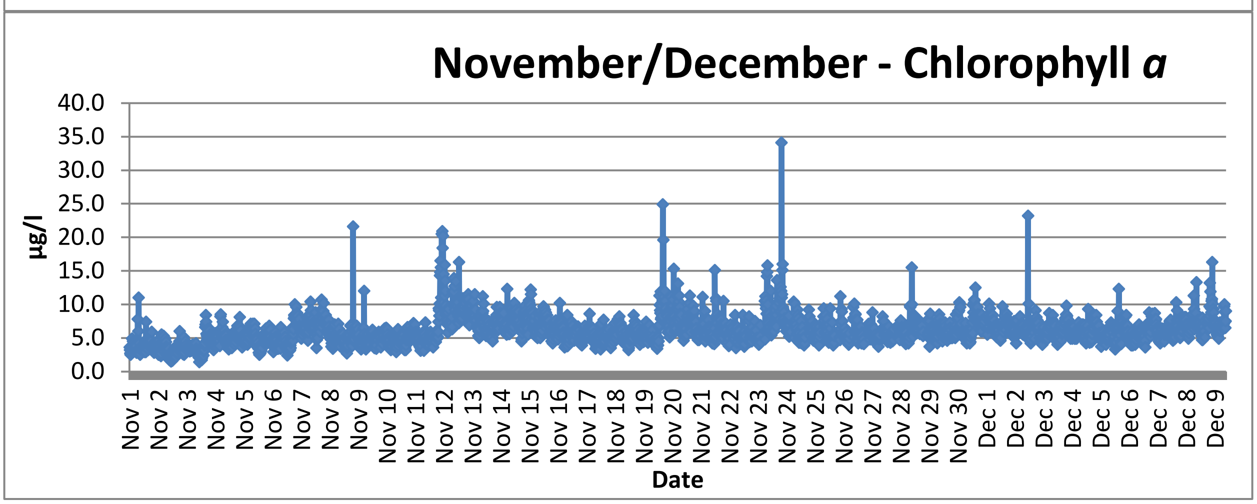
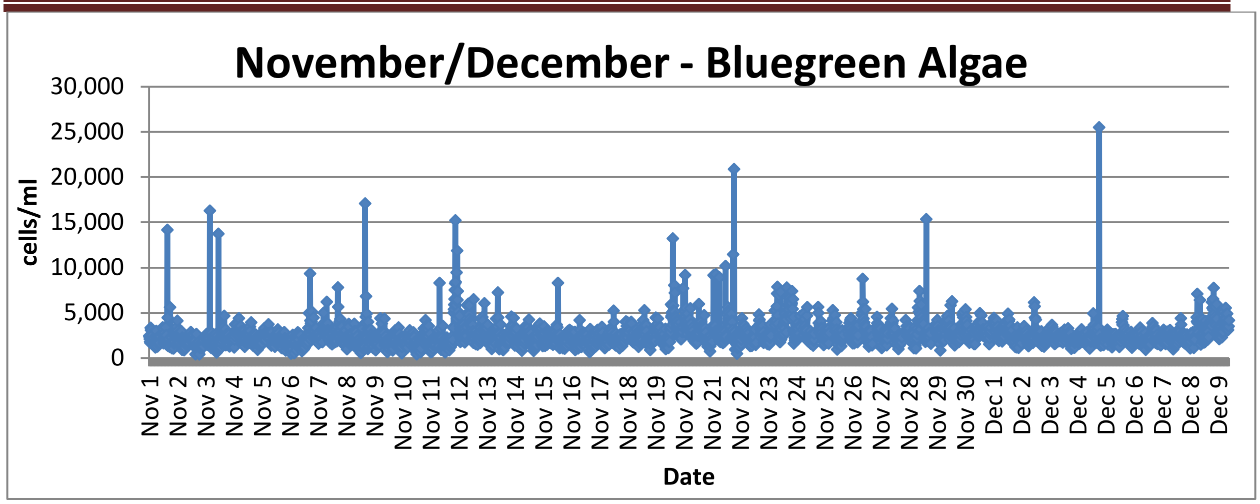
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - pH
pH units
8.3
8.2
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
Nov 26
Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - ORP
mV
150.0
100.0
50.0
0.0
-50.0
-100.0
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
Nov 26
Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - Turbidity
NTU
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
Nov 26
Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - Chlorophyll *a*
µg/l
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
Nov 26
Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date


November/December - Bluegreen Algae
30,000
25,000
20,000
15,000
10,000
5,000
0
cells/ml
Nov 1
Nov 2
Nov 3
Nov 4
Nov 5
Nov 6
Nov 7
Nov 8
Nov 9
Nov 10
Nov 11
Nov 12
Nov 13
Nov 14
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Nov 20
Nov 21
Nov 22
Nov 23
Nov 24
Nov 25
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Nov 27
Nov 28
Nov 29
Nov 30
Dec 1
Dec 2
Dec 3
Dec 4
Dec 5
Dec 6
Dec 7
Dec 8
Dec 9
Date

Figure 6. MEP Stations 1-12 in Wellfleet Harbor (CCCE 2011).

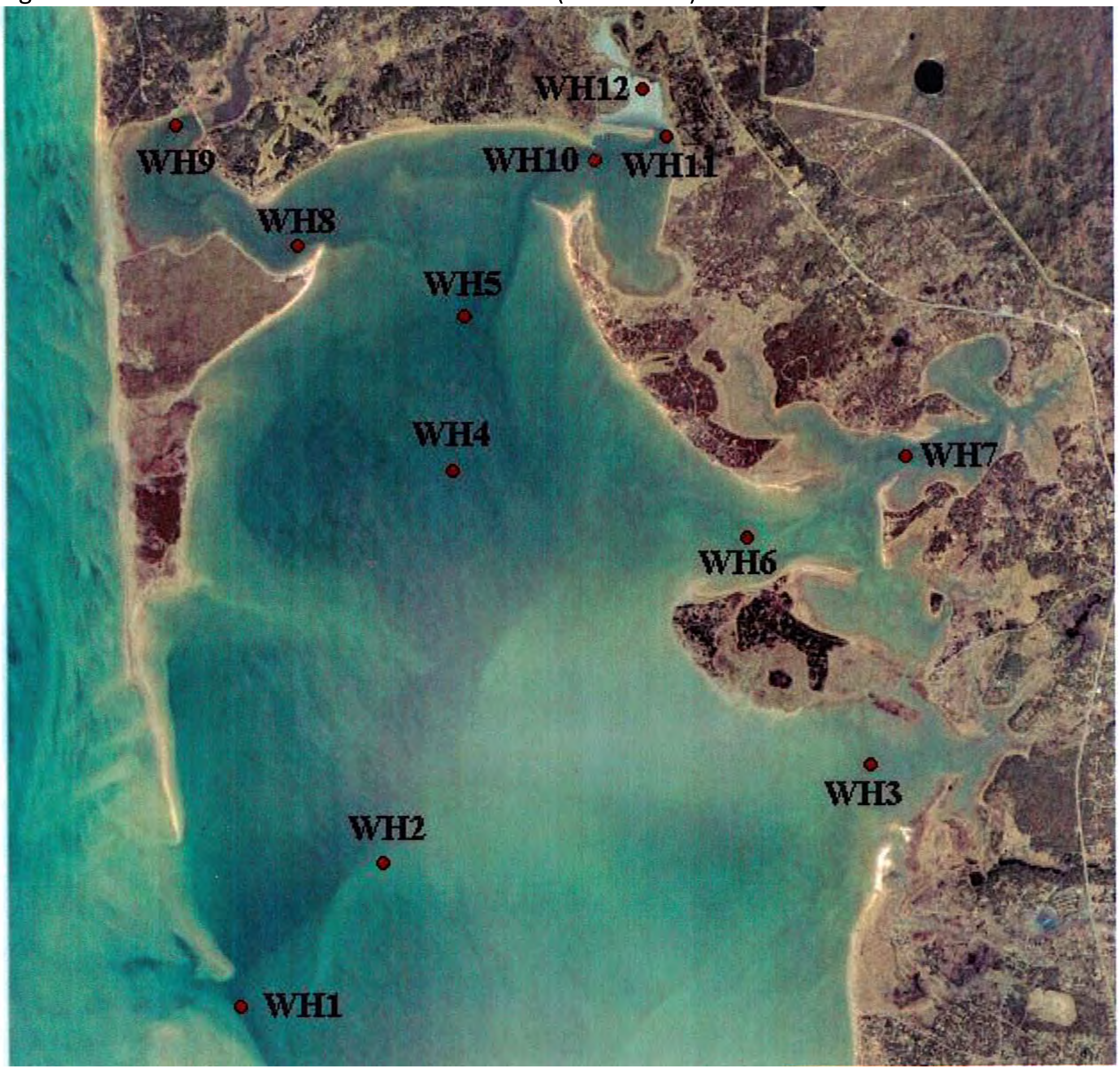


Figure 7. Dissolved oxygen levels recorded at MEP Stations 1-12 in Wellfleet Harbor, June through September in 2006 and 2007, and July through August in 2008 through 2010.

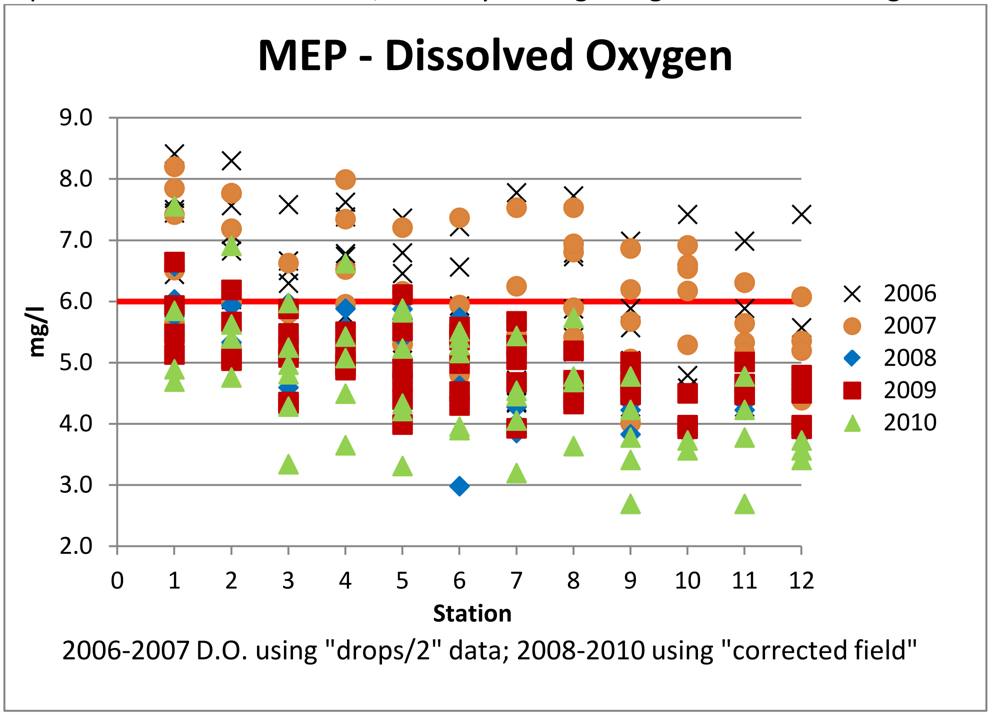


Figure 8. Annual mean dissolved oxygen levels recorded in Wellfleet Harbor 2006-2010.

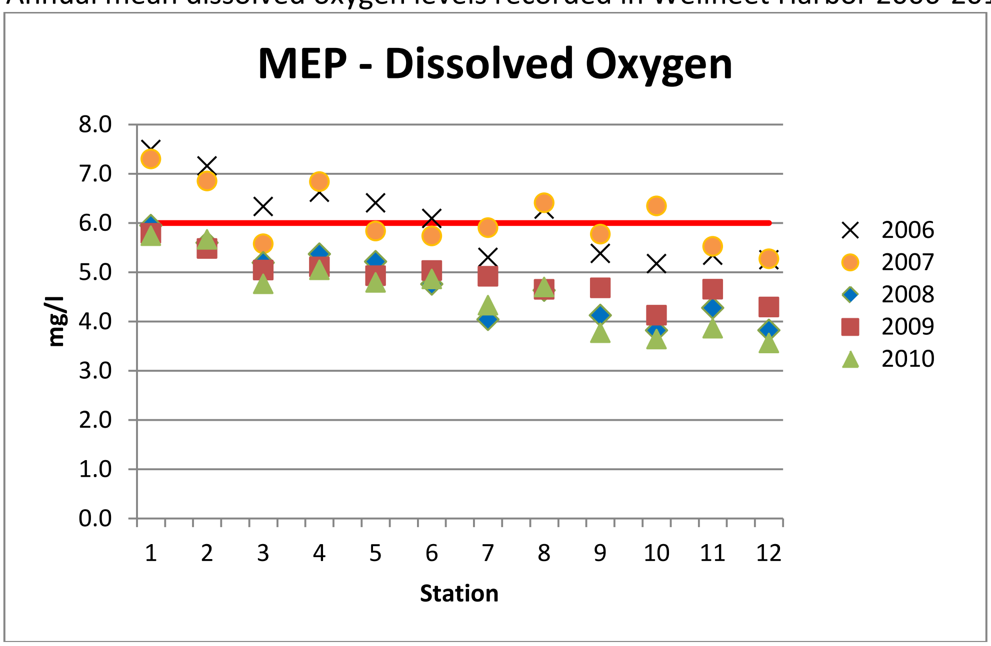


Figure 9. Dissolved oxygen levels recorded at MEP Stations 10-12 in Inner Wellfleet Harbor, 2006-2010.

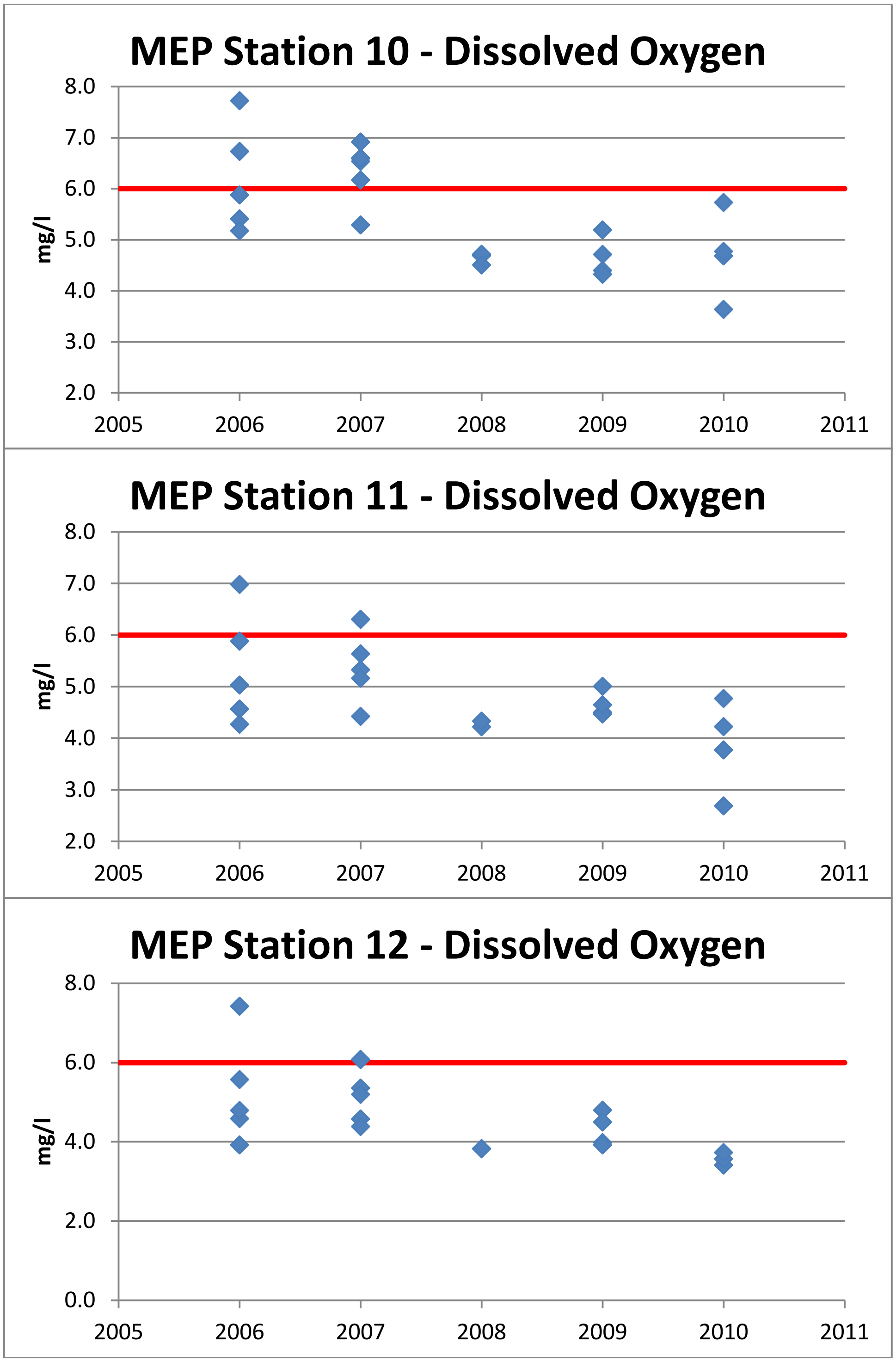


Figure 10. Dissolved oxygen values from June 19 through September 14, 2006 – 2010 collected at MEP Station 12 and daily mean dissolved oxygen levels recorded from Environmental Partners Group YSI in Wellfleet Harbor in September-December, 2011.

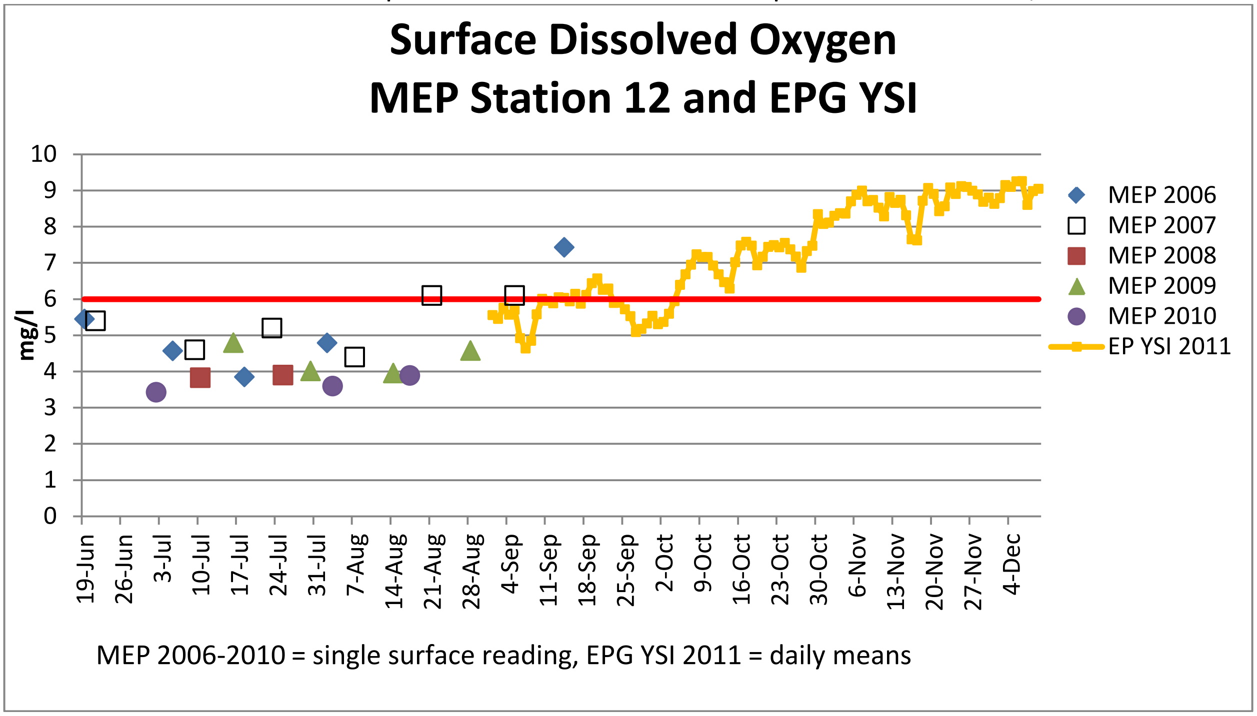


Figure 11. Total nitrogen levels recorded at MEP Stations 1-12 in Wellfleet Harbor, June through September in 2006 and 2007, and July through August in 2008 through 2010.

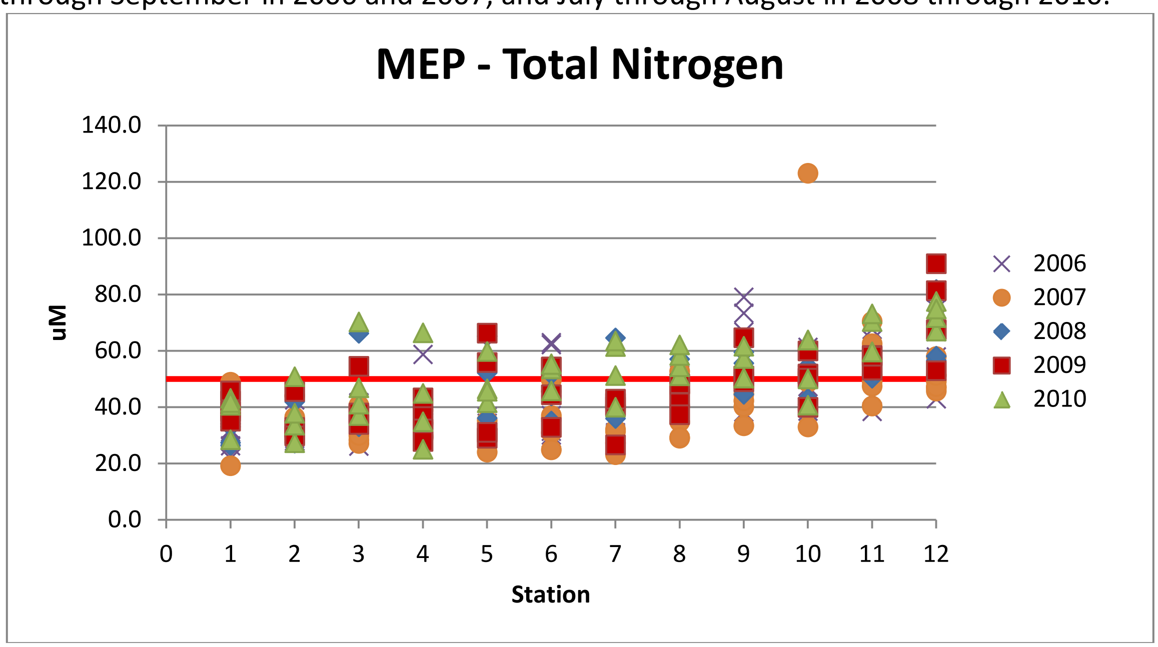


Figure 12. Total nitrogen levels recorded at MEP Stations 10-12 in Inner Wellfleet Harbor, 2006-2010.

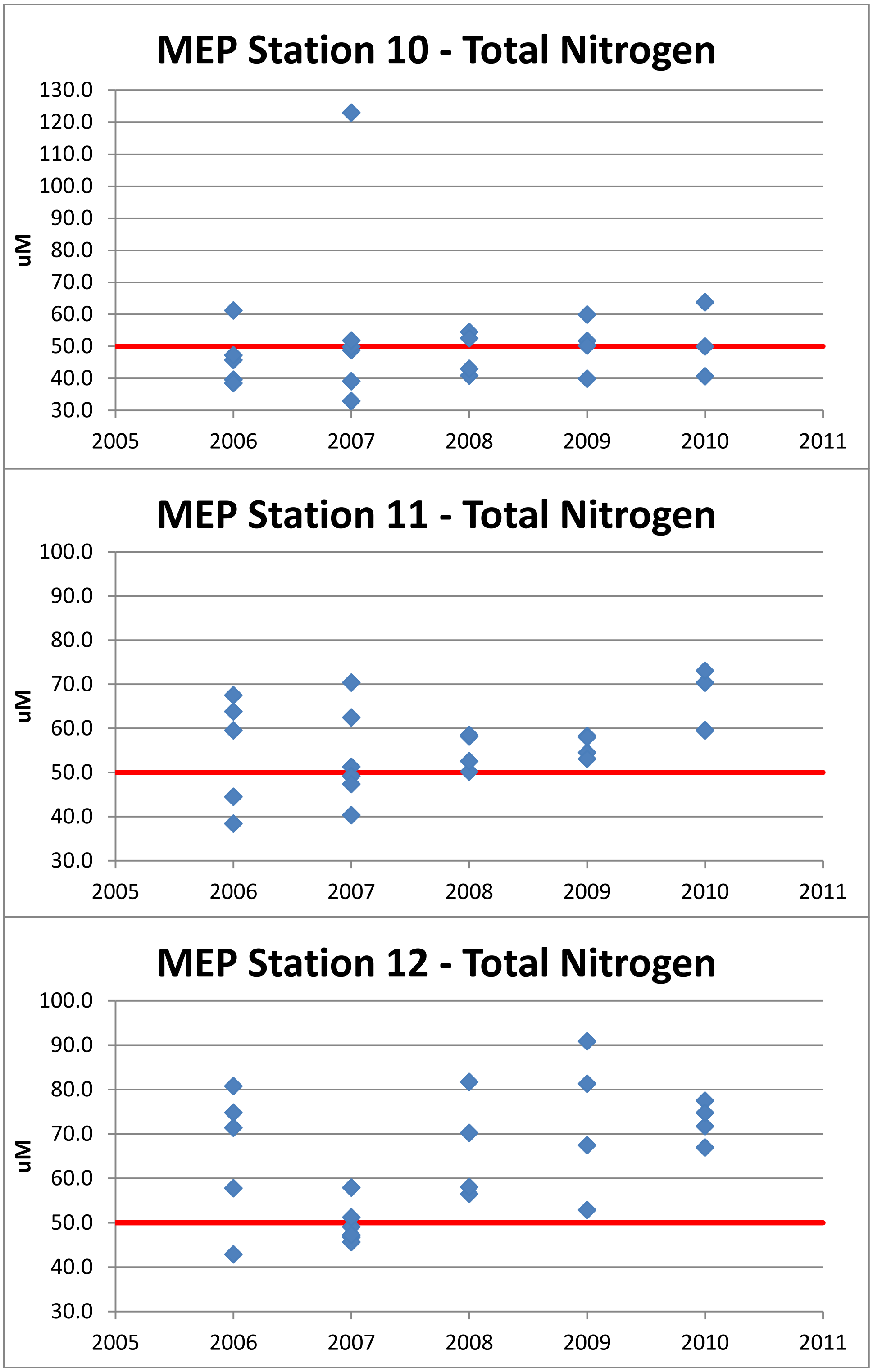


Figure 13. Chlorophyll *a* levels recorded at MEP Stations 1-12 in Wellfleet Harbor, June through September in 2006 and 2007, and July through August in 2008 through 2010.

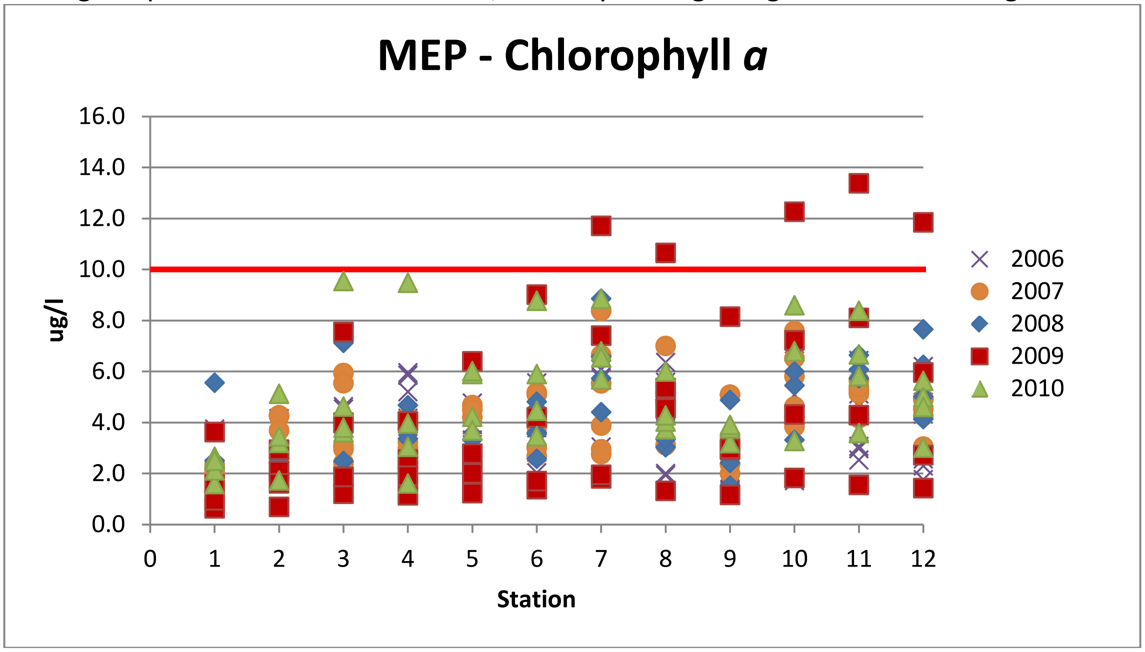


Figure 14. Chlorophyll *a* levels recorded at MEP Stations 10-12 in Inner Wellfleet Harbor, 2006-2010.

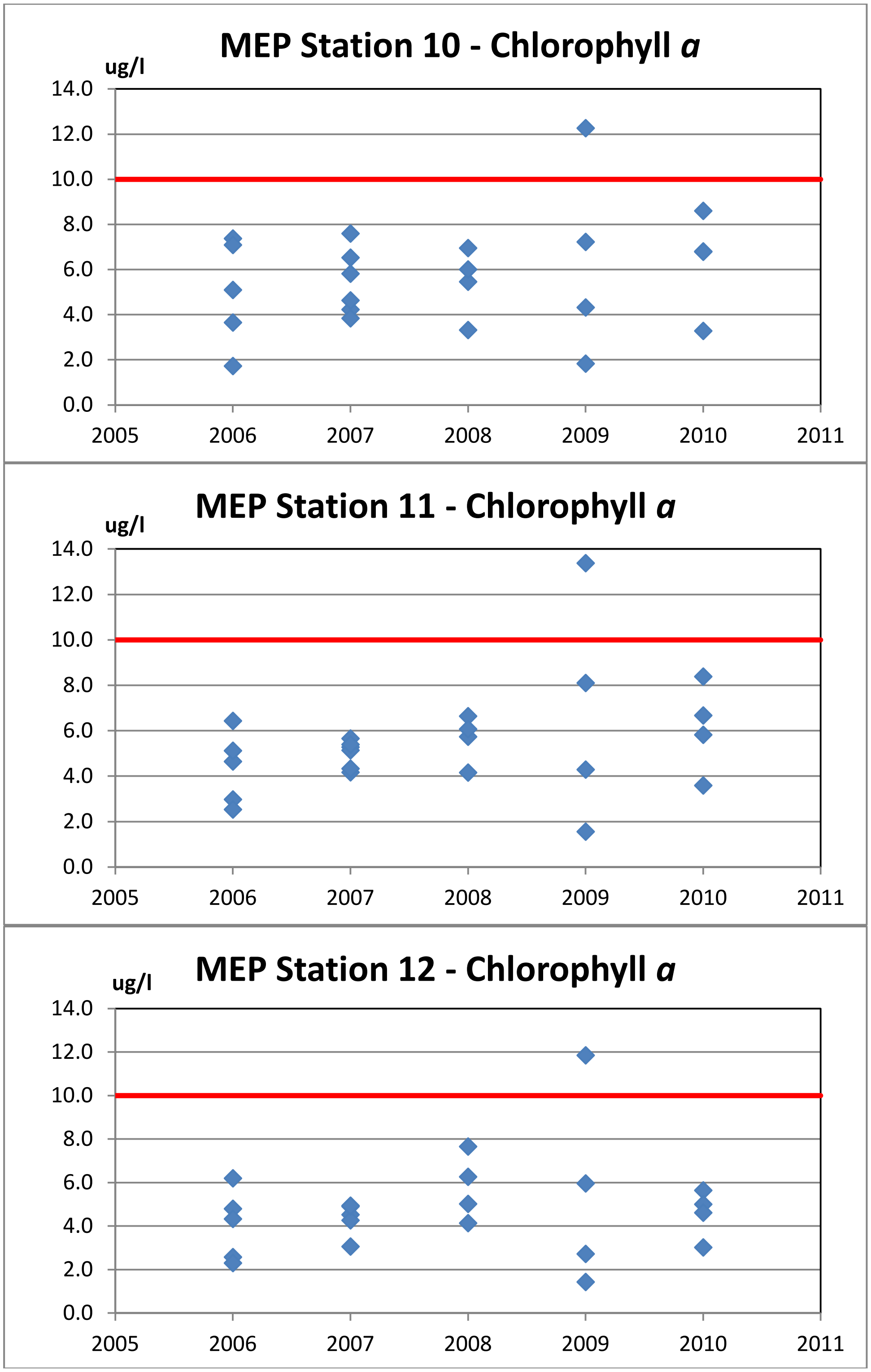


Figure 15. Daily mean dissolved oxygen levels at Egg Island in Wellfleet Harbor from June through November 2011 (CCCE YSI data).

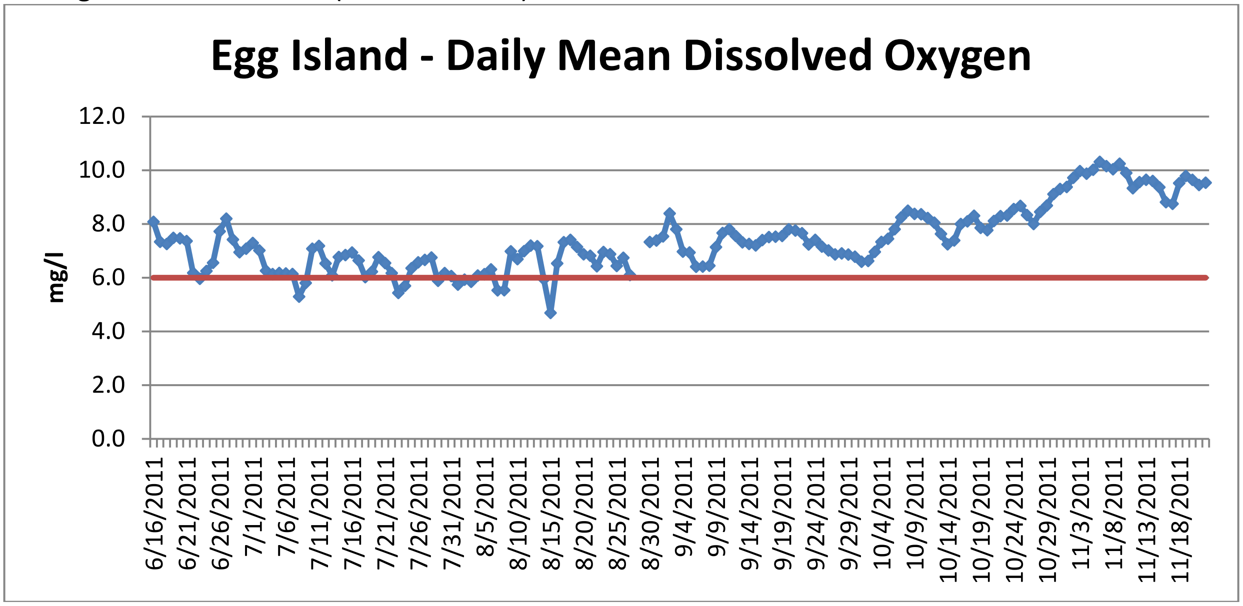


Figure 16. Daily mean dissolved oxygen levels at L-Pier in Wellfleet Harbor from July 24 through December 11, 2009; March 19 through June 15, July 29 through August 5, and October 22 through December 9 2010; and May 20 through June 21, 2011 (CCCE YSI data).

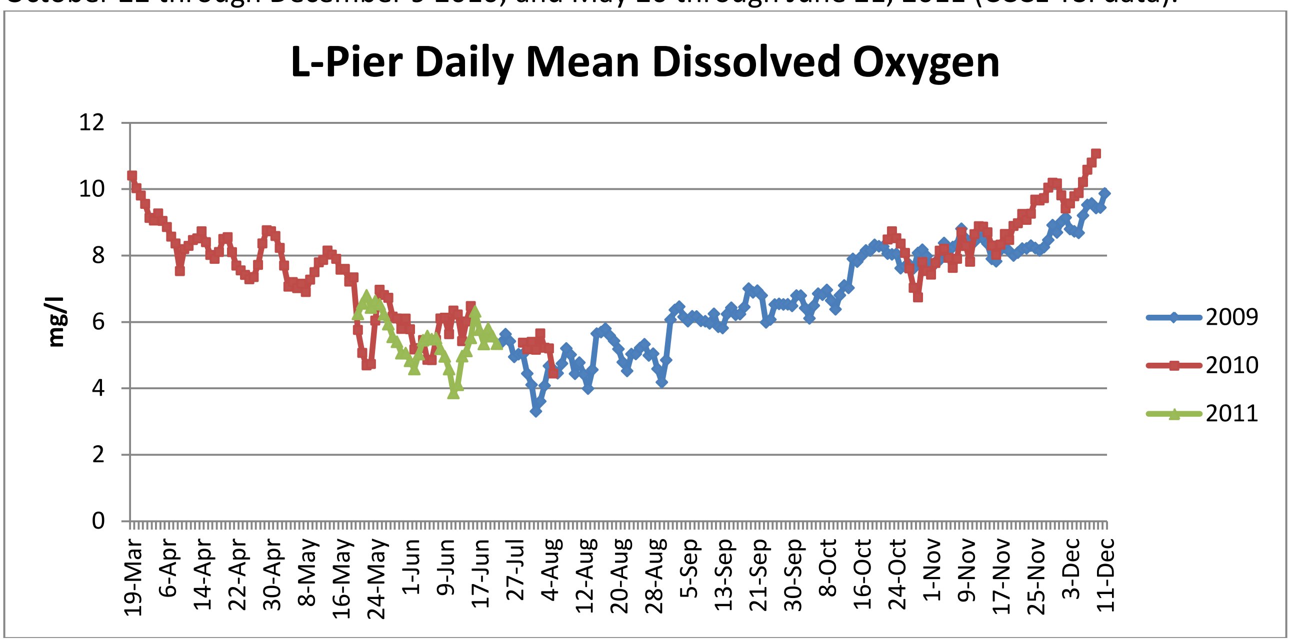


Figure 17. Dissolved oxygen levels recorded at L-Pier in Wellfleet Harbor from July through December , 2009, March through December 2010, and May through June 2011 (CCCE YSI data).

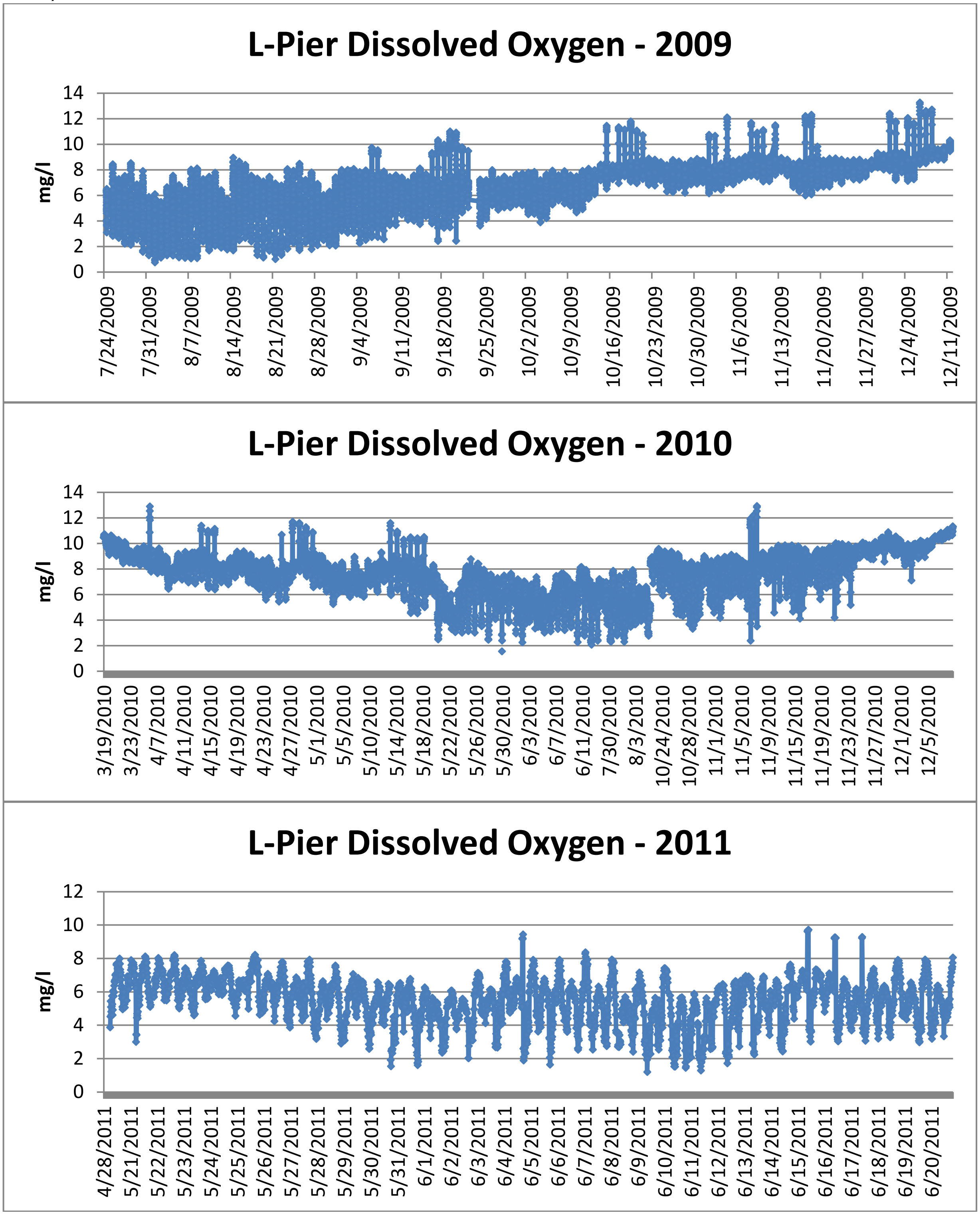


Figure 18. Daily mean chlorophyll *a* at Egg Island in Wellfleet Harbor from June through November 2011 (CCCE YSI data).

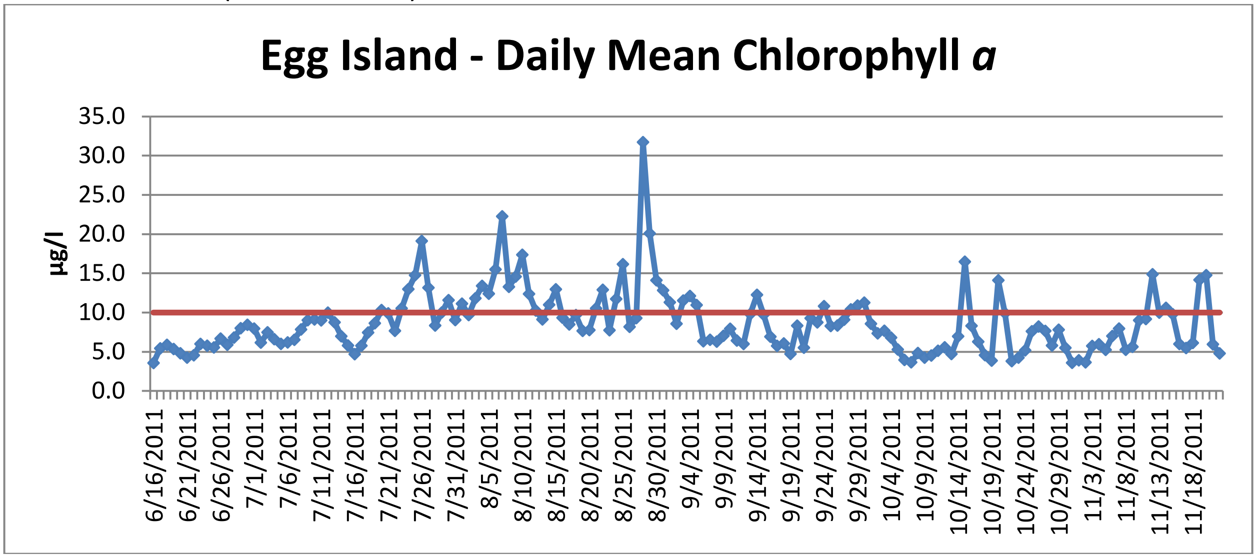


Figure 19. Daily mean chlorophyll levels at L-Pier in Wellfleet Harbor from July through December, 2009 March through December 2010, and April through June 2011 (CCCE YSI data).

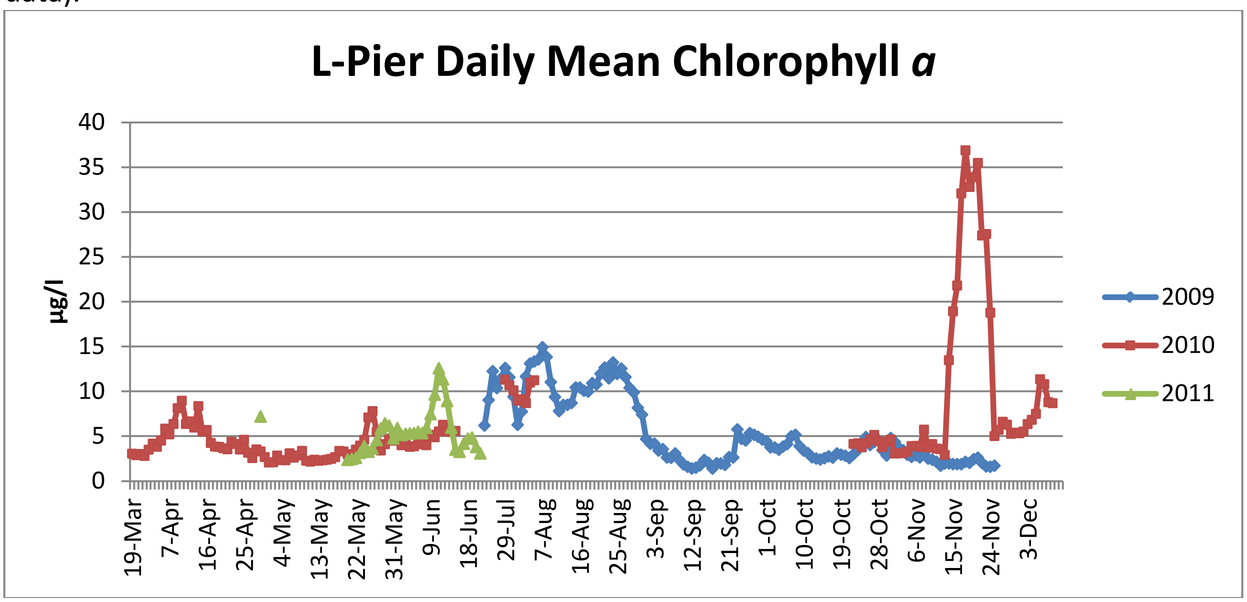


Figure 20. Chlorophyll a levels recorded at L-Pier in Wellfleet Harbor, July through December, 2009, March through December 2010, and May through June 2011 (CCCE YSI data).

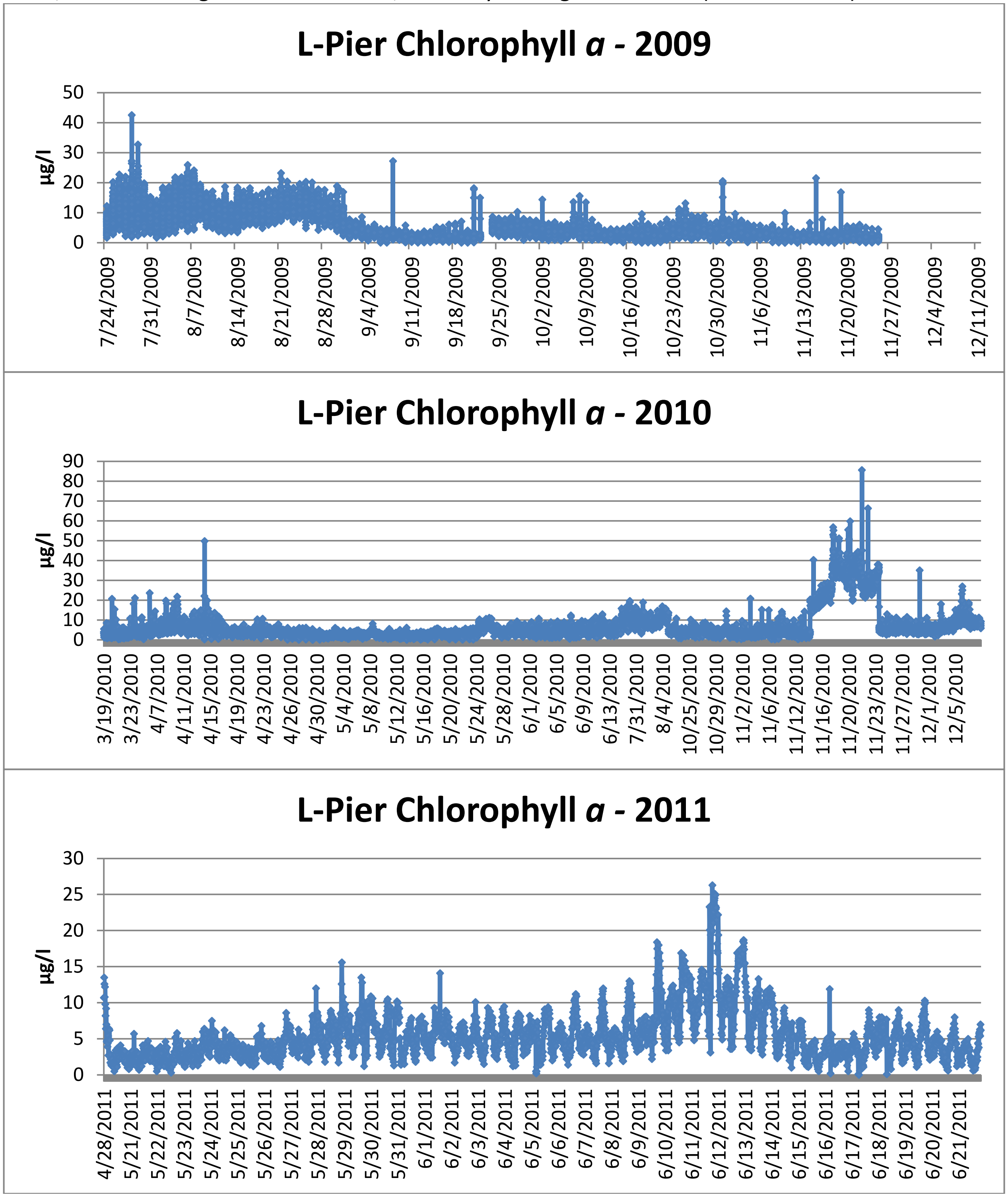


Figure 21. Daily mean turbidity at Egg Island in Wellfleet Harbor from June through November 2011 (CCCE YSI data).

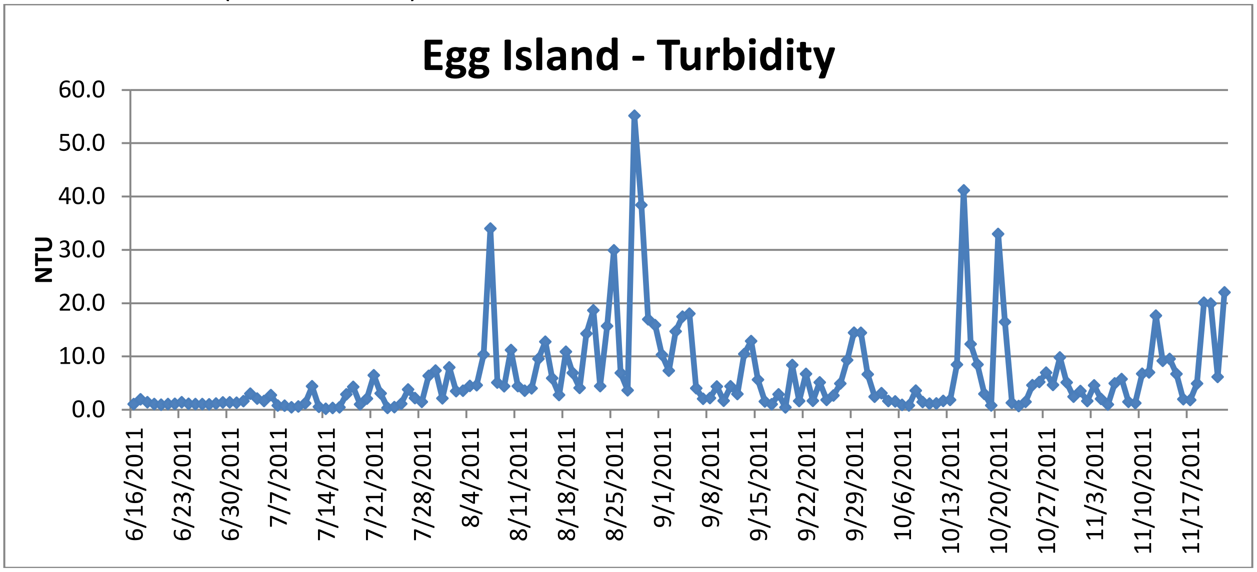


Figure 22. Daily mean turbidity levels at L-Pier in Wellfleet Harbor from July through December, 2009 March through December 2010, and May through June 2011 (CCCE YSI data).

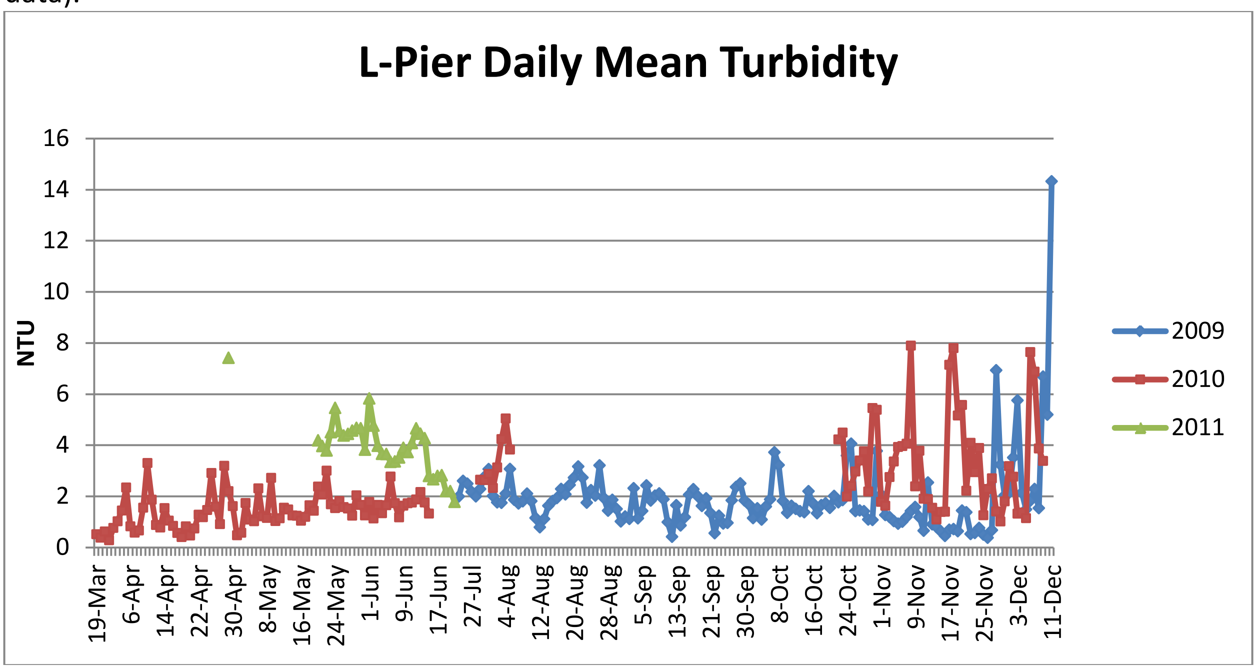


Figure 23. Turbidity levels recorded at L-Pier in Wellfleet Harbor from July through December, 2009, March through December 2010, and May through June 2011 (CCCE YSI data).

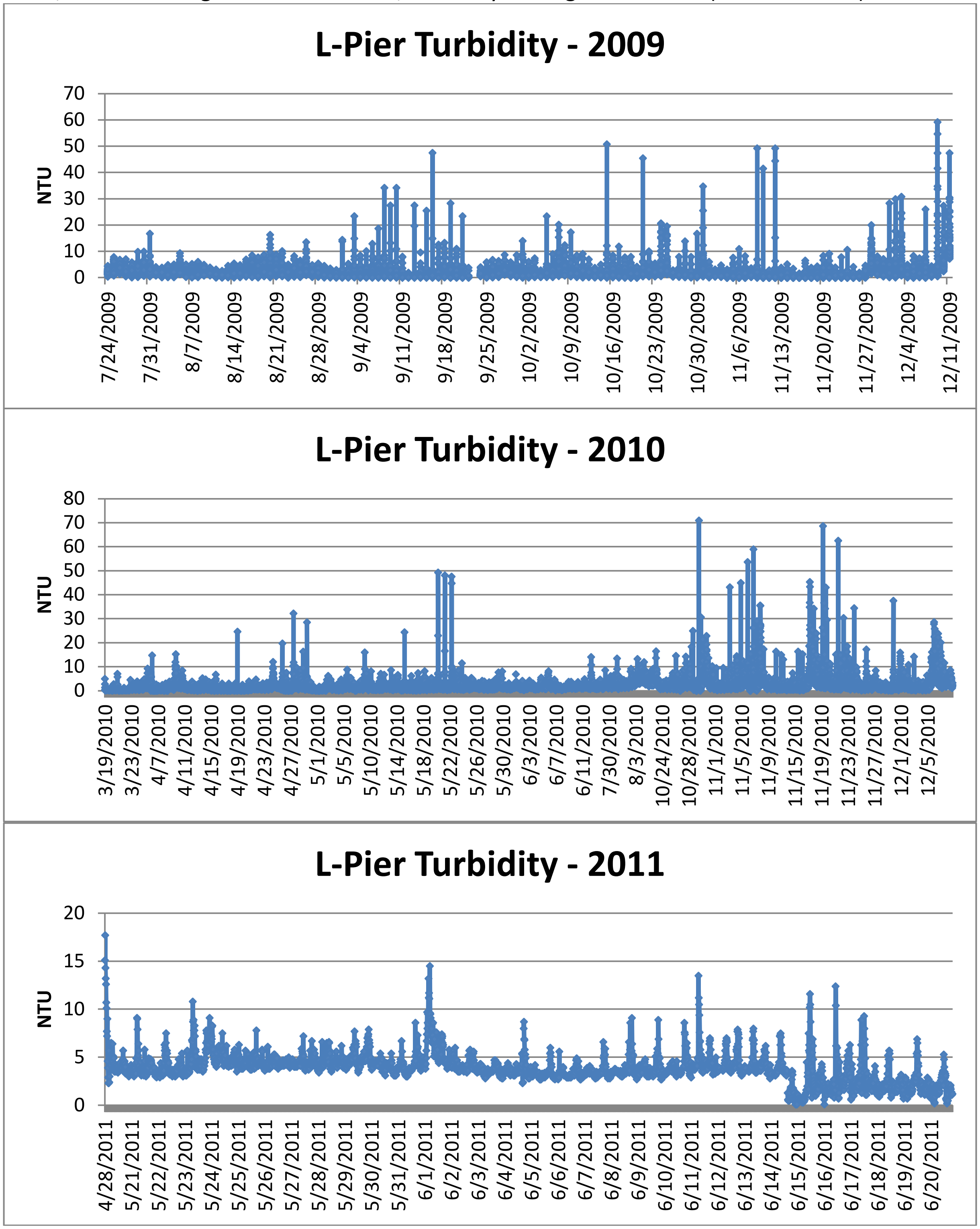


Figure 24. Daily mean pH values from Egg Island in Wellfleet Harbor from June through November 2011 (CCCE YSI data).

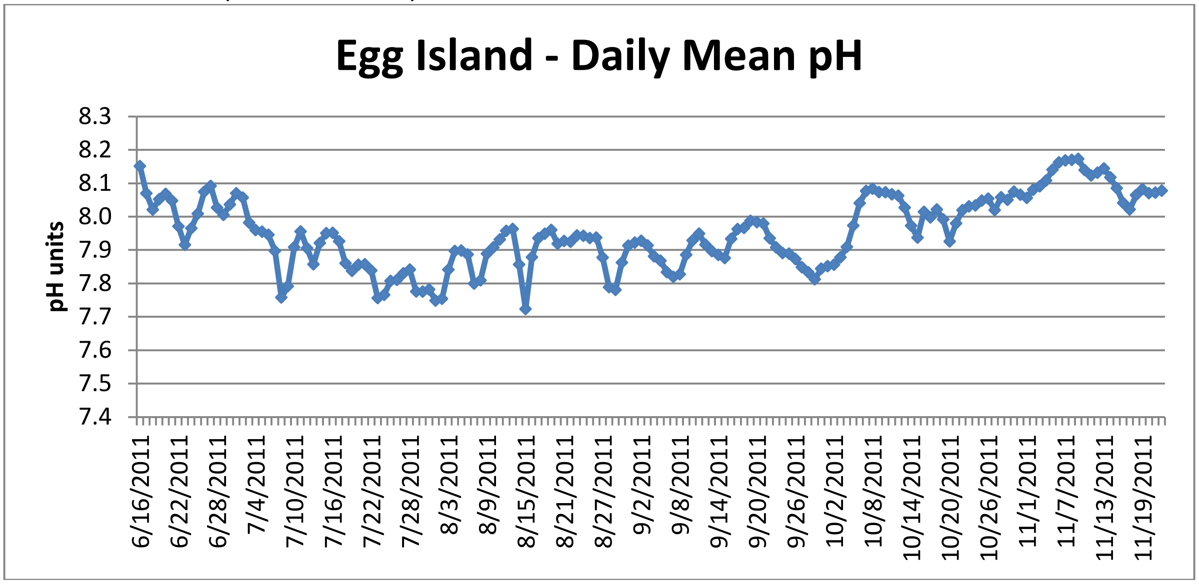


Figure 25. Daily mean pH values from the L-Pier Station in Wellfleet Harbor from July through December, 2009 March through December 2010, and May through June 2011 (CCCE YSI data).

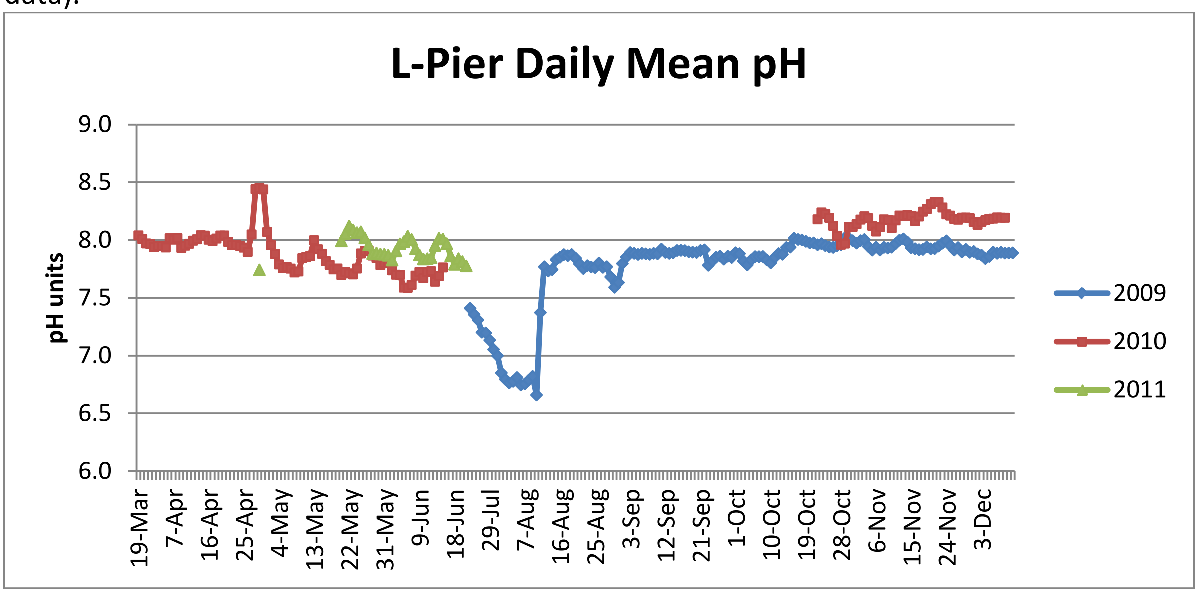
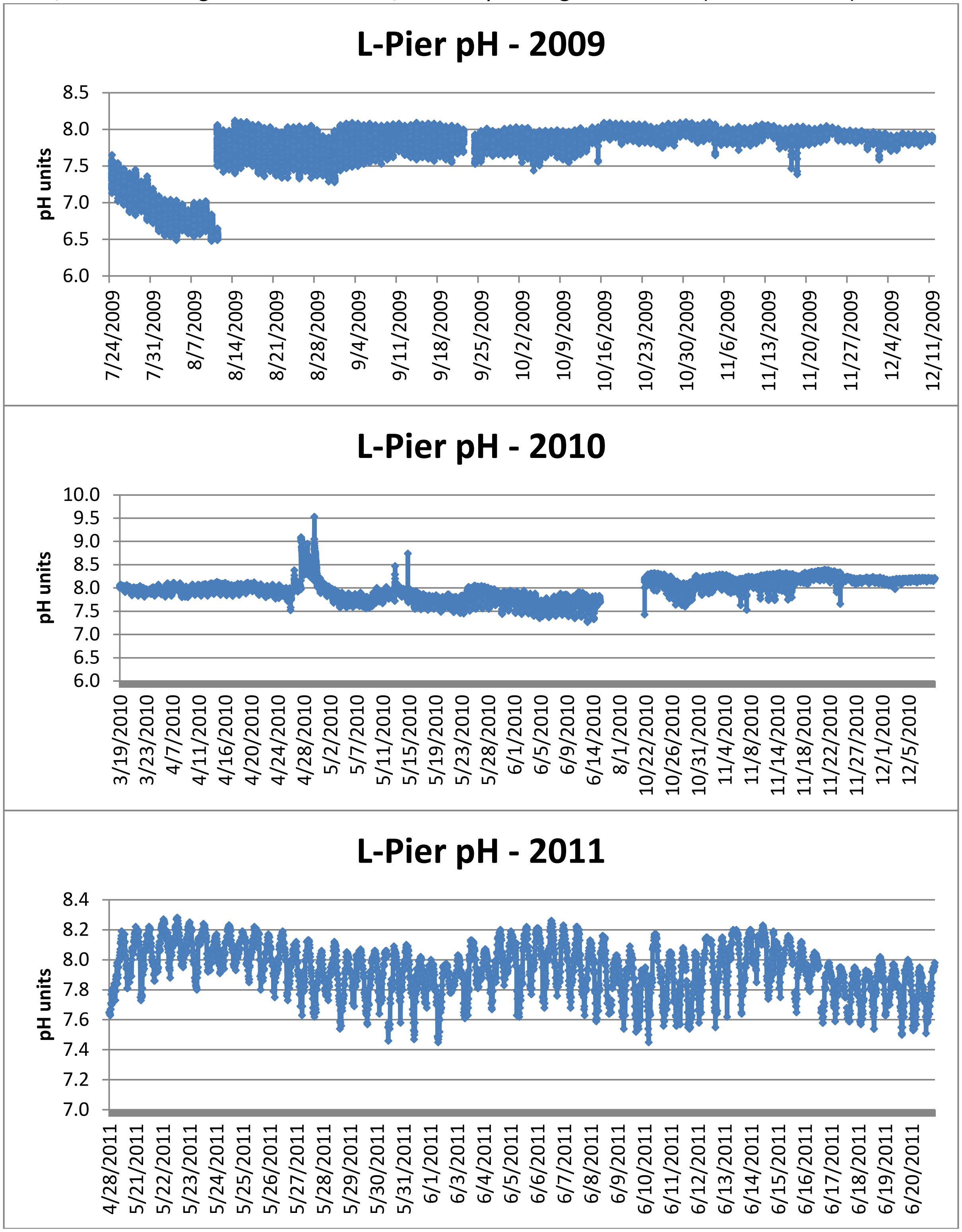


Figure 26. pH levels recorded at L-Pier in Wellfleet Harbor from July through December , 2009, March through December 2010, and May through June 2011 (CCCE YSI data).



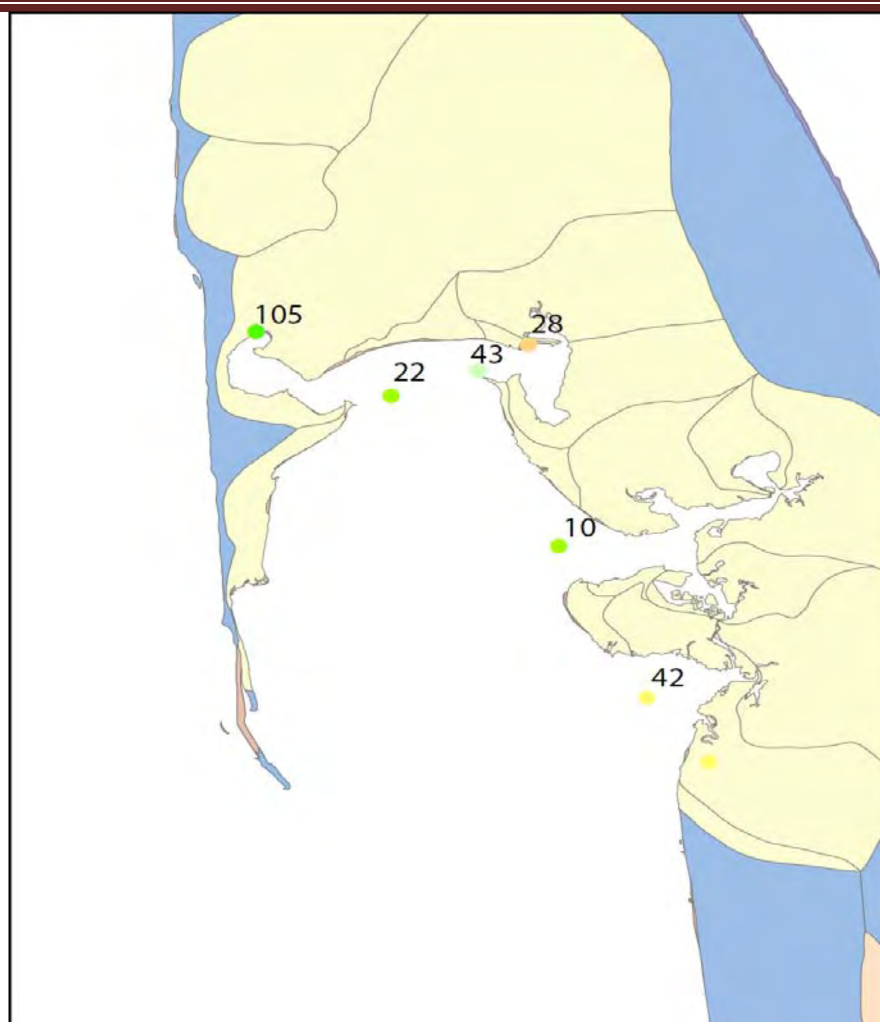


Figure 27. Provincetown Center for Coastal Studies station locations: Herring River (105), Great Island Channel (22), Wellfleet Harbor (43), Inner Wellfleet Harbor (28), Blackfish Creek (10), and Sunken Meadow (42; PCCS 2011a, personal communication).

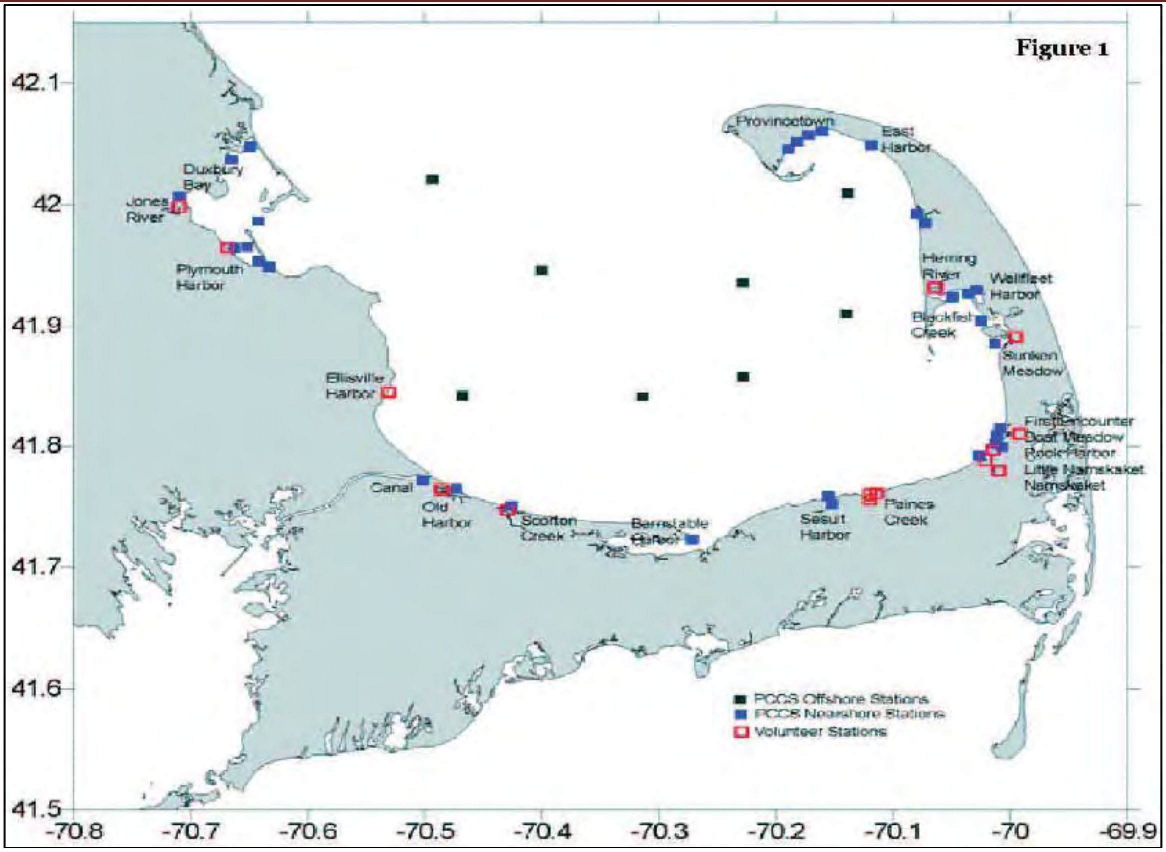


Figure 28. Inshore/nearshore stations (blue and red squares) in Cape Cod Bay, sampled from May – October 2006-2009 (PCCS 2009).

APPENDIX B

ANALYTICAL REPORT

Lab Number:	L1115893
Client:	Environmental Partners 1900 Crown Colony Drive Suite 402 4th Floor Quincy, MA 02169
ATTN:	Marie Petricca
Phone:	(617) 657-0200
Project Name:	WELLFLEET HARBOR
Project Number:	113-1105 TASK 14
Report Date:	10/18/11

Certifications & Approvals: MA (M-MA086), NY NELAC (11148), CT (PH-0574), NH (2003), NJ (MA935), RI (LAO00065), ME (MA0086), PA (Registration #68-03671), USDA (Permit #S-72578), US Army Corps of Engineers, Naval FESC.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14

Lab Number: L1115893
Report Date: 10/18/11

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1115893-01	OW-1S	WELLFLEET	10/03/11 11:00
L1115893-02	OW-1D	WELLFLEET	10/03/11 11:45

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14

Lab Number: L1115893
Report Date: 10/18/11

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

Sample Receipt

The samples were received above the appropriate pH for the Total Nitrogen analysis. The laboratory added additional H_2SO_4 to a pH <2.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom

Title: Technical Director/Representative

Date: 10/18/11

INORGANICS
&
MISCELLANEOUS

Project Name: WELLFLEET HARBOR

Project Number: 113-1105 TASK 14

Lab Number: L1115893

Report Date: 10/18/11

SAMPLE RESULTS

Lab ID: L1115893-01
Client ID: OW-1S
Sample Location: WELLFLEET
Matrix: Water

Date Collected: 10/03/11 11:00
Date Received: 10/04/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.27		mg/l	0.10	--	1	-	10/04/11 23:21	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.27		mg/l	0.10	--	1	-	10/04/11 23:21	30,4500NO3-F	TH
Total Nitrogen	0.69		mg/l	0.30	--	1	-	10/17/11 15:50	41,-	JO
Nitrogen, Total Kjeldahl	0.42		mg/l	0.30	--	1	10/11/11 13:00	10/13/11 21:27	30,4500N-C	AT

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14

Lab Number: L1115893
Report Date: 10/18/11

SAMPLE RESULTS

Lab ID: L1115893-02
Client ID: OW-1D
Sample Location: WELLFLEET
Matrix: Water

Date Collected: 10/03/11 11:45
Date Received: 10/04/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.18		mg/l	0.10	--	1	-	10/04/11 23:22	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.18		mg/l	0.10	--	1	-	10/04/11 23:22	30,4500NO3-F	TH
Total Nitrogen	0.61		mg/l	0.30	--	1	-	10/17/11 15:50	41,-	JO
Nitrogen, Total Kjeldahl	0.43		mg/l	0.30	--	1	10/11/11 13:00	10/13/11 21:28	30,4500N-C	AT

Project Name: WELLFLEET HARBOR **Lab Number:** L1115893
Project Number: 113-1105 TASK 14 **Report Date:** 10/18/11

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG493900-2										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 22:55	30,4500NO3-F	TH
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG493902-2										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 22:55	30,4500NO3-F	TH
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG494993-1										
Nitrogen, Total Kjeldahl	ND		mg/l	0.30	--	1	10/11/11 13:00	10/13/11 21:11	30,4500N-C	AT

Lab Control Sample Analysis
Batch Quality Control

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14

Lab Number: L1115893
Report Date: 10/18/11

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG493900-1								
Nitrogen, Nitrate	98		-		90-110	-		
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG493902-1								
Nitrogen, Nitrate/Nitrite	98		-		90-110	-		20
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG494993-2								
Nitrogen, Total Kjeldahl	92		-		85-110	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14
Lab Number: L1115893
Report Date: 10/18/11

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG493900-3 QC Sample: L1115893-01 Client ID: OW-1S												
Nitrogen, Nitrate	0.27	4	4.1	96		-	-		83-113	-		17
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG493902-3 QC Sample: L1115893-01 Client ID: OW-1S												
Nitrogen, Nitrate/Nitrite	0.27	4	4.1	96		-	-		80-120	-		20
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG494993-4 QC Sample: L1116338-01 Client ID: MS Sample												
Nitrogen, Total Kjeldahl	37	8	45	100		-	-		77-111	-		24

Project Name: WELLFLEET HARBOR

Project Number: 113-1105 TASK 14

Lab Duplicate Analysis
Batch Quality Control

Lab Number: L1115893

Report Date: 10/18/11

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG493900-4 QC Sample: L1115893-01 Client ID: OW-1S						
Nitrogen, Nitrate	0.27	0.27	mg/l	0		17
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG493902-4 QC Sample: L1115893-01 Client ID: OW-1S						
Nitrogen, Nitrate/Nitrite	0.27	0.27	mg/l	0		20
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG494993-3 QC Sample: L1116020-08 Client ID: DUP Sample						
Nitrogen, Total Kjeldahl	0.75	0.74	mg/l	1		24

Project Name: WELLFLEET HARBOR
Project Number: 113-1105 TASK 14

Lab Number: L1115893
Report Date: 10/18/11

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1115893-01A	Plastic 500ml unpreserved	A	7	3	Y	Absent	NO3-4500(2)
L1115893-01B	Plastic 250ml H2SO4 preserved	A	<2	3	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1115893-02A	Plastic 500ml unpreserved	A	7	3	Y	Absent	NO3-4500(2)
L1115893-02B	Plastic 250ml H2SO4 preserved	A	<2	3	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)

*Values in parentheses indicate holding time in days

Project Name: WELLFLEET HARBOR | **Lab Number:** L1115893
Project Number: 113-1105 TASK 14 | **Report Date:** 10/18/11

GLOSSARY

Acronyms

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The RPD between the results for the two columns exceeds the method-specified criteria; however, the lower value has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

Report Format: Data Usability Report

Data Qualifiers

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

REFERENCES

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

41 Alpha Analytical Labs Internally-developed Performance-based Method.

LIMITATION OF LIABILITIES

Certificate/Approval Program Summary

Last revised September 19, 2011 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB), 1,4-Dioxane (Mod 8270). Microbiology Parameters: Total Coliform-MF mEndo (SM9222B), Total Coliform – Colilert (SM9223 P/A), E. Coli. – Colilert (SM9223 P/A), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D))

Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, TPH (HEM/SGT), Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH. Microbiology Parameters: Total Coliform – MF mEndo (SM9222B), Total Coliform – MTF (SM9221B), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform – A-1 Broth (SM9221E).)

Solid Waste/Soil (Inorganic Parameters: pH, Sulfide, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), SPLP Leach (1312 metals only), Reactivity. Organic Parameters: PCBs, PCBs in Oil, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9222D, 9223B, EPA 180.1, 353.2, SM2130B, 2320B, 2540C, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B, 4500NO3-F, EPA 200.7, EPA 200.8, 245.1, EPA 300.0. Organic Parameters: 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, SM2320B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B, 4500P-E, 5210B, 5220D, 5310C, 9010B, 9040B, 9030B, 7470A, 7196A, 2340B, EPA 200.7, 6010, 200.8, 6020, 245.1, 1311, 1312, 3005A, Enterolert, 9223D, 9222D. Organic Parameters: 608, 8081, 8082, 8330, 8151A, 624, 8260, 3510C, 3630C, 5030B, ME-DRO, ME-GRO, MA-EPH, MA-VPH.)

Solid Waste/Soil (Inorganic Parameters: 9010B, 9012A, 9014A, 9040B, 9045C, 6010B, 7471A, 7196A, 9050A, 1010, 1030, 9065, 1311, 1312, 3005A, 3050B. Organic Parameters: ME-DRO, ME-GRO, MA-EPH, MA-VPH, 8260B, 8270C, 8330, 8151A, 8081A, 8082, 3540C, 3546, 3580A, 3630C, 5030B, 5035.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water (Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl) (EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate); (EPA 353.2 for: Nitrate-N, Nitrite-N); (SM4500NO3-F for: Nitrate-N and Nitrite-N); 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B. Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics); (504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), EPA 332. Microbiology Parameters: SM9215B; ENZ. SUB. SM9223; ColilertQT SM9223B; MF-SM9222D.)

Non-Potable Water (Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn); (EPA 200.7 for: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl, V,Zn); 245.1, SM4500H,B, EPA 120.1,

SM2510B, 2540C, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics),(608 for: Chlordane, Aldrin, Dieldrin, DDD, DDE, DDT, Heptachlor, Heptachlor Epoxide, PCBs-Water), (EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables), 600/4-81-045-PCB-Oil. Microbiology Parameters: (ColilertQT SM9223B;Enterolert-QT: SM9222D-MF.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM 9222B, 9223B, 9215B, EPA 200.7, 200.8, 245.2, 300.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 332.0. Organic Parameters: 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 3005A, 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 350.2, 351.1, 353.2, 410.4, 420.1, 1664A, SW-846 9010, 9030, 9040B, SM426C, SM2120B, 2310B, 2320B, 2540B, 2540D, 4500H+B, 4500CL-E, 4500CN-E, 4500NH3-H, 4500NO3-F, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 5220D, 2510B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3510C, 3630C, 5030B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A, 8151A.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040B, 9045C, 9050C, 9065,1311, 1312, 3005A, 3050B. Organic Parameters: SW-846 3540C, 3546, 3550B, 3580A, 3630C, 5030B, 5035, 8260B, 8270C, 8330, 8151A, 8015B, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500CN-CE, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 200.8, 245.2, 2540C, SM2120B, 2320B, 2510B, 5310C, SM4500H-B. Organic Parameters: EPA 332, 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-E, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM510ABC, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, 9222D, 9221B, 9221C, 9221E, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.1, 350.2, SW-846 1312, 6020, 6020A, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, 4500CN-CE, EPA 245.1, 245.2, SW-846 9040B, 3005A, 3015, EPA 6010B, 6010C, 7196A, 3060A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3510C, EPA 608, 624, 625, SW-846 3630C, 5030B, 8081A, 8081B, 8082, 8082A, 8151A, 8330, NJ OQA-QAM-025 Rev.7, NJ EPH.)

Solid & Chemical Materials (Inorganic Parameters: SW-846, 6010B, 6010C, 7196A, 3060A, 9010B, 9030B, 1010, 1030, 1311, 1312, 3005A, 3050B, 7471A, 7471B, 9014, 9012A, 9040B, 9045C, 9050A, 9065. Organic Parameters: SW-846 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3540C, 3545, 3546, 3550B, 3580A, 3630C, 5030B, 5035L, 5035H, NJ OQA-QAM-025 Rev.7, NJ EPH.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500H-B, 4500NO3-F, 2540C, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, 5310C, EPA 410.4, SM5220D, 2310B-4a, 2320B, EPA 200.7, 300.0, SM4500CL-E, 4500F-C, SM15 426C, EPA 350.1, SM4500NH3-BH, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-04-1-C, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, SM3500Cr-D, EPA 245.1, 245.2, 7470A, SM2120B, LACHAT 10-204-00-1-A, EPA 9040B, SM4500-HB, EPA 1664A, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 3005A, 9010B, 9030B.. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, EPA 3510C, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: 1010, 1030, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 1312, 3005A, 3050B, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8015B, 8081A, 8151A, 8330, 8082, 3540C, 3545, 3546, 3580, 5030B, 5035.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. Organic Parameters: MA-EPH, MA-VPH.

Drinking Water Program Certificate/Lab ID: 25700. (Inorganic Parameters: Chloride EPA 300.0. Organic Parameters: 524.2)

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Drinking Water (Organic Parameters: EPA 524.2, 504.1)

Non-Potable Water (Inorganic Parameters: EPA 1312, 200.7, 410.4, 1664A, SM2540D, 5210B, 5220D, 4500-P,BE. Organic Parameters: EPA 3510C, 3005A, 3630C, 5030B, 625, 624, 608, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Solid & Hazardous Waste (Inorganic Parameters: EPA 350.1, 1010, 1030, 1311, 1312, 3050B, 6010B, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065, SM 4500NH3-H. Organic Parameters: 3540C, 3545, 3546, 3550B, 3580A, 3630C, 5035, 8015B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NJ-DEP Certificate for Potable and Non-Potable Water.

Texas Commisson on Environmental Quality Certificate/Lab ID: T104704476-09-1. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664, 200.7, 200.8, 245.1, 245.2, 300.0, 350.1, 351.1, 353.2, 376.2, 410.4, 420.1, 6010, 6020, 7196, 7470, 9040, SM 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500CL-E, 4500CN-E, 4500F-C, 4500H+B, 4500NH3-H, 4500NO2B, 4500P-E, 4500 S2¯D, 510C, 5210B, 5220D, 5310C, 5540C. Organic Parameters: EPA 608, 624, 625, 8081, 8082, 8151, 8260, 8270, 8330.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312, 9012, 9014, 9040, 9045, 9050, 9065.)

Department of Defense Certificate/Lab ID: L2217.
Drinking Water (Inorganic Parameters: SM 4500H-B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: EPA 200.7, 200.8, 6010B, 6020, 245.1, 245.2, 7470A, 9040B, 300.0, 332.0, 6860, 353.2, 410.4, 9060, 1664A, SM 4500CN-E, 4500H-B, 4500NO3-F, 5220D, 5310C, 2320B, 2540C, 3005A, 3015, 9010B, 9056. Organic Parameters: EPA 8260B, 8270C, 8330A, 625, 8082, 8081A, 3510C, 5030B, MassDEP EPH, MassDEP VPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 200.7, 6010B, 7471A, 9010, 9012A, 6860, 1311, 1312, 3050B, 7196A, 9010B, 3500-CR-D, 4500CN-CE, 2540G, Organic Parameters: EPA 8260B, 8270C, 8330A/B-prep, 8082, 8081A, 3540C, 3546, 3580A, 5035A, MassDEP EPH, MassDEP VPH.)

The following analytes are not included in our current NELAP/TNI Scope of Accreditation:
EPA 8260B: Freon-113, 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes, 1,4-Diphenylhydrazine (Azobenzene). **EPA 625:** 4-Chloroaniline, 4-Methylphenol. Total Phosphorus in a soil matrix, Chloride in a soil matrix, TKN in a soil matrix, NO2 in a soil matrix, NO3 in a soil matrix, SO4 in a soil matrix.

Serial_No:10181108:58

ALPHA ANALYTICAL

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 10-4-11

ALPHA Job #: L1115893

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Environmental Partners
Address: 1900 Crown Colony Dr. Suite 402
Quincy, MA 02169
Phone: (617) 657-0200
Fax: (617) 657-0201
Email: amp@envpartners.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Wellfleet Harbor
Project Location: Wellfleet
Project #: 113-1105 Task 14
Project Manager: AnnMarie Petricca
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: 10/11/11 Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Is Matrix Spike (MS) Required on this SDG? (If yes see note in Comments)
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

If MS is required, indicate in Sample Specific Comments which samples and what tests MS to be performed.
(Note: All *CAM* methods for inorganic analyses require MS every 20 soil samples)

SAMPLE HANDLING

Filtration ______
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: Total Nitrates	Total Nitrogen	Sample Specific Comments	TOTAL # BOTTLES
15893 1	OW-1S	10/3/11	11:00			X	X		
2	OW-1D	10/3/11	11:45			X	X		
Container Type						P	P		
Preservative						—	—		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
AnnMarie Petricca	10/4/11 8:00AM	P. Gilbert	10/4/11 1140
P. Gilbert	10/4/11 1630	T. [illegible]	10/4/11 1630
T. [illegible]	10/4/11 1730	[illegible]	10/4/11 1730

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 18-Jan-2010)

ANALYTICAL REPORT

Lab Number:	L1115829
Client:	Environmental Partners 1900 Crown Colony Drive Suite 402 4th Floor Quincy, MA 02169
ATTN:	Eric Kelley
Phone:	(617) 657-0200
Project Name:	WELLFLEET HARBOR
Project Number:	Not Specified
Report Date:	10/17/11

Certifications & Approvals: MA (M-MA086), NY NELAC (11148), CT (PH-0574), NH (2003), NJ (MA935), RI (LAO00065), ME (MA0086), PA (Registration #68-03671), USDA (Permit #S-72578), US Army Corps of Engineers, Naval FESC.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1115829-01	0F	Not Specified	10/02/11 11:00
L1115829-02	1A	Not Specified	10/02/11 11:15
L1115829-03	1B	Not Specified	10/02/11 11:30
L1115829-04	1C	Not Specified	10/02/11 11:45
L1115829-05	YSI	Not Specified	10/02/11 12:00

Project Name: WELLFLEET HARBOR **Lab Number:** L1115829
Project Number: Not Specified **Report Date:** 10/17/11

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

Sample Receipt

The samples were received without the containers for the Total Nitrogen analysis. Aliquots were taken from unpreserved containers and preserved appropriately.

Nitrogen, Nitrate

L1115829-01 through -05 were analyzed for Nitrite within the method required holding time. An aliquot of each sample was then preserved and analyzed for Nitrate.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Elizabeth Simmons

Title: Technical Director/Representative Date: 10/17/11

INORGANICS
&
MISCELLANEOUS

Project Name: WELLFLEET HARBOR

Project Number: Not Specified

Lab Number: L1115829

Report Date: 10/17/11

SAMPLE RESULTS

Lab ID: L1115829-01
Client ID: 0F
Sample Location: Not Specified
Matrix: Water

Date Collected: 10/02/11 11:00
Date Received: 10/03/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.18		mg/l	0.10	--	1	-	10/04/11 23:03	44,353.2	TH
Nitrogen, Nitrate/Nitrite	0.18		mg/l	0.10	--	1	-	10/04/11 23:03	44,353.2	TH
Total Nitrogen	1.7		mg/l	0.30	--	1	-	10/14/11 13:30	41,-	JO
Nitrogen, Total Kjeldahl	1.5		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:38	30,4500N-C	AT

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

SAMPLE RESULTS

Lab ID: L1115829-02
Client ID: 1A
Sample Location: Not Specified
Matrix: Water

Date Collected: 10/02/11 11:15
Date Received: 10/03/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 23:03	44,353.2	TH
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 23:03	44,353.2	TH
Total Nitrogen	1.3		mg/l	0.30	--	1	-	10/14/11 13:30	41,-	JO
Nitrogen, Total Kjeldahl	1.3		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:39	30,4500N-C	AT

Project Name: WELLFLEET HARBOR

Project Number: Not Specified

Lab Number: L1115829

Report Date: 10/17/11

SAMPLE RESULTS

Lab ID: L1115829-03
Client ID: 1B
Sample Location: Not Specified
Matrix: Water

Date Collected: 10/02/11 11:30
Date Received: 10/03/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 23:04	44,353.2	TH
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 23:04	44,353.2	TH
Total Nitrogen	1.0		mg/l	0.30	--	1	-	10/14/11 13:30	41,-	JO
Nitrogen, Total Kjeldahl	1.0		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:47	30,4500N-C	AT

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

SAMPLE RESULTS

Lab ID: L1115829-04
Client ID: 1C
Sample Location: Not Specified
Matrix: Water

Date Collected: 10/02/11 11:45
Date Received: 10/03/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 23:05	44,353.2	TH
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 23:05	44,353.2	TH
Total Nitrogen	0.61		mg/l	0.30	--	1	-	10/14/11 13:30	41,-	JO
Nitrogen, Total Kjeldahl	0.61		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:48	30,4500N-C	AT

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

SAMPLE RESULTS

Lab ID: L1115829-05
Client ID: YSI
Sample Location: Not Specified
Matrix: Water

Date Collected: 10/02/11 12:00
Date Received: 10/03/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 23:05	44,353.2	TH
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 23:05	44,353.2	TH
Total Nitrogen	0.61		mg/l	0.30	--	1	-	10/14/11 13:30	41,-	JO
Nitrogen, Total Kjeldahl	0.61		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:49	30,4500N-C	AT

Project Name: WELLFLEET HARBOR **Lab Number:** L1115829

Project Number: Not Specified **Report Date:** 10/17/11

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-05 Batch: WG493895-2										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	10/04/11 22:46	44,353.2	TH
General Chemistry - Westborough Lab for sample(s): 01-05 Batch: WG493897-2										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	10/04/11 22:47	44,353.2	TH
General Chemistry - Westborough Lab for sample(s): 01-05 Batch: WG494946-1										
Nitrogen, Total Kjeldahl	ND		mg/l	0.30	--	1	10/10/11 23:00	10/13/11 20:31	30,4500N-C	AT

Lab Control Sample Analysis
Batch Quality Control

Project Name: WELLFLEET HARBOR

Project Number: Not Specified

Lab Number: L1115829

Report Date: 10/17/11

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-05 Batch: WG493895-1								
Nitrogen, Nitrate	96		-		90-110	-		
General Chemistry - Westborough Lab Associated sample(s): 01-05 Batch: WG493897-1								
Nitrogen, Nitrate/Nitrite	96		-		90-110	-		
General Chemistry - Westborough Lab Associated sample(s): 01-05 Batch: WG494946-2								
Nitrogen, Total Kjeldahl	92		-		85-110	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: WELLFLEET HARBOR
Project Number: Not Specified
Lab Number: L1115829
Report Date: 10/17/11

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG493895-3 QC Sample: L1115856-01 Client ID: MS Sample												
Nitrogen, Nitrate	12	4	16	100		-	-		83-113	-		6
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG493897-3 QC Sample: L1115870-01 Client ID: MS Sample												
Nitrogen, Nitrate/Nitrite	0.12	4	4.0	97		-	-		80-120	-		20
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG494946-3 QC Sample: L1116262-01 Client ID: MS Sample												
Nitrogen, Total Kjeldahl	42	8	52	**125**	Q	-	-		77-111	-		24

Lab Duplicate Analysis
Batch Quality Control

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG493895-4 QC Sample: L1115856-01 Client ID: DUP Sample						
Nitrogen, Nitrate	12	12	mg/l	0		6
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG493897-4 QC Sample: L1115870-01 Client ID: DUP Sample						
Nitrogen, Nitrate/Nitrite	0.12	0.13	mg/l	8		20
General Chemistry - Westborough Lab Associated sample(s): 01-05 QC Batch ID: WG494946-4 QC Sample: L1115829-05 Client ID: YSI						
Nitrogen, Total Kjeldahl	0.61	0.62	mg/l	2		24

Project Name: WELLFLEET HARBOR
Project Number: Not Specified

Lab Number: L1115829
Report Date: 10/17/11

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1115829-01A	Other container unpreserved	A	7	2	Y	Absent	NO3-353(2)
L1115829-01B	Plastic 250ml H2SO4 preserved sp	A	<2	2	Y	Absent	TKN-4500(28),NO3/NO2-353(28),TNITROGEN(28)
L1115829-02A	Other container unpreserved	A	7	2	Y	Absent	NO3-353(2)
L1115829-02B	Plastic 250ml H2SO4 preserved sp	A	<2	2	Y	Absent	TKN-4500(28),NO3/NO2-353(28),TNITROGEN(28)
L1115829-03A	Other container unpreserved	A	7	2	Y	Absent	NO3-353(2)
L1115829-03B	Plastic 250ml H2SO4 preserved sp	A	<2	2	Y	Absent	TKN-4500(28),NO3/NO2-353(28),TNITROGEN(28)
L1115829-04A	Other container unpreserved	A	7	2	Y	Absent	NO3-353(2)
L1115829-04B	Plastic 250ml H2SO4 preserved sp	A	<2	2	Y	Absent	TKN-4500(28),NO3/NO2-353(28),TNITROGEN(28)
L1115829-05A	Other container unpreserved	A	7	2	Y	Absent	NO3-353(2)
L1115829-05B	Plastic 250ml H2SO4 preserved sp	A	<2	2	Y	Absent	TKN-4500(28),NO3/NO2-353(28),TNITROGEN(28)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The RPD between the results for the two columns exceeds the method-specified criteria; however, the lower value has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

Report Format: Data Usability Report

Data Qualifiers

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

REFERENCES

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

41 Alpha Analytical Labs Internally-developed Performance-based Method.

44 Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August 1993.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certificate/Approval Program Summary

Last revised September 19, 2011 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB), 1,4-Dioxane (Mod 8270). Microbiology Parameters: Total Coliform-MF mEndo (SM9222B), Total Coliform – Colilert (SM9223 P/A), E. Coli. – Colilert (SM9223 P/A), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D))

Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, TPH (HEM/SGT), Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH. Microbiology Parameters: Total Coliform – MF mEndo (SM9222B), Total Coliform – MTF (SM9221B), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform – A-1 Broth (SM9221E).)

Solid Waste/Soil (Inorganic Parameters: pH, Sulfide, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), SPLP Leach (1312 metals only), Reactivity. Organic Parameters: PCBs, PCBs in Oil, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9222D, 9223B, EPA 180.1, 353.2, SM2130B, 2320B, 2540C, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B, 4500NO3-F, EPA 200.7, EPA 200.8, 245.1, EPA 300.0. Organic Parameters: 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, SM2320B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B, 4500P-E, 5210B, 5220D, 5310C, 9010B, 9040B, 9030B, 7470A, 7196A, 2340B, EPA 200.7, 6010, 200.8, 6020, 245.1, 1311, 1312, 3005A, Enterolert, 9223D, 9222D. Organic Parameters: 608, 8081, 8082, 8330, 8151A, 624, 8260, 3510C, 3630C, 5030B, ME-DRO, ME-GRO, MA-EPH, MA-VPH.)

Solid Waste/Soil (Inorganic Parameters: 9010B, 9012A, 9014A, 9040B, 9045C, 6010B, 7471A, 7196A, 9050A, 1010, 1030, 9065, 1311, 1312, 3005A, 3050B. Organic Parameters: ME-DRO, ME-GRO, MA-EPH, MA-VPH, 8260B, 8270C, 8330, 8151A, 8081A, 8082, 3540C, 3546, 3580A, 3630C, 5030B, 5035.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water (Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl) (EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate); (EPA 353.2 for: Nitrate-N, Nitrite-N); (SM4500NO3-F for: Nitrate-N and Nitrite-N); 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B. Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics); (504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), EPA 332. Microbiology Parameters: SM9215B; ENZ. SUB. SM9223; ColilertQT SM9223B; MF-SM9222D.)

Non-Potable Water (Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn); (EPA 200.7 for: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl, V,Zn); 245.1, SM4500H,B, EPA 120.1,

SM2510B, 2540C, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics),(608 for: Chlordane, Aldrin, Dieldrin, DDD, DDE, DDT, Heptachlor, Heptachlor Epoxide, PCBs-Water), (EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables), 600/4-81-045-PCB-Oil. Microbiology Parameters: (ColilertQT SM9223B;Enterolert-QT: SM9222D-MF.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM 9222B, 9223B, 9215B, EPA 200.7, 200.8, 245.2, 300.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 332.0. Organic Parameters: 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 3005A, 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 350.2, 351.1, 353.2, 410.4, 420.1, 1664A, SW-846 9010, 9030, 9040B, SM426C, SM2120B, 2310B, 2320B, 2540B, 2540D, 4500H+B, 4500CL-E, 4500CN-E, 4500NH3-H, 4500NO3-F, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 5220D, 2510B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3510C, 3630C, 5030B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A, 8151A.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040B, 9045C, 9050C, 9065,1311, 1312, 3005A, 3050B. Organic Parameters: SW-846 3540C, 3546, 3550B, 3580A, 3630C, 5030B, 5035, 8260B, 8270C, 8330, 8151A, 8015B, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500CN-CE, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 200.8, 245.2, 2540C, SM2120B, 2320B, 2510B, 5310C, SM4500H-B. Organic Parameters: EPA 332, 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-E, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM510ABC, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, 9222D, 9221B, 9221C, 9221E, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.1, 350.2, SW-846 1312, 6020, 6020A, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, 4500CN-CE, EPA 245.1, 245.2, SW-846 9040B, 3005A, 3015, EPA 6010B, 6010C, 7196A, 3060A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3510C, EPA 608, 624, 625, SW-846 3630C, 5030B, 8081A, 8081B, 8082, 8082A, 8151A, 8330, NJ OQA-QAM-025 Rev.7, NJ EPH.)

Solid & Chemical Materials (Inorganic Parameters: SW-846, 6010B, 6010C, 7196A, 3060A, 9010B, 9030B, 1010, 1030, 1311, 1312, 3005A, 3050B, 7471A, 7471B, 9014, 9012A, 9040B, 9045C, 9050A, 9065. Organic Parameters: SW-846 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3540C, 3545, 3546, 3550B, 3580A, 3630C, 5030B, 5035L, 5035H, NJ OQA-QAM-025 Rev.7, NJ EPH.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500H-B, 4500NO3-F, 2540C, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, 5310C, EPA 410.4, SM5220D, 2310B-4a, 2320B, EPA 200.7, 300.0, SM4500CL-E, 4500F-C, SM15 426C, EPA 350.1, SM4500NH3-BH, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-04-1-C, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, SM3500Cr-D, EPA 245.1, 245.2, 7470A, SM2120B, LACHAT 10-204-00-1-A, EPA 9040B, SM4500-HB, EPA 1664A, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 3005A, 9010B, 9030B.. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, EPA 3510C, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: 1010, 1030, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 1312, 3005A, 3050B, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8015B, 8081A, 8151A, 8330, 8082, 3540C, 3545, 3546, 3580, 5030B, 5035.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. Organic Parameters: MA-EPH, MA-VPH.

Drinking Water Program Certificate/Lab ID: 25700. (Inorganic Parameters: Chloride EPA 300.0. Organic Parameters: 524.2)

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Drinking Water (Organic Parameters: EPA 524.2, 504.1)

Non-Potable Water (Inorganic Parameters: EPA 1312, 200.7, 410.4, 1664A, SM2540D, 5210B, 5220D, 4500-P,BE. Organic Parameters: EPA 3510C, 3005A, 3630C, 5030B, 625, 624, 608, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Solid & Hazardous Waste (Inorganic Parameters: EPA 350.1, 1010, 1030, 1311, 1312, 3050B, 6010B, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065, SM 4500NH3-H. Organic Parameters: 3540C, 3545, 3546, 3550B, 3580A, 3630C, 5035, 8015B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NJ-DEP Certificate for Potable and Non-Potable Water.

Texas Commisson on Environmental Quality Certificate/Lab ID: T104704476-09-1. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664, 200.7, 200.8, 245.1, 245.2, 300.0, 350.1, 351.1, 353.2, 376.2, 410.4, 420.1, 6010, 6020, 7196, 7470, 9040, SM 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500CL-E, 4500CN-E, 4500F-C, 4500H+B, 4500NH3-H, 4500NO2B, 4500P-E, 4500 S2¯D, 510C, 5210B, 5220D, 5310C, 5540C. Organic Parameters: EPA 608, 624, 625, 8081, 8082, 8151, 8260, 8270, 8330.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312, 9012, 9014, 9040, 9045, 9050, 9065.)

Department of Defense Certificate/Lab ID: L2217.
Drinking Water (Inorganic Parameters: SM 4500H-B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: EPA 200.7, 200.8, 6010B, 6020, 245.1, 245.2, 7470A, 9040B, 300.0, 332.0, 6860, 353.2, 410.4, 9060, 1664A, SM 4500CN-E, 4500H-B, 4500NO3-F, 5220D, 5310C, 2320B, 2540C, 3005A, 3015, 9010B, 9056. Organic Parameters: EPA 8260B, 8270C, 8330A, 625, 8082, 8081A, 3510C, 5030B, MassDEP EPH, MassDEP VPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 200.7, 6010B, 7471A, 9010, 9012A, 6860, 1311, 1312, 3050B, 7196A, 9010B, 3500-CR-D, 4500CN-CE, 2540G, Organic Parameters: EPA 8260B, 8270C, 8330A/B-prep, 8082, 8081A, 3540C, 3546, 3580A, 5035A, MassDEP EPH, MassDEP VPH.)

The following analytes are not included in our current NELAP/TNI Scope of Accreditation:
EPA 8260B: Freon-113, 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes, 1,4-Diphenylhydrazine (Azobenzene). **EPA 625:** 4-Chloroaniline, 4-Methylphenol. Total Phosphorus in a soil matrix, Chloride in a soil matrix, TKN in a soil matrix, NO2 in a soil matrix, NO3 in a soil matrix, SO4 in a soil matrix.

ALPHA Job # L1115829 Serial_No:10171115:34

Job: Wellfleet Harbor

Date Collected: 10/2/11

Sample ID	Time	Analyses	
OF	11:00	Tot. Nitrate,	Total Nitrogen
1A	11:15	↓	↓
1B	11:30	↓	↓
1C	11:45	↓	↓
YSI	12:00	↓	↓

Environmental Partners Group

AnnMarie Petruccia

RECV 1240 - Oct 3 2011

REL 1720 OCT 3 2011

Received 1720 Oct 3 2011

GROUNDWATER ANALYTICAL

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P.O. Box 1200
228 Main Street
Buzzards Bay, MA 02532

Telephone (508) 759-4441
FAX (508) 759-4475
www.groundwateranalytical.com

September 9, 2011

Ms. Ann Marie Petricca
Environmental Partners Group, Inc.
1900 Crown Colony Drive
Quincy, MA 02169

LABORATORY REPORT

Project:	**Wellfleet Harbor**
Lab ID:	**144497**
Received:	**08-25-11**

Dear Ann Marie:

Enclosed are the analytical results for the above referenced project. The project was processed for Standard turnaround.

This letter authorizes the release of the analytical results, and should be considered a part of this report. This report contains a sample receipt report detailing the samples received, a project narrative indicating project changes and non-conformances, a quality control report, and a statement of our state certifications.

The analytical results contained in this report meet all applicable NELAC standards, except as may be specifically noted, or described in the project narrative. The analytical results relate only to the samples received. This report may only be used or reproduced in its entirety.

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.

Should you have any questions concerning this report, please do not hesitate to contact me.

Sincerely,

Karyn E. Raymond

Karyn E. Raymond
Project Manager

KER/saj

GROUNDWATER ANALYTICAL

Sample Receipt Report

Project: **Wellfleet Harbor**
Client: **Environmental Partners Group, Inc.**
Lab ID: **144497**

Delivery: **GWA Courier**
Airbill: **n/a**
Lab Receipt: **08-25-11**

Temperature: **4.0°C**
Chain of Custody: **Present**
Custody Seal(s): **n/a**

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-1	S-1		Aqueous	8/24/11 0:00	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2048013	60 mL Glass	n/a	n/a	None	n/a	n/a	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-2	S-2		Aqueous	8/24/11 0:00	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2048010	60 mL Glass	n/a	n/a	None	n/a	n/a	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-3	S-3		Aqueous	8/24/11 0:00	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2048012	60 mL Glass	n/a	n/a	None	n/a	n/a	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-4	S-3		Aqueous	8/24/11 0:00	EPA 351.2/SM 4500-NO3 F Total Nitrogen (as TKN, Nitrate and Nitrite)				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2041536	250 mL Plastic	Proline	BX39556	H2SO4	R-6407A	08-24-11	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-5	S-2		Aqueous	8/24/11 0:00	EPA 351.2/SM 4500-NO3 F Total Nitrogen (as TKN, Nitrate and Nitrite)				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2041510	250 mL Plastic	Proline	BX39556	H2SO4	R-6407A	08-24-11	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144497-6	S-1		Aqueous	8/24/11 0:00	EPA 351.2/SM 4500-NO3 F Total Nitrogen (as TKN, Nitrate and Nitrite)				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2041486	250 mL Plastic	Proline	BX39556	H2SO4	R-6407A	08-24-11	n/a		

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-1** Matrix: **Aqueous**
Project: **Wellfleet Harbor** Received: **08-25-11 16:00**
Client: **Environmental Partners Group, Inc.**

Lab ID: **144497-01** Sampled: **08-24-11 00:00** Container: **60 mL Glass** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.11**	mg/L	0.02	1	5 mL	08-25-11 21:36	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH

Lab ID: **144497-06** Sampled: **08-24-11 00:00** Container: **250 mL Plastic** Preservation: **H2SO4/Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrogen, Total (as TKN, Nitrate and Nitrite)	**1.6**	mg/L	0.5	1	20 mL	08-27-11 12:57	TKN-2990-W	Lachat 10-107-06-2 EPA 351.2	1	JR
				1	5 mL	08-25-11 21:39	NI-4974-W	SM 4500-NO3 F	1	BH

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-2** Matrix: **Aqueous**
Project: **Wellfleet Harbor** Received: **08-25-11 16:00**
Client: **Environmental Partners Group, Inc.**

Lab ID: **144497-02** Sampled: **08-24-11 00:00** Container: **60 mL Glass** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.05**	mg/L	0.02	1	5 mL	08-25-11 21:37	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH

Lab ID: **144497-05** Sampled: **08-24-11 00:00** Container: **250 mL Plastic** Preservation: **H2SO4/Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrogen, Total (as TKN, Nitrate and Nitrite)	**1.4**	mg/L	0.5	1	20 mL	08-27-11 12:56	TKN-2990-W	Lachat 10-107-06-2 EPA 351.2	1	JR
				1	5 mL	08-25-11 21:37	NI-4974-W	SM 4500-NO3 F	1	BH

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-3**
Project: **Wellfleet Harbor**
Client: **Environmental Partners Group, Inc.**

Matrix: **Aqueous**
Received: **08-25-11 16:00**

Lab ID: **144497-03** Sampled: **08-24-11 00:00** Container: **60 mL Glass** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.05**	mg/L	0.02	1	5 mL	08-25-11 21:39	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH

Lab ID: **144497-04** Sampled: **08-24-11 00:00** Container: **250 mL Plastic** Preservation: **H2SO4/Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrogen, Total (as TKN, Nitrate and Nitrite)	**3.3**	mg/L	0.5	1	20 mL	08-27-11 12:54	TKN-2990-W	Lachat 10-107-06-2 EPA 351.2	1	JR
				1	5 mL	08-25-11 21:36	NI-4974-W	SM 4500-NO3 F	1	BH

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Project Narrative

Project:	**Wellfleet Harbor**	Lab ID:	**144497**
Client:	**Environmental Partners Group, Inc.**	Received:	**08-25-11 16:00**

A. Documentation and Client Communication

The following documentation discrepancies, and client changes or amendments were noted for this project:

1 . No documentation discrepancies, changes, or amendments were noted.

B. Method Modifications, Non-Conformances and Observations

The sample(s) in this project were analyzed by the references analytical method(s), and no method modifications, non-conformances or analytical issues were noted, except as indicated below:

1 . Samples 144497-1,-2,-3,-4,-5 and -6 were not received with sample collection times listed on the Chain of Custody. Samples were reported with a sampling collection time of 00:00 by the laboratory.

Jon Angell

From: Ann Marie Petricca [amp@envpartners.com]

Sent: Thursday, August 25, 2011 4:01 PM

To: jangell@groundwateranalytical.com

Cc: kraymond@groundwateranalytical.com

Subject: Water Samples Picked up Today

John,

Thank you for picking up the Wellfleet Harbor water samples at 85 Great Hill Road in Sandwich today. There should have been three samples there S-1, S-2 and S-3. The samples were collected on 8/24/11. I would like to analyze all three samples for Total Nitrogen and Nitrates.

Please call me on my cell phone if you have questions..
Thanks.
Ann Marie

Ann Marie Petricca, CPG
Environmental Partners Group
Quincy, MA and Hyannis, MA

Phone (office): (617) 657-0299
Phone (cell): (508) 223-5717

GROUNDWATER ANALYTICAL

Quality Assurance/Quality Control

A. Program Overview

Groundwater Analytical conducts an active Quality Assurance program to ensure the production of high quality, valid data. This program closely follows the guidance provided by *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans,* US EPA QAMS-005/80 (1980), and *Test Methods for Evaluating Solid Waste,* US EPA, SW-846, Update III (1996).

Quality Control protocols include written Standard Operating Procedures (SOPs) developed for each analytical method. SOPs are derived from US EPA methodologies and other established references. Standards are prepared from commercially obtained reference materials of certified purity, and documented for traceability.

Quality Assessment protocols for most organic analyses include a minimum of one laboratory control sample, one method blank, one matrix spike sample, and one sample duplicate for each sample preparation batch. All samples, standards, blanks, laboratory control samples, matrix spikes and sample duplicates are spiked with internal standards and surrogate compounds. All instrument sequences begin with an initial calibration verification standard and a blank; and excepting GC/MS sequences, all sequences close with a continuing calibration standard. GC/MS systems are tuned to appropriate ion abundance criteria daily, or for each 12 hour operating period, whichever is more frequent.

Quality Assessment protocols for most inorganic analyses include a minimum of one laboratory control sample, one method blank, one matrix spike sample, and one sample duplicate for each sample preparation batch. Standard curves are derived from one reagent blank and four concentration levels. Curve validity is verified by standard recoveries within plus or minus ten percent of the curve.

B. Definitions

Batches are used as the basic unit for Quality Assessment. A Batch is defined as twenty or fewer samples of the same matrix which are prepared together for the same analysis, using the same lots of reagents and the same techniques or manipulations, all within the same continuum of time, up to but not exceeding 24 hours.

Laboratory Control Samples are used to assess the accuracy of the analytical method. A Laboratory Control Sample consists of reagent water or sodium sulfate spiked with a group of target analytes representative of the method analytes. Accuracy is defined as the degree of agreement of the measured value with the true or expected value. Percent Recoveries for the Laboratory Control Samples are calculated to assess accuracy.

Method Blanks are used to assess the level of contamination present in the analytical system. Method Blanks consist of reagent water or an aliquot of sodium sulfate. Method Blanks are taken through all the appropriate steps of an analytical method. Sample data reported is not corrected for blank contamination.

Surrogate Compounds are used to assess the effectiveness of an analytical method in dealing with each sample matrix. Surrogate Compounds are organic compounds which are similar to the target analytes of interest in chemical behavior, but which are not normally found in environmental samples. Percent Recoveries are calculated for each Surrogate Compound.

GROUNDWATER ANALYTICAL

Quality Control Report
Laboratory Control Sample

Category: **Inorganic Chemistry**
Matrix: **Aqueous**

Analyte	Units	Spiked	Measured	Recovery	QC Limits	Analyzed	QC Batch	Method	Inst	Analyst
Nitrite (as Nitrogen)	mg/L	1.00	1.0	**98 %**	80 - 120 %	08-25-11 21:02	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH
Nitrate (as Nitrogen)	mg/L	4.00	3.9	**98 %**	80 - 120 %	08-25-11 21:02	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations: All calculations performed prior to rounding. Quality Control Limits are defined by the methodology, or alternatively based upon the historical average recovery plus or minus three standard deviation units.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Quality Control Report
Method Blank

Category: **Inorganic Chemistry**
Matrix: **Aqueous**

Analyte	Result	Units	RL	Analyzed	QC Batch	Method	Inst	Analyst
Nitrite (as Nitrogen)	BRL	mg/L	0.02	08-25-11 21:02	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH
Nitrate (as Nitrogen)	BRL	mg/L	0.02	08-25-11 21:02	NI-4974-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	BH

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER
ANALYTICAL

Certifications and Approvals

Groundwater Analytical maintains environmental laboratory certification in a variety of states.
Copies of our current certificates may be obtained from our website:

http://www.groundwateranalytical.com/qualifications.htm

CONNECTICUT

Department of Health Services, PH-0586 — Potable Water, Wastewater, Solid Waste and Soil
http://www.ct.gov/dph/lib/dph/environmental health/environmental laboratories/pdf/Out State.pdf

MASSACHUSETTS

Department of Environmental Protection, M-MA-103 — Potable Water and Non-Potable Water
http://public.dep.state.ma.us/labcert/labcert.aspx

Department of Labor,
Division of Occupational Safety, AA000195 — Asbestos Analytical Services, Class A
http://www.mass.gov/dos/forms/la-rpt_list_aa.pdf

NEW HAMPSHIRE

Department of Environmental Services, 202708 — Potable Water, Non-Potable Water, Solid and Chemical Materials
http://www4.egov.nh.gov/DES/NHELAP

NEW YORK

Department of Health, 11754 — Potable Water, Non-Potable Water, Solid and Hazardous Waste
http://www.wadsworth.org/labcert/elap/comm.html

RHODE ISLAND

Department of Health,
Division of Laboratories, LAO00054 — Potable and Non-Potable Water Microbiology, Organic and Inorganic Chemistry
http://www.health.ri.gov/labs/outofstatelabs.pdf

U.S. DEPARTMENT OF AGRICULTURE

USDA, Soil Permit, S-53921 — Foreign soil import permit

VERMONT

Department of Health, VT-87643 — Potable Water
http://healthvermont.gov/enviro/ph_lab/water_test.aspx#cert

GROUNDWATER ANALYTICAL

Certifications and Approvals

MASSACHUSETTS	Department of Environmental Protection, M-MA-103

Groundwater Analytical maintains MassDEP environmental laboratory certification for only the methods and analytes listed below. Analyses for certified analytes are conducted in accordance with MassDEP certification standards, except as may be specifically noted in the project narrative.

Potable Water (Drinking Water)

Analyte	Method
1,2-Dibromo-3-Chloropropane	EPA 504.1
1,2-Dibromoethane	EPA 504.1
Alkalinity, Total	SM 2320-B
Antimony	EPA 200.8
Arsenic	EPA 200.8
Barium	EPA 200.7
Barium	EPA 200.8
Beryllium	EPA 200.7
Beryllium	EPA 200.8
Cadmium	EPA 200.7
Cadmium	EPA 200.8
Calcium	EPA 200.7
Chlorine, Residual Free	SM 4500-CL-G
Chromium	EPA 200.7
Copper	EPA 200.7
Copper	EPA 200.8
Cyanide, Total	Lachat 10-204-00-1-A
E. Coli (Treatment and Distribution)	Enz. Sub. SM 9223
E. Coli (Treatment and Distribution)	NA-MUG SM 9222-G
Fecal Coliform (Source Water)	MF SM 9222-D
Fluoride	EPA 300.0
Fluoride	SM 4500-F-C
Haloacetic Acids	EPA 552.2
Heterotrophic Plate Count	SM 9215-B
Lead	EPA 200.8
Mercury	EPA 245.1
Nickel	EPA 200.7
Nickel	EPA 200.8
Nitrate-N	EPA 300.0
Nitrate-N	Lachat 10-107-04-1-C
Nitrite-N	EPA 300.0
Nitrite-N	Lachat 10-107-04-1-C
pH	SM 4500-H-B
Selenium	EPA 200.8
Silver	EPA 200.7
Silver	EPA 200.8
Sodium	EPA 200.7
Sulfate	EPA 300.0
Thallium	EPA 200.8
Total Coliform (Treatment and Distribution)	Enz. Sub. SM 9223
Total Coliform (Treatment and Distribution)	MF SM 9222-B
Total Dissolved Solids	SM 2540-C
Trihalomethanes	EPA 524.2
Turbidity	SM 2130-B
Volatile Organic Compounds	EPA 524.2

Non-Potable Water (Wastewater)

Analyte	Method
Aldrin	EPA 608
Alkalinity, Total	SM 2320-B
Alpha-BHC	EPA 608
Aluminum	EPA 200.7

Non-Potable Water (Wastewater)

Analyte	Method
Aluminum	EPA 200.8
Ammonia-N	Lachat 10-107-06-1-B
Antimony	EPA 200.7
Antimony	EPA 200.8
Arsenic	EPA 200.7
Arsenic	EPA 200.8
Beryllium	EPA 200.7
Beryllium	EPA 200.8
Beta-BHC	EPA 608
Biochemical Oxygen Demand	SM 5210-B
Cadmium	EPA 200.7
Cadmium	EPA 200.8
Calcium	EPA 200.7
Chemical Oxygen Demand	SM 5220-D
Chlordane	EPA 608
Chloride	EPA 300.0
Chlorine, Total Residual	SM 4500-CL-G
Chromium	EPA 200.7
Chromium	EPA 200.8
Cobalt	EPA 200.7
Cobalt	EPA 200.8
Copper	EPA 200.7
Copper	EPA 200.8
Cyanide, Total	Lachat 10-204-00-1-A
DDD	EPA 608
DDE	EPA 608
DDT	EPA 608
Delta-BHC	EPA 608
Dieldrin	EPA 608
Endosulfan I	EPA 608
Endosulfan II	EPA 608
Endosulfan Sulfate	EPA 608
Endrin	EPA 608
Endrin Aldehyde	EPA 608
Gamma-BHC	EPA 608
Hardness (CaCO3), Total	EPA 200.7
Hardness (CaCO3), Total	SM 2340-B
Heptachlor	EPA 608
Heptachlor Epoxide	EPA 608
Iron	EPA 200.7
Kjeldahl-N	Lachat 10-107-06-02-D
Lead	EPA 200.7
Magnesium	EPA 200.7
Manganese	EPA 200.7
Manganese	EPA 200.8
Mercury	EPA 245.1
Molybdenum	EPA 200.7
Molybdenum	EPA 200.8
Nickel	EPA 200.7
Nickel	EPA 200.8
Nitrate-N	EPA 300.0
Nitrate-N	Lachat 10-107-04-1-C
Non-Filterable Residue	SM 2540-D
Oil and Grease	EPA 1664

Certifications and Approvals

MASSACHUSETTS	Department of Environmental Protection, M-MA-103

Groundwater Analytical maintains MassDEP environmental laboratory certification for only the methods and analytes listed below. Analyses for certified analytes are conducted in accordance with MassDEP certification standards, except as may be specifically noted in the project narrative.

Non-Potable Water (Wastewater)

Analyte	Method
Orthophosphate	Lachat 10-115-01-1-A
pH	SM 4500-H-B
Phenolics, Total	EPA 420.4
Phenolics, Total	Lachat 10-210-00-1-B
Phosphorus, Total	Lachat 10-115-01-1-C
Phosphorus, Total	SM 4500-P-B,E
Polychlorinated Biphenyls (Oil)	EPA 600/4-81-045
Polychlorinated Biphenyls (Water)	EPA 608
Potassium	EPA 200.7
Selenium	EPA 200.7
Selenium	EPA 200.8
Silver	EPA 200.7
Sodium	EPA 200.7
Specific Conductivity	SM 2510-B
Strontium	EPA 200.7
Sulfate	EPA 300.0
SVOC-Acid Extractables	EPA 625
SVOC-Base/Neutral Extractables	EPA 625
Thallium	EPA 200.7
Thallium	EPA 200.8
Titanium	EPA 200.7
Total Dissolved Solids	SM 2540-C
Total Organic Carbon	SM 5310-B
Toxaphene	EPA 608
Vanadium	EPA 200.7
Vanadium	EPA 200.8
Volatile Aromatics	EPA 602
Volatile Aromatics	EPA 624
Volatile Halocarbons	EPA 624
Zinc	EPA 200.7
Zinc	EPA 200.8

GROUNDWATER ANALYTICAL

Groundwater Analytical, Inc.
P.O. Box 1200
228 Main Street
Buzzards Bay, MA 02532

Telephone (508) 759-4441
FAX (508) 759-4475
www.groundwateranalytical.com

August 22, 2011

Ms. Ann Marie Petricca
Environmental Partners Group, Inc.
1900 Crown Colony Drive
Quincy, MA 02169

LABORATORY REPORT

Project: **Wellfleet**
Lab ID: **144049**
Received: **08-08-11**

Dear Ann Marie:

Enclosed are the analytical results for the above referenced project. The project was processed for Standard turnaround.

This letter authorizes the release of the analytical results, and should be considered a part of this report. This report contains a sample receipt report detailing the samples received, a project narrative indicating project changes and non-conformances, a quality control report, and a statement of our state certifications.

The analytical results contained in this report meet all applicable NELAC standards, except as may be specifically noted, or described in the project narrative. The analytical results relate only to the samples received. This report may only be used or reproduced in its entirety.

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.

Should you have any questions concerning this report, please do not hesitate to contact me.

Sincerely,

Karyn E. Raymond

Karyn E. Raymond
Project Manager

KER/ams

GROUNDWATER ANALYTICAL

Sample Receipt Report

Project:	**Wellfleet**	Delivery:	**GWA Courier**	Temperature:	**4.4ºC**
Client:	**Environmental Partners Group, Inc.**	Airbill:	**n/a**	Chain of Custody:	**Present**
Lab ID:	**144049**	Lab Receipt:	**08-08-11**	Custody Seal(s):	**n/a**

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144049-1	S-1		Aqueous	8/7/11 11:00	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2044983	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		
C2044984	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144049-2	S-2		Aqueous	8/7/11 11:15	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2044979	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		
C2044981	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		

Lab ID	Field ID		Matrix	Sampled	Method				Notes
144049-3	S-3		Aqueous	8/7/11 11:30	Lachat 10-107-04-1-C (SM 4500-NO3 F) Nitrate				
Con ID	**Container**	**Vendor**	**QC Lot**	**Preserv**	**QC Lot**	**Prep**	**Ship**		
C2044980	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		
C2044982	250 mL Plastic	n/a	n/a	None	n/a	n/a	n/a		

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-1** Matrix: **Aqueous**
Project: **Wellfleet** Received: **08-08-11 16:40**
Client: **Environmental Partners Group, Inc.**

Lab ID: **144049-01** Sampled: **08-07-11 11:00** Container: **250 mL Plastic** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.07**	mg/L	0.02	1	5 mL	08-09-11 15:10	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-2** Matrix: **Aqueous**
Project: **Wellfleet** Received: **08-08-11 16:40**
Client: **Environmental Partners Group, Inc.**

Lab ID: **144049-02** Sampled: **08-07-11 11:15** Container: **250 mL Plastic** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.07**	mg/L	0.02	1	5 mL	08-09-11 15:16	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Inorganic Chemistry

Field ID: **S-3** Matrix: **Aqueous**
Project: **Wellfleet** Received: **08-08-11 16:40**
Client: **Environmental Partners Group, Inc.**

Lab ID: **144049-03** Sampled: **08-07-11 11:30** Container: **250 mL Plastic** Preservation: **Cool**

Analyte	Result	Units	RL	DF	Volume	Analyzed	QC Batch	Method	Inst	Analyst
Nitrate (as Nitrogen)	**0.09**	mg/L	0.02	1	5 mL	08-09-11 15:17	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

BRL Indicates concentration, if any, is below reporting limit for analyte. Reporting limit is the lowest concentration that can be reliably quantified under routine laboratory operating conditions. Reporting limits are adjusted for sample size and dilution.

RL Reporting Limit.

DF Dilution Factor.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Project Narrative

Project:	**Wellfleet**	Lab ID:	**144049**
Client:	**Environmental Partners Group, Inc.**	Received:	**08-08-11 16:40**

A. Documentation and Client Communication

The following documentation discrepancies, and client changes or amendments were noted for this project:

1 . No documentation discrepancies, changes, or amendments were noted.

B. Method Modifications, Non-Conformances and Observations

The sample(s) in this project were analyzed by the references analytical method(s), and no method modifications, non-conformances or analytical issues were noted, except as indicated below:

1 . No method modifications, non-conformances or analytical issues were noted.

Environmental Partners GROUP

www.envpartners.com

Quincy Office:
TL 617-657-0200 · FX 617-657-0201

Hyannis Office:
TL 508-568-5103 · FX 508-568-5125

Client Environmental Partners Group			
Project WellFleet			
Comp. By:	Checked By:	Page of	
Date:	Date:		

Sample ID	Date/Time	Sample Type	Analyses Total Nitrate	# Bottles
S-1	8/7/11 11:00	Water Grab	X	2
S-2	8/7/11 11:15	Water Grab	X	2
S-3	8/7/11 11:30	Water Grab	X	2

Standard Turnaround

Report to: Ann Marie Petricca
Bill To: SAME
Environmental Partners Group
1900 Crown Colony Drive Suite 402
Quincy, MA 02169
(508) 223-5717
Report: amp@envpartners.com

Relinquished By	Time / Date
Ann Marie Petricca	8:15 AM 8/8/11
Received By	**Time / Date**
MCM	1400 / 8/8/2011
MCM	1640 / 8/8/2011

4.4c

Quality Assurance/Quality Control

A. Program Overview

Groundwater Analytical conducts an active Quality Assurance program to ensure the production of high quality, valid data. This program closely follows the guidance provided by *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans,* US EPA QAMS-005/80 (1980), and *Test Methods for Evaluating Solid Waste,* US EPA, SW-846, Update III (1996).

Quality Control protocols include written Standard Operating Procedures (SOPs) developed for each analytical method. SOPs are derived from US EPA methodologies and other established references. Standards are prepared from commercially obtained reference materials of certified purity, and documented for traceability.

Quality Assessment protocols for most organic analyses include a minimum of one laboratory control sample, one method blank, one matrix spike sample, and one sample duplicate for each sample preparation batch. All samples, standards, blanks, laboratory control samples, matrix spikes and sample duplicates are spiked with internal standards and surrogate compounds. All instrument sequences begin with an initial calibration verification standard and a blank; and excepting GC/MS sequences, all sequences close with a continuing calibration standard. GC/MS systems are tuned to appropriate ion abundance criteria daily, or for each 12 hour operating period, whichever is more frequent.

Quality Assessment protocols for most inorganic analyses include a minimum of one laboratory control sample, one method blank, one matrix spike sample, and one sample duplicate for each sample preparation batch. Standard curves are derived from one reagent blank and four concentration levels. Curve validity is verified by standard recoveries within plus or minus ten percent of the curve.

B. Definitions

Batches are used as the basic unit for Quality Assessment. A Batch is defined as twenty or fewer samples of the same matrix which are prepared together for the same analysis, using the same lots of reagents and the same techniques or manipulations, all within the same continuum of time, up to but not exceeding 24 hours.

Laboratory Control Samples are used to assess the accuracy of the analytical method. A Laboratory Control Sample consists of reagent water or sodium sulfate spiked with a group of target analytes representative of the method analytes. Accuracy is defined as the degree of agreement of the measured value with the true or expected value. Percent Recoveries for the Laboratory Control Samples are calculated to assess accuracy.

Method Blanks are used to assess the level of contamination present in the analytical system. Method Blanks consist of reagent water or an aliquot of sodium sulfate. Method Blanks are taken through all the appropriate steps of an analytical method. Sample data reported is not corrected for blank contamination.

Surrogate Compounds are used to assess the effectiveness of an analytical method in dealing with each sample matrix. Surrogate Compounds are organic compounds which are similar to the target analytes of interest in chemical behavior, but which are not normally found in environmental samples. Percent Recoveries are calculated for each Surrogate Compound.

GROUNDWATER ANALYTICAL

Quality Control Report
Laboratory Control Sample

Category: **Inorganic Chemistry**
Matrix: **Aqueous**

Analyte	Units	Spiked	Measured	Recovery	QC Limits	Analyzed	QC Batch	Method	Inst	Analyst
Nitrite (as Nitrogen)	mg/L	2.0	1.9	**93 %**	80 - 120 %	08-12-11 10:16	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB
Nitrate (as Nitrogen)	mg/L	4.0	3.8	**95 %**	80 - 120 %	08-09-11 15:01	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations: All calculations performed prior to rounding. Quality Control Limits are defined by the methodology, or alternatively based upon the historical average recovery plus or minus three standard deviation units.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Quality Control Report
Method Blank

Category: **Inorganic Chemistry**
Matrix: **Aqueous**

Analyte	Result	Units	RL	Analyzed	QC Batch	Method	Inst	Analyst
Nitrite (as Nitrogen)	BRL	mg/L	0.02	08-12-11 10:16	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB
Nitrate (as Nitrogen)	BRL	mg/L	0.02	08-09-11 15:01	NI-4959-W	Lachat 10-107-04-1-C (SM 4500-NO3 F)	1	DEB

Method Reference: Methods for Chemical Analysis of Water and Wastes, US EPA, EPA-600/4-790-020 (Revised 1983), and Methods for the Determination of Inorganic Substances in Environmental Samples, US EPA, EPA/600/R-93/100 (1993), and Standard Methods for the Examination of Water and Wastewater, APHA, Twentieth Edition (1998), and Test Methods for Evaluating Solid Waste, US EPA, SW-846, Third Edition, Update III (1996).

Report Notations:

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RL Reporting Limit.

1 Instrument ID: Lachat 8000 Autoanalyzer

GROUNDWATER ANALYTICAL

Certifications and Approvals

Groundwater Analytical maintains environmental laboratory certification in a variety of states.
Copies of our current certificates may be obtained from our website:

http://www.groundwateranalytical.com/qualifications.htm

CONNECTICUT

Department of Health Services, PH-0586 — Potable Water, Wastewater, Solid Waste and Soil
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/Out_State.pdf

MASSACHUSETTS

Department of Environmental Protection, M-MA-103 — Potable Water and Non-Potable Water
http://public.dep.state.ma.us/labcert/labcert.aspx

Department of Labor,
Division of Occupational Safety, AA000195 — Asbestos Analytical Services, Class A
http://www.mass.gov/dos/forms/la-rpt_list_aa.pdf

NEW HAMPSHIRE

Department of Environmental Services, 202708 — Potable Water, Non-Potable Water, Solid and Chemical Materials
http://www4.egov.nh.gov/DES/NHELAP

NEW YORK

Department of Health, 11754 — Potable Water, Non-Potable Water, Solid and Hazardous Waste
http://www.wadsworth.org/labcert/elap/comm.html

RHODE ISLAND

Department of Health,
Division of Laboratories, LAO00054 — Potable and Non-Potable Water Microbiology, Organic and Inorganic Chemistry
http://www.health.ri.gov/labs/outofstatelabs.pdf

U.S. DEPARTMENT OF AGRICULTURE

USDA, Soil Permit, S-53921 — Foreign soil import permit

VERMONT

Department of Health, VT-87643 — Potable Water
http://healthvermont.gov/enviro/ph_lab/water_test.aspx#cert

GROUNDWATER ANALYTICAL

Certifications and Approvals

MASSACHUSETTS	Department of Environmental Protection, M-MA-103

Groundwater Analytical maintains MassDEP environmental laboratory certification for only the methods and analytes listed below. Analyses for certified analytes are conducted in accordance with MassDEP certification standards, except as may be specifically noted in the project narrative.

Potable Water (Drinking Water)

Analyte	Method
1,2-Dibromo-3-Chloropropane	EPA 504.1
1,2-Dibromoethane	EPA 504.1
Alkalinity, Total	SM 2320-B
Antimony	EPA 200.8
Arsenic	EPA 200.8
Barium	EPA 200.7
Barium	EPA 200.8
Beryllium	EPA 200.7
Beryllium	EPA 200.8
Cadmium	EPA 200.7
Cadmium	EPA 200.8
Calcium	EPA 200.7
Chlorine, Residual Free	SM 4500-CL-G
Chromium	EPA 200.7
Copper	EPA 200.7
Copper	EPA 200.8
Cyanide, Total	Lachat 10-204-00-1-A
E. Coli (Treatment and Distribution)	Enz. Sub. SM 9223
E. Coli (Treatment and Distribution)	NA-MUG SM 9222-G
Fecal Coliform (Source Water)	MF SM 9222-D
Fluoride	EPA 300.0
Fluoride	SM 4500-F-C
Haloacetic Acids	EPA 552.2
Heterotrophic Plate Count	SM 9215-B
Lead	EPA 200.8
Mercury	EPA 245.1
Nickel	EPA 200.7
Nickel	EPA 200.8
Nitrate-N	EPA 300.0
Nitrate-N	Lachat 10-107-04-1-C
Nitrite-N	EPA 300.0
Nitrite-N	Lachat 10-107-04-1-C
pH	SM 4500-H-B
Selenium	EPA 200.8
Silver	EPA 200.7
Silver	EPA 200.8
Sodium	EPA 200.7
Sulfate	EPA 300.0
Thallium	EPA 200.8
Total Coliform (Treatment and Distribution)	Enz. Sub. SM 9223
Total Coliform (Treatment and Distribution)	MF SM 9222-B
Total Dissolved Solids	SM 2540-C
Trihalomethanes	EPA 524.2
Turbidity	SM 2130-B
Volatile Organic Compounds	EPA 524.2

Non-Potable Water (Wastewater)

Analyte	Method
Aldrin	EPA 608
Alkalinity, Total	SM 2320-B
Alpha-BHC	EPA 608
Aluminum	EPA 200.7

Non-Potable Water (Wastewater)

Analyte	Method
Aluminum	EPA 200.8
Ammonia-N	Lachat 10-107-06-1-B
Antimony	EPA 200.7
Antimony	EPA 200.8
Arsenic	EPA 200.7
Arsenic	EPA 200.8
Beryllium	EPA 200.7
Beryllium	EPA 200.8
Beta-BHC	EPA 608
Biochemical Oxygen Demand	SM 5210-B
Cadmium	EPA 200.7
Cadmium	EPA 200.8
Calcium	EPA 200.7
Chemical Oxygen Demand	SM 5220-D
Chlordane	EPA 608
Chloride	EPA 300.0
Chlorine, Total Residual	SM 4500-CL-G
Chromium	EPA 200.7
Chromium	EPA 200.8
Cobalt	EPA 200.7
Cobalt	EPA 200.8
Copper	EPA 200.7
Copper	EPA 200.8
Cyanide, Total	Lachat 10-204-00-1-A
DDD	EPA 608
DDE	EPA 608
DDT	EPA 608
Delta-BHC	EPA 608
Dieldrin	EPA 608
Endosulfan I	EPA 608
Endosulfan II	EPA 608
Endosulfan Sulfate	EPA 608
Endrin	EPA 608
Endrin Aldehyde	EPA 608
Gamma-BHC	EPA 608
Hardness (CaCO3), Total	EPA 200.7
Hardness (CaCO3), Total	SM 2340-B
Heptachlor	EPA 608
Heptachlor Epoxide	EPA 608
Iron	EPA 200.7
Kjeldahl-N	Lachat 10-107-06-02-D
Lead	EPA 200.7
Magnesium	EPA 200.7
Manganese	EPA 200.7
Manganese	EPA 200.8
Mercury	EPA 245.1
Molybdenum	EPA 200.7
Molybdenum	EPA 200.8
Nickel	EPA 200.7
Nickel	EPA 200.8
Nitrate-N	EPA 300.0
Nitrate-N	Lachat 10-107-04-1-C
Non-Filterable Residue	SM 2540-D
Oil and Grease	EPA 1664

GROUNDWATER ANALYTICAL

Certifications and Approvals

MASSACHUSETTS	**Department of Environmental Protection, M-MA-103**

Groundwater Analytical maintains MassDEP environmental laboratory certification for only the methods and analytes listed below. Analyses for certified analytes are conducted in accordance with MassDEP certification standards, except as may be specifically noted in the project narrative.

Non-Potable Water (Wastewater)

Analyte	**Method**
Orthophosphate	Lachat 10-115-01-1-A
pH	SM 4500-H-B
Phenolics, Total	EPA 420.4
Phenolics, Total	Lachat 10-210-00-1-B
Phosphorus, Total	Lachat 10-115-01-1-C
Phosphorus, Total	SM 4500-P-B,E
Polychlorinated Biphenyls (Oil)	EPA 600/4-81-045
Polychlorinated Biphenyls (Water)	EPA 608
Potassium	EPA 200.7
Selenium	EPA 200.7
Selenium	EPA 200.8
Silver	EPA 200.7
Sodium	EPA 200.7
Specific Conductivity	SM 2510-B
Strontium	EPA 200.7
Sulfate	EPA 300.0
SVOC-Acid Extractables	EPA 625
SVOC-Base/Neutral Extractables	EPA 625
Thallium	EPA 200.7
Thallium	EPA 200.8
Titanium	EPA 200.7
Total Dissolved Solids	SM 2540-C
Total Organic Carbon	SM 5310-B
Toxaphene	EPA 608
Vanadium	EPA 200.7
Vanadium	EPA 200.8
Volatile Aromatics	EPA 602
Volatile Aromatics	EPA 624
Volatile Halocarbons	EPA 624
Zinc	EPA 200.7
Zinc	EPA 200.8

CERTIFICATE OF ANALYSIS

Barnstable County Health Laboratory (M-MA009)

Report Prepared For: **Report Dated:** 7/21/2011

AnnMarie Petricca
Environmental Partners Group
1900 Crown Colony Drive Suite 402
Quincy, MA 02169

Order No.: G1163671

Laboratory ID #: 1163671-01 **Description:** Water - Surface Water

Sample #: **Sample Location:** Wellfleet harbor **Collected** 7/17/2011

Collected by: Customer W-1 **Received** 7/18/2011

Test Parameters

ITEM	RESULT	UNITS	RL	MCL	METHOD #	TESTED
Nitrate as Nitrogen	**1.3**	mg/L	0.50		EPA 300.0	7/20/2011

Laboratory ID #: 1163671-02 **Description:** Water - Surface Water

Sample #: **Sample Location:** Wellfleet harbor **Collected** 7/17/2011

Collected by: Customer W-2 **Received** 7/18/2011

Test Parameters

ITEM	RESULT	UNITS	RL	MCL	METHOD #	TESTED
Nitrate as Nitrogen	**1.6**	mg/L	0.50		EPA 300.0	7/20/2011

Attached please find the laboratory certified parameter list.

Approved By [signature] (Lab Director)

7/28/2011

ND = None Detected RL = Reporting Limit MCL = Maximum Contaminant Level

Table 1. Nitrate Water Quality Monitoring
Oyster Spawning Project
Wellfleet Harbor

Date	Nitrogen, Nitrate								Nitrogen, Nitrate/Nitrite							
Sampled	OF (W-2)	1A	1B	1C (W-1)	YSI (W-3)	W-150 YSI Duplicate	OW-1S	OW-1D	OF (W-2)	1A	1B	1C (W-1)	YSI (W-3)	W-150 YSI Duplicate	OW-1S	OW-1D
7/17/2011 (a)	1.6	-	-	1.3	NS	-	-	-	-	-	-	-	-	-	-	-
8/7/2011 (b)	0.07	-	-	0.07	0.09	-	-	-	-	-	-	-	-	-	-	-
8/24/2011 (b)	0.05	-	-	0.11	0.05	-	-	-	-	-	-	-	-	-	-	-
10/2-3/2011 (c)	0.18	ND	ND	ND	ND	-	0.27	0.18	0.18	ND	ND	ND	ND	-	0.27	0.18
11/5/2011 (c)	0.38	-	-	ND	0.11	0.12	0.26	0.31	0.38	-	-	ND	0.11	0.12	0.26	0.31

Date	Total Nitrogen (TKN, Nitrate and Nitrite)								Nitrogen, Total Kjeldahl							
Sampled	OF (W-2)	1A	1B	1C (W-1)	YSI (W-3)	W-150 YSI Duplicate	OW-1S	OW-1D	OF (W-2)	1A	1B	1C (W-1)	YSI (W-3)	W-150 YSI Duplicate	OW-1S	OW-1D
7/17/2011 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8/7/2011 (b)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8/24/2011 (b)	1.4		-	1.6	3.3	-	-	-	-	-	-	-	-	-	-	-
10/2-3/2011 (c)	1.7	1.3	1.0	0.61	0.61	-	0.69	0.61	1.5	1.3	1.0	0.61	0.61	-	0.42	0.43
11/5/2011 (c)	0.99	-	-	0.45	ND	0.42	1.7	0.31	0.61	-	-	0.45	ND	0.3	1.7	ND

Notes:
(a) Analyses by Barnstable County Health Laboratory, Barnstable, MA
(b) Analyses by Groundwater Analytical, Buzzards Bay, MA
(c) Analyses by Alpha Analytical Laboratory, Westborough, MA

NS = Not Sampled
ND = Not detected above Method Detection Limits
- = Not Analyzed

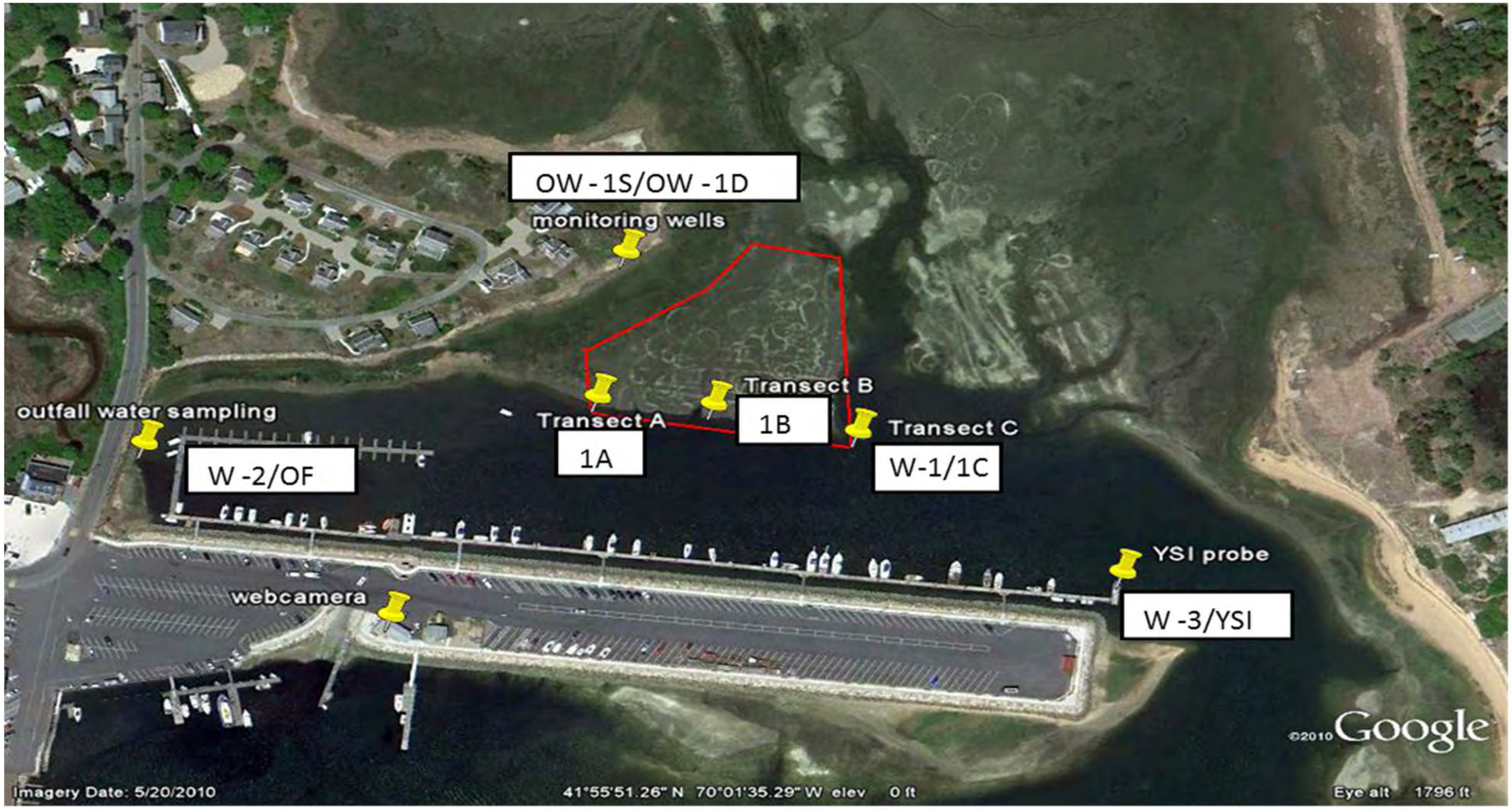


Figure 1. Surface Water Sampling Locations - Wellfleet Oyster Spawning Project, Wellfleet Harbor

ANALYTICAL REPORT

Lab Number:	L1118393
Client:	Environmental Partners 1900 Crown Colony Drive Suite 402 4th Floor Quincy, MA 02169
ATTN:	Marie Petricca
Phone:	(617) 657-0200
Project Name:	OYSTER BED MONITORING
Project Number:	Not Specified
Report Date:	11/21/11

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), USDA (Permit #P-330-11-00240), NC (666), TX (T104704476), DOD (L2217), US Army Corps of Engineers.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: OYSTER BED MONITORING
Project Number: Not Specified

Lab Number: L1118393
Report Date: 11/21/11

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1118393-01	YSI	WELLFLEET HARBOR	11/05/11 14:35
L1118393-02	OW-1S	WELLFLEET HARBOR	11/05/11 15:15
L1118393-03	OW-1D	WELLFLEET HARBOR	11/05/11 15:30
L1118393-04	OUTFALL	WELLFLEET HARBOR	11/05/11 14:40
L1118393-05	W-1	WELLFLEET HARBOR	11/05/11 14:30
L1118393-06	W-150	WELLFLEET HARBOR	11/05/11 15:35

Project Name: OYSTER BED MONITORING **Lab Number:** L1118393
Project Number: Not Specified **Report Date:** 11/21/11

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

Sample Receipt

The samples were received without containers for Total Nitrogen. Aliquots were taken from unpreserved containers and preserved with H_2SO_4.

Nitrogen, Nitrate

With the client's authorization, the samples were analyzed with the method required holding time exceeded.

Nitrogen, Total Kjeldahl

L1118393-01 has an elevated detection limit due to limited sample volume available for analysis.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Cynthia McQueen

Title: Technical Director/Representative Date: 11/21/11

INORGANICS
&
MISCELLANEOUS

Project Name: OYSTER BED MONITORING
Lab Number: L1118393
Project Number: Not Specified
Report Date: 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-01
Client ID: YSI
Sample Location: WELLFLEET HARBOR
Matrix: Water

Date Collected: 11/05/11 14:35
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.11		mg/l	0.10	--	1	-	11/08/11 22:11	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.11		mg/l	0.10	--	1	-	11/08/11 22:11	30,4500NO3-F	TH
Total Nitrogen	ND		mg/l	0.60	--	2	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	ND		mg/l	0.60	--	2	11/08/11 14:30	11/09/11 00:32	30,4500N-C	AT

Project Name: OYSTER BED MONITORING
Project Number: Not Specified

Lab Number: L1118393
Report Date: 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-02
Client ID: OW-1S
Sample Location: WELLFLEET HARBOR
Matrix: Water

Date Collected: 11/05/11 15:15
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.26		mg/l	0.10	--	1	-	11/08/11 22:12	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.26		mg/l	0.10	--	1	-	11/08/11 22:12	30,4500NO3-F	TH
Total Nitrogen	1.7		mg/l	0.30	--	1	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	1.4		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:35	30,4500N-C	AT

Project Name: OYSTER BED MONITORING
Project Number: Not Specified

Lab Number: L1118393
Report Date: 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-03
Client ID: OW-1D
Sample Location: WELLFLEET HARBOR
Matrix: Water

Date Collected: 11/05/11 15:30
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.31		mg/l	0.10	--	1	-	11/08/11 22:13	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.31		mg/l	0.10	--	1	-	11/08/11 22:13	30,4500NO3-F	TH
Total Nitrogen	0.31		mg/l	0.30	--	1	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	ND		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:36	30,4500N-C	AT

Project Name: OYSTER BED MONITORING
Lab Number: L1118393
Project Number: Not Specified
Report Date: 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-04
Client ID: OUTFALL
Sample Location: WELLFLEET HARBOR
Matrix: Water
Date Collected: 11/05/11 14:40
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.38		mg/l	0.10	--	1	-	11/08/11 22:13	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.38		mg/l	0.10	--	1	-	11/08/11 22:13	30,4500NO3-F	TH
Total Nitrogen	0.99		mg/l	0.30	--	1	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	0.61		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:37	30,4500N-C	AT

Project Name: OYSTER BED MONITORING
Lab Number: L1118393
Project Number: Not Specified
Report Date: 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-05
Client ID: W-1
Sample Location: WELLFLEET HARBOR
Matrix: Water
Date Collected: 11/05/11 14:30
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	11/08/11 22:16	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	11/08/11 22:16	30,4500NO3-F	TH
Total Nitrogen	0.45		mg/l	0.30	--	1	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	0.45		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:37	30,4500N-C	AT

Project Name: OYSTER BED MONITORING | **Lab Number:** L1118393
Project Number: Not Specified | **Report Date:** 11/21/11

SAMPLE RESULTS

Lab ID: L1118393-06
Client ID: W-150
Sample Location: WELLFLEET HARBOR
Matrix: Water

Date Collected: 11/05/11 15:35
Date Received: 11/07/11
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate	0.12		mg/l	0.10	--	1	-	11/08/11 22:17	30,4500NO3-F	TH
Nitrogen, Nitrate/Nitrite	0.12		mg/l	0.10	--	1	-	11/08/11 22:17	30,4500NO3-F	TH
Total Nitrogen	0.42		mg/l	0.30	--	1	-	11/16/11 19:50	41,-	AT
Nitrogen, Total Kjeldahl	0.30		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:38	30,4500N-C	AT

Project Name: OYSTER BED MONITORING **Lab Number:** L1118393
Project Number: Not Specified **Report Date:** 11/21/11

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-06 Batch: WG500899-1										
Nitrogen, Total Kjeldahl	ND		mg/l	0.30	--	1	11/08/11 14:30	11/09/11 00:20	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 01-06 Batch: WG500991-2										
Nitrogen, Nitrate	ND		mg/l	0.10	--	1	-	11/08/11 21:44	30,4500NO3-F	TH
General Chemistry - Westborough Lab for sample(s): 01-06 Batch: WG500992-2										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	11/08/11 21:44	30,4500NO3-F	TH

Lab Control Sample Analysis
Batch Quality Control

Project Name: OYSTER BED MONITORING
Lab Number: L1118393
Project Number: Not Specified
Report Date: 11/21/11

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-06 Batch: WG500899-2								
Nitrogen, Total Kjeldahl	100		-		85-110	-		
General Chemistry - Westborough Lab Associated sample(s): 01-06 Batch: WG500991-1								
Nitrogen, Nitrate	102		-		90-110	-		
General Chemistry - Westborough Lab Associated sample(s): 01-06 Batch: WG500992-1								
Nitrogen, Nitrate/Nitrite	102		-		90-110	-		20

Matrix Spike Analysis
Batch Quality Control

Project Name: OYSTER BED MONITORING
Project Number: Not Specified
Lab Number: L1118393
Report Date: 11/21/11

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500899-4 QC Sample: L1118393-01 Client ID: YSI												
Nitrogen, Total Kjeldahl	ND	16	17	104		-	-		77-111	-		24
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500991-3 QC Sample: L1118393-01 Client ID: YSI												
Nitrogen, Nitrate	0.11	4	4.2	102		-	-		83-113	-		17
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500992-3 QC Sample: L1118393-01 Client ID: YSI												
Nitrogen, Nitrate/Nitrite	0.11	4	4.2	102		-	-		80-120	-		20

Lab Duplicate Analysis
Batch Quality Control

Project Name: OYSTER BED MONITORING
Project Number: Not Specified

Lab Number: L1118393
Report Date: 11/21/11

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500899-3 QC Sample: L1118393-01 Client ID: YSI						
Nitrogen, Total Kjeldahl	ND	0.69	mg/l	NC		24
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500991-4 QC Sample: L1118393-01 Client ID: YSI						
Nitrogen, Nitrate	0.11	0.12	mg/l	9		17
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG500992-4 QC Sample: L1118393-01 Client ID: YSI						
Nitrogen, Nitrate/Nitrite	0.11	0.12	mg/l	9		20

Project Name: OYSTER BED MONITORING **Lab Number:** L1118393
Project Number: Not Specified **Report Date:** 11/21/11

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1118393-01A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-01B	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-01C	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-01D	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-01E	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-01F	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-02A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-02B	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-03A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-03B	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-04A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-04B	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-05A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-05B	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1118393-06A	Plastic 250ml unpreserved	A	7	2.0	Y	Absent	NO3-4500(2)
L1118393-06B	Plastic 250ml H2SO4 preserved sp	A	<2	2.0	Y	Absent	TKN-4500(28),NO3/NO2-4500(28),TNITROGEN(28)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The RPD between the results for the two columns exceeds the method-specified criteria; however, the lower value has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

Report Format: Data Usability Report

Project Name: OYSTER BED MONITORING **Lab Number:** L1118393

Project Number: Not Specified **Report Date:** 11/21/11

Data Qualifiers

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

Report Format: Data Usability Report

REFERENCES

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

41 Alpha Analytical Labs Internally-developed Performance-based Method.

LIMITATION OF LIABILITIES

Certificate/Approval Program Summary

Last revised November 17, 2011 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB), 1,4-Dioxane (Mod 8270). Microbiology Parameters: Total Coliform-MF mEndo (SM9222B), Total Coliform – Colilert (SM9223 P/A), E. Coli. – Colilert (SM9223 P/A), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D))

Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, TPH (HEM/SGT), Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH. Microbiology Parameters: Total Coliform – MF mEndo (SM9222B), Total Coliform – MTF (SM9221B), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform – A-1 Broth (SM9221E).)

Solid Waste/Soil (Inorganic Parameters: pH, Sulfide, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), SPLP Leach (1312 metals only), Reactivity. Organic Parameters: PCBs, PCBs in Oil, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9222D, 9223B, EPA 180.1, 353.2, SM2130B, 2320B, 2540C, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B, 4500NO3-F, EPA 200.7, EPA 200.8, 245.1, EPA 300.0. Organic Parameters: 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, SM2320B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B, 4500P-E, 5210B, 5220D, 5310C, 9010B, 9040B, 9030B, 7470A, 7196A, 2340B, EPA 200.7, 6010, 200.8, 6020, 245.1, 1311, 1312, 3005A, Enterolert, 9223D, 9222D. Organic Parameters: 608, 8081, 8082, 8330, 8151A, 624, 8260, 3510C, 3630C, 5030B, ME-DRO, ME-GRO, MA-EPH, MA-VPH.)

Solid Waste/Soil (Inorganic Parameters: 9010B, 9012A, 9014A, 9040B, 9045C, 6010B, 7471A, 7196A, 9050A, 1010, 1030, 9065, 1311, 1312, 3005A, 3050B. Organic Parameters: ME-DRO, ME-GRO, MA-EPH, MA-VPH, 8260B, 8270C, 8330, 8151A, 8081A, 8082, 3540C, 3546, 3580A, 3630C, 5030B, 5035.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water (Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl) (EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate); (EPA 353.2 for: Nitrate-N, Nitrite-N); (SM4500NO3-F for: Nitrate-N and Nitrite-N); 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B. Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics); (504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), EPA 332. Microbiology Parameters: SM9215B; ENZ. SUB. SM9223; ColilertQT SM9223B; MF-SM9222D.)

Non-Potable Water (Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn); (EPA 200.7 for: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn); 245.1, SM4500H,B, EPA 120.1,

SM2510B, 2540C, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics),(608 for: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT,Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs-Water), (EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables), 600/4-81-045-PCB-Oil. Microbiology Parameters: (ColilertQT SM9223B;Enterolert-QT: SM9222D-MF.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM 9222B, 9223B, 9215B, EPA 200.7, 200.8, 245.2, 300.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 332.0. Organic Parameters: 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 3005A, 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 350.2, 351.1, 353.2, 410.4, 420.1, 1664A, SW-846 9010, 9030, 9040B, SM426C, SM2120B, 2310B, 2320B, 2540B, 2540D, 4500H+B, 4500CL-E, 4500CN-E, 4500NH3-H, 4500NO3-F, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 5220D, 2510B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3510C, 3630C, 5030B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A, 8151A.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040B, 9045C, 9050C, 9065,1311, 1312, 3005A, 3050B. Organic Parameters: SW-846 3540C, 3546, 3550B, 3580A, 3630C, 5030B, 5035, 8260B, 8270C, 8330, 8151A, 8015B, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500CN-CE, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 200.8, 245.2, 2540C, SM2120B, 2320B, 2510B, 5310C, SM4500H-B. Organic Parameters: EPA 332, 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-E, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM510ABC, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, 9222D, 9221B, 9221C, 9221E, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.1, 350.2, SW-846 1312, 6020, 6020A, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, 4500CN-CE, EPA 245.1, 245.2, SW-846 9040B, 3005A, 3015, EPA 6010B, 6010C, 7196A, 3060A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3510C, EPA 608, 624, 625, SW-846 3630C, 5030B, 8081A, 8081B, 8082, 8082A, 8151A, 8330, NJ OQA-QAM-025 Rev.7, NJ EPH.)

Solid & Chemical Materials (Inorganic Parameters: SW-846, 6010B, 6010C, 7196A, 3060A, 9010B, 9030B, 1010, 1030, 1311, 1312, 3005A, 3050B, 7471A, 7471B, 9014, 9012A, 9040B, 9045C, 9050A, 9065. Organic Parameters: SW-846 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3540C, 3545, 3546, 3550B, 3580A, 3630C, 5030B, 5035L, 5035H, NJ OQA-QAM-025 Rev.7, NJ EPH.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500H-B, 4500NO3-F, 2540C, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, 5310C, EPA 410.4, SM5220D, 2310B-4a, 2320B, EPA 200.7, 300.0, SM4500CL-E, 4500F-C, SM15 426C, EPA 350.1, SM4500NH3-BH, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-04-1-C, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, SM3500Cr-D, EPA 245.1, 245.2, 7470A, SM2120B, LACHAT 10-204-00-1-A, EPA 9040B, SM4500-HB, EPA 1664A, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 3005A, 9010B, 9030B.. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, EPA 3510C, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: 1010, 1030, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 1312, 3005A, 3050B, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8015B, 8081A, 8151A, 8330, 8082, 3540C, 3545, 3546, 3580, 5030B, 5035.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. Organic Parameters: MA-EPH, MA-VPH.

Drinking Water Program Certificate/Lab ID: 25700. (Inorganic Parameters: Chloride EPA 300.0. Organic Parameters: 524.2)

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Drinking Water (Organic Parameters: EPA 524.2, 504.1)

Non-Potable Water (Inorganic Parameters: EPA 1312, 200.7, 410.4, 1664A, SM2540D, 5210B, 5220D, 4500-P,BE. Organic Parameters: EPA 3510C, 3005A, 3630C, 5030B, 625, 624, 608, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Solid & Hazardous Waste (Inorganic Parameters: EPA 350.1, 1010, 1030, 1311, 1312, 3050B, 6010B, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065, SM 4500NH3-H. Organic Parameters: 3540C, 3545, 3546, 3550B**,** 3580A, 3630C, 5035, 8015B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NJ-DEP Certificate for Potable and Non-Potable Water.

Texas Commisson on Environmental Quality Certificate/Lab ID: T104704476-09-1. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664, 200.7, 200.8, 245.1, 245.2, 300.0, 350.1, 351.1, 353.2, 410.4, 420.1, 6010, 6020, 7196, 7470, 9040, SM 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500CL-E, 4500CN-E, 4500F-C, 4500H+B, 4500NH3-H, 4500NO2B, 4500P-E, 4500 S2¯D, 510C, 5210B, 5220D, 5310C, 5540C. Organic Parameters: EPA 608, 624, 625, 8081, 8082, 8151, 8260, 8270, 8330.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312, 9012, 9014, 9040, 9045, 9050, 9065.)

Department of Defense Certificate/Lab ID: L2217.
Drinking Water (Inorganic Parameters: SM 4500H-B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: EPA 200.7, 200.8, 6010B, 6020, 245.1, 245.2, 7470A, 9040B, 300.0, 332.0, 6860, 353.2, 410.4, 9060, 1664A, SM 4500CN-E, 4500H-B, 4500NO3-F, 5220D, 5310C, 2320B, 2540C, 3005A, 3015, 9010B, 9056. Organic Parameters: EPA 8260B, 8270C, 8330A, 625, 8082, 8081A, 3510C, 5030B, MassDEP EPH, MassDEP VPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 200.7, 6010B, 7471A, 9010, 9012A, 6860, 1311, 1312, 3050B, 7196A, 9010B, 3500-CR-D, 4500CN-CE, 2540G, Organic Parameters: EPA 8260B, 8270C, 8330A/B-prep, 8082, 8081A, 3540C, 3546, 3580A, 5035A, MassDEP EPH, MassDEP VPH.)

The following analytes are not included in our current NELAP/TNI Scope of Accreditation:
EPA 8260B: Freon-113, 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes, 1,4-Diphenylhydrazine (Azobenzene). **EPA 625:** 4-Chloroaniline, 4-Methylphenol. Total Phosphorus in a soil matrix, Chloride in a soil matrix, TKN in a soil matrix, NO2 in a soil matrix, NO3 in a soil matrix, SO4 in a soil matrix.

Serial_No:11211113:02

CHAIN OF CUSTODY

PAGE 1 OF 1

ALPHA ANALYTICAL

Westborough, MA
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA
TEL: 508-822-9300
FAX: 508-822-3288

Date Rec'd in Lab: 11/7/11

ALPHA Job #: L1118393

Client Information

Client: Environmental Partners Group
Address: 1900 Crown Colony Drive
Suite 402
Phone: 508-223-5717
Fax: 617-657-0201
Email: amp@envpartners.com

☐ These samples have been Previously analyzed by Alpha

Project Information

Project Name: Oyster Bed Monitorin
Project Location: Wellfleet Harbor
Project #:
Project Manager: Ann Marie Petricca
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ Rush (ONLY IF PRE-APPROVED)

Due Date: 11/14/11 Time:

Report Information Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State/Fed Program | Criteria

Other Project Specific Requirements/Comments/Detection Limits:
Please analyze samples even if outside hold times.

SAMPLE HANDLING
Filtration
☐ Done
☐ Not Needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ANALYSIS

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials		Total Nitrogen	Nitrate Nitrogen	Sample Specific Comments
8393. 1	YSI	11/5/11	1435	w		☐	☒	☒	
1 2	YSI MS/MSD	11/5/11	1435	w		☐	☒	☒	
2 3	OW-1S	11/5/11	1515	W		☐	☒	☒	
3 4	OW-1D	11/5/11	1530	W		☐	☒	☒	
4 5	OUTFALL	11/5/11	1440	W		☐	☒	☒	
5 6	W-1	11/5/11	1430	W		☐	☒	☒	
6 7	W-150	11/5/11	1535	W		☐	☒	☐	
Container Type						-	P	P	
Preservative						-	-	-	

Relinquished By:	Date/Time	Received By:	Date/Time
Ann Marie Petricca	11/7/11 9:50	[illegible]	11/7/11 1042
[illegible]	11/7/11 1210	[illegible]	11/7/11 1210

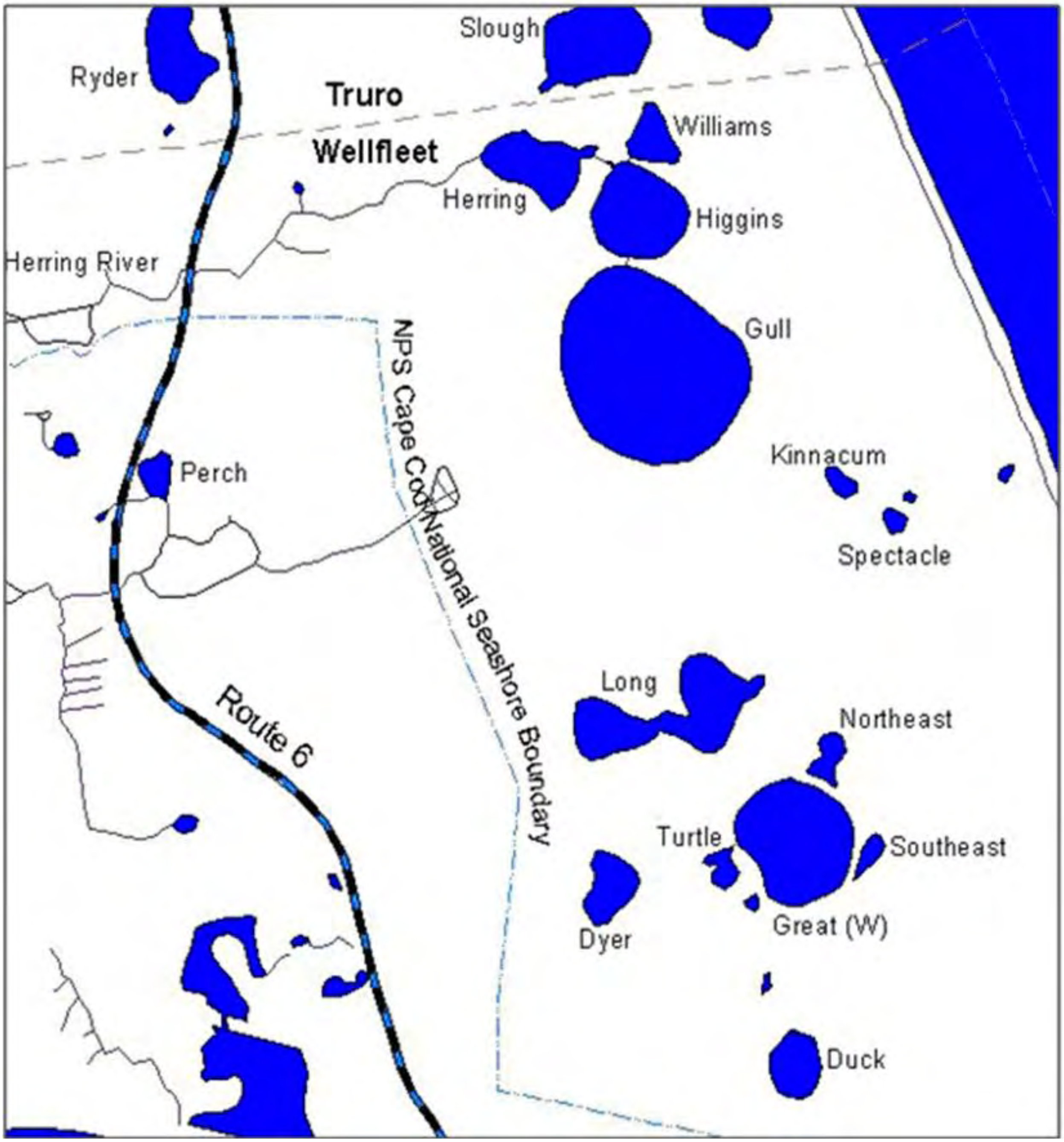
Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms.

FORM NO: 01-01(I-NJ)
(rev. 29-APR-09)

APPENDIX C

A PONDS MANAGEMENT PLAN

Wellfleet, Massachusetts



PONDS MANAGEMENT PLAN

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Natural Resources Advisory Board
February 2011

OVERVIEW

The focus of this Ponds Management Plan will be the kettle ponds of Wellfleet, especially the great ponds, and their key management issues, namely, water quality and shoreline management. The emphasis will be on the role of the Town of Wellfleet in ponds management. The first chapter is an overview of the ponds' human intervention, ownership, access and management. Chapter Two addresses water quality concerns, Chapter Three addresses shoreline use issues, and Chapter Four discusses issues for the ponds of major public use in Wellfleet: Gull, Great, Long, Duck and Dyer. All four chapters will refer occasionally to larger themes that are common to all resource concerns in our fragile, water bound environment. They include developing long-term perspectives on a shared resource, respect for what we don't know about the resource, awareness of multiple, traditional and historical uses, and the issues associated with public access. A key issue, developed more fully in Chapter Three is the idea that we may be "loving the ponds to death" with increasing human use.

Wellfleet is blessed with approximately 20 freshwater ponds (Table 1 and front cover). They are places of great beauty and tranquility, mostly surrounded by a national park. The waters are clear and sparkling. They are special places enjoyed by residents and visitors alike for swimming, boating, walking, family outings, skating and fishing. They are important to Wellfleet's tourist business as key attractions for summer visitors.

The popularity of the ponds can create conditions of overuse which threatens the very features which make the ponds popular in the first place. There needs to be a balance between use and preservation. There is no simple set of guidelines or regulations that will ensure this balance. We will need to keep in mind that it is much easier to cause damage to the resource - a damage that may appear only slowly over time - than it is to remediate that damage. The ongoing challenge of pond management in Wellfleet is maintaining a balance between their use by the public and their preservation as a multifaceted resource.

SUMMARY of **RECOMMENDATIONS**

The recommendations of this Ponds Management Plan are summarized in two groups:

- Change or Do
  - These are recommendations in the usual sense, for action
- Keep & Improve
  - We identify actions underway or regulations already in effect, urging that they continue and be supported by the Town

CHANGE ACTIONS

- Shorelines
  - Monitor for erosion
  - Undertake shoreline repairs at Gull (main beach & sluiceway) and Duck Ponds
  - Maintain naturally vegetated borders, banks and forested slopes around all ponds, in co-operation with private land owners and CCNS. Manicured lawns can be particularly harmful and should be discouraged
  - Educate all pond visitors and users on need to respect shoreline erosion risks
  - Enforce parking, Chapter 91 and other regulations
- Paths and Parking
  - Repair parking at Gull Pond and define parking areas
  - Repair path to Duck Pond
  - Manage the parking related overuse stress at the Sluiceway
- Water quality
  - Support CCNS water quality review: be prepared to act if remediation needs are demonstrated
  - Remind abutters of simple steps to help preserve water quality (see Ch 2, p7)

KEEP and IMPROVE ACTIONS

- Maintain user friendly toilets at all Town landings
- Prohibit dogs and other domestic animals from ponds and pond beaches during the summer season; enforce this rule
- Gull Pond: limit kayak/canoe racks and rentals; prohibit in water boat moorings
- Annual Ponds Review by the Beach Administrator, with participation by CCNS, the Conservation Commission, and NRAB
- Education programs to emphasize the care needed to preserve Wellfleet's wonderful ponds

CHAPTER ONE: HISTORICAL & MANAGEMENT OVERVIEW

Pond Geology and Setting

All the ponds in **Table 1** are “kettle ponds” (ref. 1,”the Ponds Atlas”). The depressions that are currently the kettle ponds were formed after the ice age by blocks of remnant ice. Some of the great ponds – Duck, Dyer, Great, Long and Williams – are “perched” ponds. These have semi-permeable bottoms of silt and clay and started to fill with water 11,000 years ago, perhaps within a few thousand years of glacial retreat. The other great ponds – Gull, Higgins and Williams – started to fill only about 5,000 years ago, when sea level rise pushed the ground water from the Chequessett lens high enough to intercept their bottoms. Currently, most of the water filling the ponds arrives as groundwater from the Chequessett lens

Table 1. Wellfleet Ponds

NAME	GREAT POND	PUBLIC ACCESS	AREA (Ac)	DEPTH (m)
*** Gull**	Y	Y	108.7	19
Great	Y	Y	44	16
Long	Y	Y	37.1	15
*** Higgins**	Y	Y	27.9	6
*** Herring**	Y	Y/boat	20	4
Duck	Y	Y	12.6	18
Dyer	Y	Y	11.9	10
*** Williams**		Y/boat	8.9	2
Perch			6	2
Northeast			4.2	4
Turtle		Y	4	2
Southeast			2.7	4
Kinnacum			2	2
Squires		Y	2	6
Spectacle 1		Y	1.2	7
Crowell's		Y	1	3
Grassy			0.6	
*** Black**			0.3	
Doane's Bog			0.3	
Spectacle 2		Y	0.3	

Note: * Located in Wellfleet Harbor Area of Critical Environmental Concern (ACEC) that underlies Wellfleet. None of the ponds is stream-fed; only Herring Pond has a stream exit – the Herring River. The seven great ponds in Wellfleet lie above the high ridge of the lens. The highest surface of these ponds is Duck Pond, at about 8-9 feet above sea level, varying somewhat from dry to wet years.

The kettle ponds of Wellfleet do not have identical geological histories as is thoroughly discussed in the Ponds Atlas. Over the centuries they have all evolved but significant differences continue to exist. Change in the ponds has not stopped. In recent memory and even in the last decade, the ponds as a group, as well as individually, have shown they are far from static. Water level differences are perhaps the most obvious to lay observers, but there are other variations, too. Although this document makes no effort to provide a detailed history of the ponds, it is our intent to highlight the fact that there are both natural and human causes for short and long-term changes in the ponds. The geology of the ponds, so-called natural changes and human use/intervention in the environment of the ponds, as well as their water quality, are closely intertwined. Thus, developing a management plan is a complex task.

Human Intervention

The earliest indication of human intervention affecting the ponds' natural evolution was a change in sedimentary remains in the Gull Pond chain (Herring, Higgins, Williams and Gull Ponds), suggesting that Native Americans altered the Gull Pond complex by creating or improving sluiceways between the ponds. This was probably done to improve the herring run, perhaps as much as 1000 years ago.

Among the more significant human activities around the ponds that appear to have had a serious impact was the almost total deforestation of the outer Cape in the late 17th and early 18th centuries. Increased runoff from the denuded land apparently changed pond chemistry significantly for a period of time. It is known, for example, that phosphorous, a key pond nutrient causing increased plant growth is released from eroded soils when they wash into ponds. With reforestation beginning in the late 19th and early 20th century, these changes were largely reversed.

Shoreline erosion continues to threaten several of the ponds heavily used by property owners, summer renters and visitors from nearby towns: Gull, Higgins, Dyer, and Duck, Great and Long Ponds. Especially in the last 25 years human intervention has been due to increased use of the ponds area. Residential properties are intensively used, either by owners or renters. The few public landings are crowded throughout the summer. As a result, shoreline devegetation is again an issue. Also, there is a concern that nutrients – phosphorous and nitrogen – leaching into ponds via groundwater may lead to water quality degradation. The water in many of Wellfleet's ponds is remarkably clear and crystalline, so that even a small loss of quality is noticeable.

Pond Ownership, Access and Management

Seven of Wellfleet's ponds are "great" ponds: Gull, Higgins, Herring, Great, Long, Duck and Dyer. Great ponds are defined as those whose surface area is 10 acres or greater. This is significant because in Massachusetts law, all great ponds and the land beneath them are the property of the Commonwealth. Common ownership of great ponds is a long-standing legal principle in Massachusetts, tracing back to colonial common law. Ponds and their submerged lands under 10 acres, are owned by shoreline property owners.

All of Wellfleet's great ponds lie within the boundaries of the Cape Cod National Seashore (CCNS). However, legal ownership of great ponds remains with the Commonwealth. As a practical matter, though, the state has had little direct involvement in the management of Wellfleet's ponds in recent years. Local responsibility – through the Town of Wellfleet and the CCNS – remains paramount.

Various sections of shoreline on Wellfleet's great ponds are owned by the CCNS, by the Town of Wellfleet or privately. The mix of ownership varies greatly from pond-to-pond. As a consequence, the management of shoreline activity on the great ponds is a shared responsibility among the Commonwealth, the CCNS, the Town of Wellfleet, and private shoreline owners. Town agencies involved in pond management include the Health and Conservation Departments, the Conservation Commission and the Beach Department. The Board of Selectmen represents the Town of Wellfleet and its taxpayers in this responsibility.

The management structure of the ponds is thus complicated. Cooperation amongst the many stakeholders – government entities, the CCNS, private landowners, abutters and visitors – is essential. It is particularly important to recognize the relationship between the Town and the CCNS, as the two largest entities. For example, a walker of dogs can start at the Town dog walk area at the old Boy Scout camp, access trails that cross CCNS property, come to a public pathway on CCNS land that leads down to the Town landing on Duck Pond. There are many common management issues in this scenario: land management, consistency of animal and other regulations, enforcement, opportunities for education, etc. Many examples of good cooperation on these issues can be cited and some of them are described in Chapters Two and Three. Continued emphasis on this cooperation will be even more important in the future.

Public access is granted to all great ponds by Massachusetts law. The Town of Wellfleet owns landings on Gull, Higgins, Great, Long and Duck Ponds; the CCNS owns a landing on Dyer Pond. The Town landings are managed by the Beach Administrator. Beach Administrators have been and continue to be proactive in maintaining a balance between resource protection and human use.

Massachusetts law requires a Chapter 91 Waterways license for any structure – such as piers or floats – placed in great ponds. Locally, the Conservation Commission oversees Chapter 91 issues. Gull, Higgins, Williams, Herring and Black Ponds, sometimes called the "gull ponds", are interconnected as part of the Herring River system. They are all located within the Wellfleet Harbor Area of Critical Environmental Concern (ACEC). These ponds and their immediate shorelines thus have two layers of protection administered by the Town Conservation Commission. In addition to state wetlands regulations, the land within the ACEC must meet specific performance standards as established by the Wellfleet Environmental by-law and its regulations.

As stated previously, the CCNS, as the major owner of the uplands surrounding the ponds, has a critical role in local ponds management. The CCNS General Management Plan has specific goals for the kettle ponds within its boundaries:

> "Activities at kettle ponds – The National Park Service will encourage the consistent management of human activities at kettle ponds under municipal, state or federal jurisdiction in order to protect the ponds from degradation due to development, overuse, or inappropriate use."

In addition to the great ponds, smaller ponds and their shorelines within and owned by the CCNS are also open to the public unless restricted for resource or public protection purposes. The CCNS has worked closely with abutters (e.g. – Dyer and Duck Ponds) and the Town itself (e.g. – the Sluiceway) to protect the resource which lies within its borders.

Usually, but not always, the many stakeholders work together to protect and sustain the ponds. It should be noted that private owners and residents have sometimes been pro-active in mounting efforts to protect the ponds. Several neighborhood conservation and advocacy groups have developed, notably the Gull Pond Area Conservation Association (GUPACA). This organization in particular has worked consistently to encourage "best practices" for shoreline home owners and other pond users to maintain water quality and to carefully conserve the ponds as valuable resources. GUPACA currently has an excellent web-site of ponds information, which is linked to the Town of Wellfleet web-site and is listed among other references at the end of this document.

CHAPTER TWO: WATER QUALITY

Water quality is an essential feature of Wellfleet's ponds. Monitoring of ponds for water quality and chemistry is required to understand any changes in water quality and the causes of such changes. Monitoring and scientific studies of Wellfleet ponds go back to at least the mid-1950s. With the formation of the CCNS, this monitoring has been a priority activity of the park since about 1980. The early data were summarized in 2001 in the Ponds Atlas.

The Park Service is currently undertaking an extensive analysis of all the data. This should be ready in 2011/2012. One issue that makes this a major undertaking is that each pond has to been seen as unique. This report will be a critical factor in helping guide decisions about any remediation steps for pond water quality.

The great ponds of Wellfleet form a chain from south to north: Duck, Dyer, Great, Long, Gull, Higgins, Herring. These ponds sit above a ridge of the Chequessett groundwater lens, which underlies most of Wellfleet. This freshwater lens is recharged by rain water. (The geology of groundwater under the Cape has been mapped by the United States Geological Survey (USGS); refs. 7 & 8.)

The surface water level of these ponds is the top of the lens crest, which, in Wellfleet, takes the form of a narrow ridge running south to north. The highest of the ponds is Duck Pond, at a local high point of the lens ridge, about 9 feet above sea level. From thence, the lens ridge slopes gradually down to the north. The surface of Herring Pond in the Herring River valley headwaters is about 6 feet above sea level. Groundwater in the lens flows gradually downhill south to north from Duck Pond towards Herring Pond, and also west and east towards Cape Cod Bay and the Atlantic Ocean. The bay, the ocean and the Herring River estuary act as ground-water drains or release valves for discharging ground water. The rate of flow averages about a foot a day.

Included in the USGS studies is a delineation of the recharge areas of the ponds. A recharge area is the land area that actually contributes water, via groundwater inflow, to a pond. The size and shape of a recharge area depends on the shape of the water table. In general, the recharge areas around Wellfleet ponds are extremely narrow. A consequence of this is that only a limited number of land-based sources could contribute contaminants into the ponds. Many of the properties in the ponds area of Wellfleet are outside recharge areas of the ponds. The specific recharge area for Gull and Duck ponds has also been determined (ref. 9): these are discussed in Chapter 4.

For most of Wellfleet's great ponds, one feature soon becomes apparent: the water is not only clean but remarkably clear. For some of the ponds (such as Duck), the transparency depth can be over 50 feet in the early spring. The implication of this is that the ponds are relatively biologically non-productive. In Wellfleet harbor, transparency depths are 3-6 feet: the harbor is naturally a much more biologically productive body of water than the ponds.

Several water quality tests are used to characterize and monitor the state of water in the ponds:

1) Secchi depth – the measure of water clarity is determined using a black & white disk, lowered into the pond until it is no longer visible: that depth is the Secchi depth
2) pH and alkalinity – pH is a direct measure of acidity; alkalinity is a measure of the ability of water to withstand (buffer) changes in acidity
3) Phosphorus (P) & Nitrogen (N) – phosphorus and nitrogen are nutrients essential for plant and animal growth; the main sources of P (as phosphate, PO_4) for the ponds are the soils, septic wastes and regeneration from bottom sediments formed by earlier soils erosion; the main sources of nitrogen (as nitrate, NO_3, or as ammonium, NH_4) are septic wastes, rainwater and regeneration from high productivity organic sediments. Excessive amounts of phosphorous and nitrogen can lead to excessive biological activity in a pond, resulting in loss of water clarity and quality.
4) Dissolved oxygen (DO) – All animal life in the ponds requires adequate oxygen. For the highest quality pond surface waters, the state defines this limit as > 6 mg/l for cold waters (20C; 68F) and > 5 mg/l for warm waters (28.3C; 83F); see Massachusetts Department of Environmental Regulation 314CMR4.00). All of Wellfleet's great ponds meet this limit (refs. 1. "the Ponds Atlas" & 2. "the PALS report"). For deep ponds, in the summertime, pond waters can become stratified, with warmer surface waters above cold deep waters. These deep waters can become very low in oxygen – anoxic – until remixing occurs in the fall. Study of the current state of summer anoxia in Wellfleet's ponds will be an important piece of the CCNS ponds review.

The sands which underlie all of Wellfleet's ponds are granitic in origin, pulverized by the glaciers. These sands are low in nutrients such as nitrogen & phosphorous. (The sands, while low in general nutrients, do contain some phosphate. Soil erosion into the ponds will result in higher nutrient loadings. This issue is further discussed in Chapter 3.) The pond sands also lack basic alkali minerals, containing magnesium and calcium which provide alkalinity: there are no limestone soils on the Cape. Two consequences flow from these facts:

1. The low nutrients result in very low algal growth and therefore the clear waters mentioned above;
2. The low alkalinity results in a low buffering capacity and therefore waters which are very sensitive to human interference.

Not all ponds are expected to have crystal clear water. The process of eutrophication can be a natural one, progressing from pond to marsh to meadow. Eutrophication is especially active in shallow ponds, where strong sunlight falling on the pond bed allows an active cycle of growth, decay and sedimentation. This is almost certainly the main process active at Kinnacum, Williams, Herring and Turtle ponds.

Of course, human activity can also result in a degradation of water quality, normally by introducing an excess of nutrients to the pond. There have been recent reports in the press about ponds issues in Falmouth and Brewster, where degradation related to older agriculture and recent over-development has required controversial and expensive treatment of ponds, using liming and alum methods. At the request of NRAB, CCNS undertook a brief summary review of Duck, Dyer, Great, Long and Gull Ponds: these are the five with the greatest human activity. No evidence of any severe or critical degradation was found.

Degradation of pond water quality has usually focused only on the effects of phosphorous. This has distinguished ponds from salt estuaries, where nitrogen loading is critical. However, some recently published science from CCNS labs (ref. 6) has suggested that both phosphorous and nitrogen can be important in Wellfleet's ponds. This work has recently been confirmed by some work in other Cape Cod ponds. In part, this may be due to the relatively lower natural pH of Cape Cod ponds, which therefore more readily dissolve phosphorous. If plenty of phosphorous is available, then the amount of nitrogen becomes important as both nutrients are needed for growth.

This finding could be important if human degradation is verified at any pond. Phosphorous can be controlled by moving septics back from shorelines, by minimizing shoreline erosion, by using low phosphate detergents. Nitrogen as a nutrient comes from septics and flows readily through the Cape's sandy soils. To control nitrogen requires tertiary or composting septics, which are more expensive.
Of course, the obvious step of eliminating the use of fertilizers is a good low cost first step in nitrogen reduction.

Five of the great ponds – Duck, Dyer, Great, Long and Gull – are actively used for swimming. Water quality at the beaches of these ponds has been regularly tested for coliform bacterial contamination by the Town acting for the state health department. In recent memory, none of these beaches has been closed for swimming, as the state would be required to do if contamination is found. Bacterial contamination comes primarily from human or animal wastes, through sub-standard septic systems or directly. The Board of Health and the Beach Administrator have been proactive in requiring high quality toilet facilities. Also, animals are prohibited from pond waters and beaches during the summer. However, there are still some sub-standard septic systems located near the shorelines of Wellfleet's ponds. These septic systems should be upgraded to Title V standards and located away from the shoreline (coliform bacteria also move slowly in groundwater). As an initial step, a survey of sub-standard septic systems is needed, including monitoring of pond water quality for bacterial and other contaminations.

Swimmers and pond waders can be a source of water quality degradation, especially during the crowded summer months. Rest room facilities are provided at the major Town landings. It is critical that these be kept clean and convenient to use by all family members.

Domestic animals on the beaches of ponds or in the water can leave fecal pollution. The Town Beach regulations of both the Town of Wellfleet and the CCNS prohibit any domestic animal on the beaches of Wellfleet Ponds or in the water during the season of greatest risk, from May 15 to October 15.

It is reasonable and prudent to expect that the intensive use of the ponds (see Chapter Three) might lead to degradation. Preventive measures can be taken now which should reduce future risk. We are encouraged that many pond abutters and the Town are already implementing many of these measures:

1. Take action to minimize or eliminate shoreline erosion (even though the pond sands are low in phosphorous, this can still be a trigger for plant growth). Of course, shoreline erosion can directly degrade water clarity from sedimentation. Well vegetated shorelines and banks will reduce the risk of erosion onto the ponds
2. Upgrade non-conforming septic systems in ponds watersheds to Title V
3. Move any septic systems as far back from the pond shoreline as possible: this will reduce phosphorous flow into the ponds. (The real rational behind this recommendation is that Wellfleet soils contain high levels of iron. Iron traps and hold phosphate ions. So, moving septic systems back has a double benefit in reducing phosphorous nutrients reaching the ponds.)
4. Use no fertilizers on gardens and flower beds… or, if needed, use absolutely the minimum amounts
5. Dispose of any pharmaceuticals and drugs at the Town transfer station … not into septic systems. These pharmaceuticals can interfere with the reproductive cycles of fish and other organisms living in the ponds (ref. 9).

Finally, pond sediment analysis (ref. 1,"the Ponds Atlas") has shown an increase in time of certain dissolved metals (arsenic, lead), due to local human activity. A recent addition to this list is mercury, which is generally agreed to come from power plants emissions further to the west (even as far as China). The dissolution of mercury, and its methylation to a highly toxic and biologically active form, is encouraged by the acidic nature of Wellfleet's ponds. This methyl-mercury accumulates in the bodies of fish. Fish in the ponds are now so contaminated that the state advises against their consumption, especially by children and pregnant woman.

CHAPTER THREE: SHORELINE ISSUES

The most difficult issue facing Wellfleet's ponds is finding the right balance between the legitimate and welcome use of the ponds (by residents, visitors and abutters) and protection of the resource. We recommend a general principle: the right balance is to limit use to current levels, with a few reductions in particular cases.

Overuse manifests itself in several ways:

- Pathways and parking areas can become degraded and expand slowly into adjacent native growths.
- Beaches can become eroded, causing sediments to flow into the ponds.
- Shorelines can become denuded of native vegetations. This not only can affect the aesthetic of the pond area but can contribute to water quality degradation, as discussed in Chapter 2.

Fortunately, most of Wellfleet's ponds are located inside the CCNS, eliminating the possibility of future development. Recent zoning changes in town will maintain the appropriate scale of future building. We are also fortunate that actions taken in the past – by the Town, by the Seashore and by shoreline owners – have helped to preserve the resource. Some examples are:

1. Moving the Long Pond parking across the road allowing shoreline vegetation at the beach
2. At Gull Pond, steps down to the beach (preserving the hillside) and upgrade of the bathrooms
3. At Dyer Pond, private owners and CCNS co-operation to restore a shoreline escarpment
4. Actions taken by many shoreline residents to limit phosphate use and to move septic systems away from the shorelines.

We recommend several measures that can be applied to all ponds. (Specific discussion of individual ponds issues follows in Chapter 4.)

1. Eroded shorelines should be restored.
2. Eroding parking areas and pathways should be reconstructed to minimize further loss.
3. Shorelines should be replanted, using native species.
4. Boundaries to all Town landings on the ponds should be clearly marked. Visitors should be encouraged not to walk further along fragile shorelines.

No individual visitor seeks to cause damage to the ponds. No recommendation can be stronger than educating all in the wise use and respect for the resource.

Many private landings and structures exist on Wellfleet's great pond shorelines. Most of these should require a Chapter 91waterways license under the local jurisdiction of the Conservation Commission. A policy to deal with these landings and structures, often of considerable age, is recommended. (For more information about Chapter 91 issues, see the web-site of the state Department of Environmental Protection: http://www.mass.gov/dep/water/resources/faqs03.htm) A program of inspection for the purpose of suggesting improvements that would minimize shoreline damage would be useful. Maintaining a naturally well vegetated shoreline – for both Town and private lands – is essential to resource protection. It should be noted that not all shoreline structures are harmful to the environment. Many permit abutters to access the pond in a way that minimizes shoreline damage.

WALKING ACCESS

Many of the recommendations needed for Wellfleet's ponds necessarily require restrictions. We believe that providing sustainable ways to enjoy the ponds is also important. The upland areas around the ponds are deep oak-pine woodlands, filled with a variety of paths: sand roads, walking paths, animal tracks. Walking trails using the sand roads and other well considered paths can provide another way to appreciate the ponds area. Of course, any such trails must be used respecting private property rights and privacy and with permission of land owners including CCNS.

Encouraging the use of upland walking trails entails risk as well. Some walkers will leave the upland trail and cut through woods down to the pond shore. Pond shorelines and the slopes leading down to them are fragile and cannot sustain traffic. Examples of this fragility can be seen at Dyer and Duck Ponds. It is important to discourage this intrusion, especially by education of walkers. In some cases, owners are lead to pond shores by dogs: walking unleashed dogs violates both CCNS and Town regulations.

CHAPTER FOUR: SPECIFIC PONDS

GULL POND

Gull Pond is the most heavily used of all Wellfleet's ponds. The beach is popular and crowded on a summer's afternoon since the beach is shaded. The beach area is also used for Red Cross certified swimming lessons managed by the Town Recreation Department. Boating (kayaks, canoes, paddle boats, sunfish and electric powered rowboats only) on the pond is growing in use, which has led the Town to expand the canoe and kayak racks at the boat ramp (also a source of revenue). From Gull Pond it is possible to portage the Sluiceway and also paddle on Higgins and Williams Ponds. Gull Pond is stocked by the State with trout which provides a recreational opportunity.

The Gull Pond Landing and beach area were acquired by the Town of Wellfleet in a series of transactions from 1948-1953, predating the establishment of the CCNS.

In 2008, the Town Beach Administrator wrote a Gull Pond Management Plan (ref. 5, S.Thomas), submitted at that time to the Board of Selectmen. We broadly support the recommendations in the 2008 report. As a result of this plan, several important changes have happened at Gull Pond: an upgrade of the toilet facilities, provision of additional kayak racks, providing parking for clients at Jack's Boat Rental away from the waterfront. We urge that the Gull Pond plan be periodically updated. A similar plan for Long, Great, Duck and Dyer Ponds would be equally useful: such plans would be much simpler, as the issues are less complicated.

The parking area at Gull Pond becomes excessively crowded at times of peak use. The main parking area itself shows signs of erosion. We recommend that the parking area be repaired to minimize run-off ("water bars", which divert run-off to stable vegetation, could be used). The allowed parking spaces should be strictly delineated and enforced. With these changes, parking management at Gull Pond would be similar to that at Long and Great Ponds.

There is also evidence of shoreline erosion at the Gull Pond beach area. This is particularly noticeable just north of the main beach area, where there is only a narrow strip of beach on the way over to the kayak concession. This beach area should be rebuilt, perhaps using the opportunity to experiment in replanting underwater vegetation.

During peak summer use, the launching ramp is sometimes used by families who are there to enjoy the beach. Unfortunately, this is an illegal occupation of a public landing, which is legitimately used by others for boating. Fencing and signage should be installed to prohibit this beach usage.

Jack's Boat rentals, a Town licensed concession, has for many years provided another possibility for boating on Gull Pond. This should continue as part of the allure of Wellfleet as a vacation destination. We also believe that, by helping people appreciate the ponds, they will be more likely to join in steps to protect them. However, the same concerns about overuse apply here as well. We recommend that, in the next contract, limits be continued on the number of boats to be rented. We also recommend that the boat rental concession be managed in a way that minimizes damage to the shoreline and also underwater vegetation.

We also recommend no further expansion of the kayak racks at Gull Pond. The swimming lessons at Gull Pond are a long-standing and worthwhile activity. We recommend that they be continued but that no other Town sponsored activities take place there, at least during the peak summer season

In the past, boat moorings have been located off the Gull Pond landing. There is no room for these, given current uses of the beach: the current prohibition should be maintained. Power boating on the ponds is currently allowed, provided that low power battery powered engines are used. Internal combustion engines are prohibited for reasons of safety and avoidance of hydrocarbon contamination. This policy should be continued.

Many ponds and watersheds around the country have been degraded by invasions of invasive plants. An example is hydrilla (*Hydrilla verticillata*) from Asia, which has clogged ponds in Florida and was recently found in Brewster. At the moment, the only invasives known in Wellfleet ponds are some phragmites on Herring, Long and Doane's Bog Ponds. These occupy a limited area. Prevention of more exotic species is the best long term policy. All watercraft coming from outside Wellfleet should be required to be absolutely cleaned of any vegetative matter before launching. Education of homeowners to avoid exotic plant or animal release from aquaria or home water garden features is on-going and needed.

SLUICEWAY

The sluiceway between Gull and Higgins ponds is another area of high intensity summertime use. It is easy to see why: it is a dramatic location between the two ponds. It is easy to reach by boat or car. For family swimming and picnicking it is an ideal venue. However, it is also an environmentally fragile location. Near-by parking is already limited to two places. These two spaces are quickly and continuously occupied during summer days, forcing other visitors to turn around on the narrow barrier beach, usually after discharging passengers and beach equipment, and drive elsewhere. This phenomenon results in a steady traffic jam with vehicles maneuvering right down to the shoreline of Higgins Pond, destroying vegetation and destabilizing soils. There is also high intensity use of the Sluiceway by boaters (mostly kayaks), either arrived for a summer beach outing or passing through to Higgins Pond. A specific concern at the sluiceway is shoreline erosion from pedestrians and even vehicles. A monitoring program (in co-operation with CCNS) would clarify the extent of the problem. We also recommend that steps be taken to find the best way to preserve or even restore the current shore line. (The same actions are needed at Dyer and Duck Ponds).

Reasonable limits on the sluiceway use are needed (see Gull Pond Plan of 2008). Both parking issues and kayak landing issues need to be considered. As any plan would involve changes on both Town and CCNS lands, a joint project approach would be the best way to proceed. There has in the past been good co-operation on ponds management issue between the Town and CCNS: this is another opportunity.

Management of the sluiceway area has continued to be a difficult issue, seeking the right balance between protection of the resource and the public's enjoyment of the area. Besides the excellent recommendations in the Gull Pond Management Plan of 2008, there are some other useful actions to consider:

1. Provide educational signage to help visitors understand the history and fragility of the site.
2. A limited use of fencing to protect vegetation and strategic placement of some benches, providing viewpoints but limiting shore line access, will also be useful. We have also noted at the sluiceway an abundance of poison ivy: some thoughtfully located warning signs would both help safety and protect vegetation.
3. Even though the Sluiceway is a remote area, enforcement of regulations there is important, keeping in mind the jurisdictional responsibilities of the Town and CCNS. Enforcement should be seen as complementing education, not replacing it. It is likely that the need for enforcement would be reduced with passing time, as the public became aware of the new standards.
4. It should be recognized that the overuse concerns arise only during the peak summer season: Memorial Day through Labor Day. Regulations that are needed to limit use during that period can be removed during the spring, fall and winter seasons.

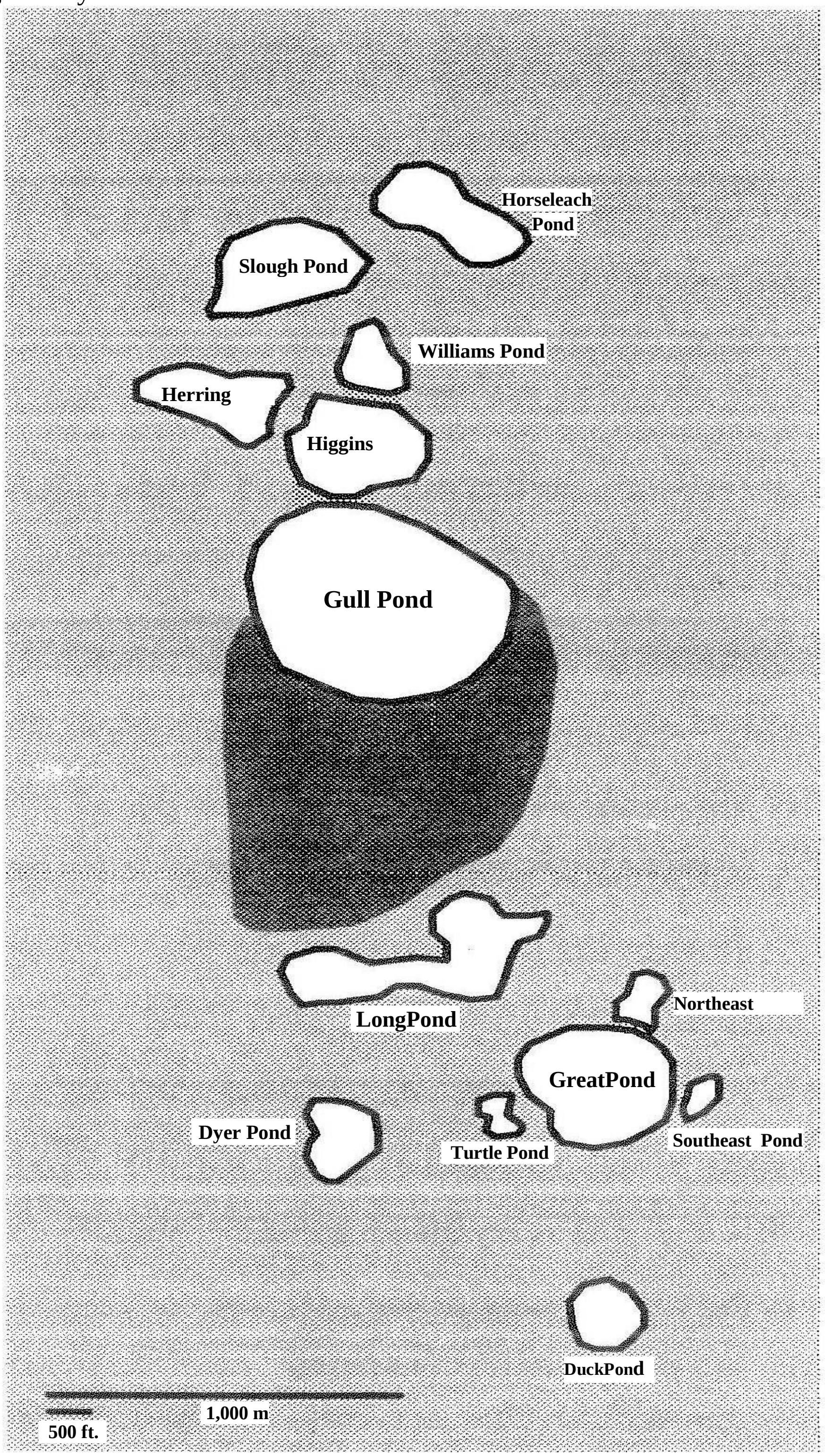
Those who live on or near the ponds can and do play an important role in helping to preserve the resource. Active ponds associations have contributed to this effort. The most active currently is the Gull Pond Area Conservation Organization (GUPACA). This group has reported an increase in vegetative growth along the northeast shore of Gull Pond, replacing what was remembered as a clear, sandy bottom. The concern is that this growth might be due to human interference.

At the suggestion of GUPACA, CCNS investigated the issue (ref. 10). Aerial photography and ground surveys showed that the plant growth had existed in the past and existed along parts of the shoreline not built upon. Similar plant growth exists along the shores of other great ponds. The dominant plant was water lobelia, which has been reported to be an indicator of pristine, oligotrophic conditions. On the other hand, there is some older evidence from sediment analysis that phytoplankton have gradually increased in Gull Pond: this may be due to increases in nutrients. The CCNS report also emphasized that a gradual pond-bottom slope, i.e. shallow water, promotes aquatic plant growth. The plants can be rooted in the bottom where the nutrients are and still receive lots of light energy. This could be a driving factor explaining the macrophytes on the shallower east side of Gull Pond.

If human activity has caused an increase in littoral plant growth, there needs to be a reason for that. Nutrients or shoreline erosion are the most likely causes. Both the summer winds (from the south-west) and the natural groundwater flow across the pond (from SW to NE, as a result of groundwater lens dynamics) might tend to concentrate nutrients along the north-east shoreline. Gull Pond has a substantial catchment area, running south almost to Long Pond. (See Fig 1)

The review of water quality by CCNS will include both nitrogen and phosphorous data. That could be indicative. If high nutrients are found, it will also be useful to do nutrient and vegetative surveys near the affected shoreline: a lack of local history, especially about nutrients, would make that a longer term project. The catchment areas for each specific pond could then be used to identify contaminant sources for each pond: septic systems, road run-off, shoreline erosion, thereby prioritizing a level of risk to each pond. Eventually, a full nutrient budget and the implementation of required nutrient limits may be needed for ponds which are at risk.

Fig.1 Recharge area for Gull Pond (ref. 8). The dark area shows the uplands from which groundwater can flow into Gull Pond, moving generally from SW to NE.



LONG & GREAT PONDS

Long Pond is very heavily used. It is a favorite fresh water swimming beach in Wellfleet. It has the highest density of shoreline dwellings of any of Wellfleet's ponds. It is near a heavily travelled road (Long Pond Road). This pond is a priority for further analysis and understanding.

CCNS data are consistent with a continued highest quality water designation of Long Pond. However, the PALS report (ref. 2) did suggest degradation concerns at Long Pond. The concern was based on low dissolved oxygen levels in the deep waters of the mid-summer pond. In mid-summer, the deep waters of the deepest ponds remain cool, being isolated from the warmer surface waters by stratification. The decay of bottom sediments can then use up the oxygen in the bottom water layer.

There also appears to be a long term, slow rise in the pH of Long Pond. This was first noticed in the CCNS Ponds Atlas and is confirmed by more recent CCNS data (H Bayley, communication to NRAB). One explanation for the pH rise would be an increase in phytoplankton. As with any plant, phytoplankton growth consumes CO_2. A decrease in dissolved CO_2 would result in lower levels of carbonic acid and higher pH. Of course, the increase in globally emitted CO_2, due to human industrial and transportation growth, could offset the trend.

Several years ago, the Town greatly improved Long Pond's management by moving the parking to the north side of Long Pond Road and by replanting the beach area. Any further recommendations for action at Long Pond await the CCNS summary report.

The parking area at Great Pond is located away from the beach area. No water quality concerns have been noted for Great Pond.

DYER and DUCK PONDS

These two smaller ponds are among the gems of the Wellfleet ponds. They have some of the clearest, most sparkling water amongst all of the great ponds. Use of these two ponds has grown over the past ten or twenty years, as Wellfleet has grown in popularity and as the other ponds have become more crowded. This growth in use has now created overcrowding conditions at both public beaches, even though a walk or a steep path is required to reach the beaches.

Shoreline erosion is a concern at both ponds, not only at the landings but at areas around the ponds. In the case of Duck Pond, the erosion issue is exacerbated as the pathway down to the pond from the parking is a steep, straight downhill walk. We recommend a broad plan of remediation at Duck Pond with the Town and CCNS working together. The pathway down from the parking area to the public landing needs to be repaired or rerouted. (Beach goers have already started this in seeking to avoid the old, degraded pathway.) The current path is a "Public Way" which crosses CCNS land: any project will need CCNS engagement.

The beaches at both ponds show signs of erosion. There is increasing devegetation adjacent to the previously existing beach areas. Further expansion of the beach areas should be limited by fencing and educational signage. The landing at Dyer Pond is managed by the CCNS. The CCNS has started internal discussions about the feasibility of restoring the shoreline at Dyer Pond, which has become severely eroded. Any technology developed here could be used by the Town for similar restorations at Gull Pond, the Sluiceway and Duck Pond.

At both Duck and Dyer Ponds, concerns have been raised about access to the ponds away from the designated public landings. Given the steep shorelines around both ponds, additional erosion is inevitable. A site of particularly bad bank erosion at Dyer Pond is undergoing remediation due to co-operative action by the CCNS and abutters. The situation at Duck Pond also needs watching, as visitors leave Town properties to cross CCNS lands to the pond shore. One needed action is to work with the CCNS to discourage pond access away from the actual beach landings.

Parking control at the Duck Pond parking lot and along the access road-ways remains a priority. ATVs are used to access both Duck and Dyer Ponds. ATVs are greatly damaging to the uplands around these ponds. The use of any internal combustion engine on private or CCNS land is illegal without written permission from the land owner. This is another situation which requires adequate enforcement of already existing regulations, both local, park and, now, state.

Concerns have also been raised about water quality degradation (cloudiness) at Dyer and Duck Ponds. A statistical analysis of Secchi disk data by CCNS shows no long term significant trend. A different analysis of the same data by a resident (BTaylor, communication to NRAB), which weights the more recent data points, suggests a possible loss of clarity. A loss of clarity could be due to increased nutrients, leading to increased production of phytoplankton, or to shoreline erosion. The catchment areas for both Duck and Dyer Ponds are very narrow, as the ponds sit near the crest of the Chequessett lens. Also, there are very few dwellings along the shores of either of these ponds.

We are therefore concerned that erosion issues may be the more likely explanation for any water quality degradation in these ponds. (This may also be the case at Gull Pond.) Shoreline erosion can directly lead to increased silting in a pond or can supply soil based nutrients. It is also possible that subtle changes in pond water chemistry may help dissolve P (as phosphate) geologically trapped in bottom sediments. Further science is needed to clarify the possibilities.

CROWELL, SQUIRES and PERCH PONDS

These three ponds are located outside of the CCNS boundaries. Perch Pond is located near Route 6. The shoreline, except that adjacent to Route 6, is private. Perch Pond was originally part of the Herring

River system and may eventually be affected by the salt marsh restoration of that river. In the meantime, it is subject to road run-off from Route 6: catchment basins along that road need to be maintained.

Crowell Pond is a small, shallow pond off Paine Hollow Road. It is eutrophying, almost certainly due to natural causes. There is a small Town landing at the pond used by fishermen; this should be maintained.

Squires Pond is located near the Town center at the end of the short road which bears its name. The pond is also eutrophying, in this case probably accelerated by the high nutrients found in the central district. It would be worthwhile collecting water samples to verify this assumption. This pond is artificially connected to the Herring River estuary (Upper Pole Dike Creek sub-basin) via a drainage ditch under Briar Lane. The Town needs to decide how to treat this situation when tides and seawater are restored to Herring River. True habitat restoration would re-isolate Squire's Pond as a naturally land-locked kettle pond. This would also restore its natural hydrology, including increased seasonal water-level fluctuations which are currently dampened by the man-made drainage system. Squires Pond is a place of quiet beauty, remarkable for a pond in the Town center. There is a small Town landing, currently overgrown with willows. Clearing the willows and installing a bench could provide a great walking destination near the Town center.

PMP REFERENCES

1. Kettle Pond Data Atlas for Cape Cod National Seashore: Paleoecology and Modern Water Chemistry, JPortnoy, et al, 2001
   - An excellent review of ponds geological history and current status. Restricted to ponds lying within CCNS. Can be found on the CCNS (http://www.nps.gov/caco/naturescience/upload/Pondatlasfinal.pdf) and GUPACA (see below) web-sites
2. Ponds and Lakes Atlas, EEichner, TCambereri, et al, Cape Cod Commission, 2003
   - Covers water quality and human impact issues for ponds across Cape Cod. Part of the "Ponds and Lakes Stewards" (PALS) program. Can be found on the web under www.capecodgroundwater.org/PALS.html
3. Gull Pond Area Conservation Organization (GUPACA).
   - A Gull Pond owners organization, proactive in concerns to preserve the character and integrity of the Gull Pond chain of lakes. The web-site has a number of useful items posted: see www.**gupaca**.org
4. Chapter 91 Overview FAQs: http://www.mass.gov/dep/water/resources/faqs03.htm
5. A Management Plan for Gull Pond, Thomas, Suzanne, 2008: see www.**gupaca**.org
   - Excellent overview of Gull Pond issues and recommendations for management
6. Responses of Periphyton to Artificial Nutrient Enrichment in Freshwater Kettle Ponds, Smith S., Lee, K., Hydrobiologia 571: 201-211 (2006)
   - Important paper on important possible role of N for ponds water quality. See www.nps.gov/caco/naturescience/upload/Smith&Lee_2006.pdf
7. Monitoring Ground Water Quality in Coastal Ecosystems, Coleman, J.A., Masterson, J.P.,USGS 2007-1149; also, Masterson, J.P., USGS 2004-5014
   - Research report includes location of ponds relative to groundwater lens

and contributing area/recharge mapping. See: http://pubs.usgs.gov/of/2007/1149/

8. Physical Hydrology of Selected Vernal Pools and Kettle Hole Ponds in the Cape cod National Seashore Massachusetts, Sobczak, R.V., Camberari, T.C., Portnoy, J.W., Cape Cod Commission/CCNS, 2003 (not on line)
9. Silent Spring web-site: www.silentspring.org
10. S.Smith, CCNS, report to GUPACA (2006) and references therein; available at www.**gupaca**.org

ACKNOWLEDGEMENTS

A number of individuals have given of their time to meet with NRAB and its members about ponds issues. These names are listed below. We thank all of them for their thoughts and interest in the ponds.

Herb Gstalder, Dorothy Altman, John Partridge, David & Ben Garrison, Lezli Rowell, John Portnoy, Shelley Hall, Sophia Fox, Steve Smith, Holly Bayley, Marjory Winkler, Barbara Taylor, Suzanne Thomas.

Terry Gips helped immeasurably with the editing of this plan.

APPENDIX D

Sustainable Oyster Propagation Project in Wellfleet Harbor

DRAFT REPORT
For The Town of Wellfleet

Wellfleet Harbor (Cape Cod, MA) is a unique ecosystem that is a home to a centuries old shellfishing industry and a growing aquaculture tradition of oysters and hard calms. Presently, tourism and shellfishing comprise the largest income generating activities in Wellfleet Harbor (WH).

Why Oyster Propagation and Reef Restoration?

Oyster reef restoration relies on spawning brood stock to obtain millions of pelagic larvae, and providing substrate (cleaned clam and oyster shells in our case) upon which the larvae will settle and adhere (spat-on-shell). In contrast, for aquaculture needs, oyster "seed" (juveniles) are generally purchased as singles from a hatchery by oyster farmers. At present, most of the larvae and seed for these needs are originating from hatcheries in other states, and oyster survival is highly variable from year to year. There are several reasons for the focus on indigenous Wellfleet oysters. With respect to restoration of natural populations, particularly, there is a growing emphasis nationally on developing region-specific—and even estuary-specific—oyster strains to provide sufficiently disease-resistant larvae for production of spat-on-shell. There is also a need for disease-resistance in farmed oysters, but fast-growth strains are also important.

Oyster reefs ecoservices facts:

- Sediment stabilization – beds of oysters act to buffer the impacts of erosion related to waves, boat wakes, and currents.
- Habitat – the structure of oyster beds provides refuge, settlement substrate, and foraging grounds for many other types of marine life.
- Food provisioning – oysters serve as a source of food for birds, marine organisms, and humans.
- Carbon Sequestration (carbon sink) – The shells of oysters naturally absorb carbon as they grow, thus helping to sequester carbon.
- Water quality and nutrient cycling (nitrogen sink) – oysters are important to water quality due to the process of filter feeding that removes microscopic particles (phytoplankton, contaminants, etc.) from the water, improving turbidity, light penetration, and overall water quality as well as serving as a source of nutrients. These water quality improvements, in turn, contribute to healthier habitat conditions for other organisms (e.g. eel grass).

Project Site Description

In the last few years, Green Boston Harbor project (GBH) has been collaborating with the Town of Wellfleet and Environmental Partners Group Inc. in developing and implementing the sustainable oyster propagation project in the Harbor.

The project has several mutually beneficial goals: 1) establish a sustainable oyster population in the harbor; 2) increase natural disease resistance of oyster population; 3) increase oysters' ecoservice capacity; and 4) help reduce nitrogen content in the coastal waters.

Geographically, WH is a semi-enclosed shallow harbor/estuary with a surface area of 6,094 acres at a mean high tide (25 km^2) and respectfully 3,815 acres at a mean low tide. Historically, 2,500 acres (10.1 km^2) has been utilized for wild shellfish harvest and only 200 acres are presently leased for aquaculture (0.8 km^2). Wellfleet oyster population wild harvest continues to decline, making ~1 million landings/year from 2,500 acres of beds, while the overall population is well below historic levels particularly those levels consistent with higher water quality (Frankic and Cataldo, 2007).

Based on an adult oyster's ability to filter between 25 (juvenile) and 50 (adult) gallons of water a day, and an individual oyster's (3 inch shell) ability to remove about 0.5 grams of nitrogen per year (Wilcox, 2009), it seems that a healthy oyster reef habitat may support the Town's need to meet state-wide nutrient loading goals. The nitrogen absorbed into the flesh and shell (biomass) has been measured in a number of studies, and is universally accepted at 0.5 grams per oyster per year (Newell et all, 2003; Rheault, 2005).

Our project established an approximately two acre oyster propagation ground at the Duck Creek site (Fig 1.). Based on project goals and our estimated calculations for an adult 3 inch oyster (please see recommendations), this project site is expected to provide the following benefits:

1) Establish a sustainable oyster population at the project site:
   Approximately 2 million additional oysters annually, with a potential commercial value to up to $1million/year
2) Expand ecoservice capacity provided by oysters:
   Approximately 100 million gallons of increased water filtration daily, and
3) Help reduce nitrogen content in the coastal waters:
   Approximately 2,200 pounds of nitrogen sink per year at the project site (based on 0.5 gN/oyster/year)

In support of project's goals, we established a comprehensive monitoring plan by using YSI 6600V2-4 unit at the site (launched on 9-1-11) that measures temperature, chlorophyll a, blue-green algae, DO, salinity, pH, conductivity, redox, TDS, and turbidity (available on line). Based on the YSI data we hope to gain insight into daily and seasonal water quality changes and to support project's additional in situ field monitoring of incoming ground water and estuary nutrients (total nitrogen) as well as oyster spat counts twice a month that started in June 2011 until December 2011.

Recommendations include (but not limited):

1. Project Site: Our first and most important recommendation, on which all other are dependent, is to close the project site for any harvesting between 3 and 5 years, in order to understand/test all the research and management questions and assumptions. During our monitoring and field visit we observed that the site has been harvested, and in order to

establish a best possible pilot project area for oyster reef research and restoration it needs to be protected from any harvesting and visits except for executing the monitoring plan.

2. Oyster Reef: How many oysters are in a sustainable oyster reef?

   Based on a literature review addressing oyster reefs research and restoration, the threshold abundance of oysters to achieve functional success of the reef is about 100 oysters/m². (Ch. Bay Report, 2011).

   Therefore, on the project's two acre (8,094 m²) propagation site functional success would be maintaining a minimum of at least 809,370 oysters (let's say 1 million) and sink about 500kgN/year! Therefore, based on current projections we are on target for what would be considered functional success.

   Based on our monitoring results, oyster spats were settling throughout July, August and September, representing at least four different settling/spawning activities. It almost seems like the spats were 'communicating' with each other in order to achieve maximum survival rate based on how successful is a settlement rate? We noticed that clam shells with older spats were repeatedly chosen as a successful substrate for new spats. So, we would find four different sizes of spat on the same shell, sometimes up to 40 and 50 spats per clam shell, and hundreds of spats per square meter (please visit the web site for images and spat counts).

   Adult size oysters were only observed along the Duck Creek channel on the side of the project area (approximately 45-55 oysters/m²). Transect assessments were done twice a month and included spat counts on the clam shells, and biodiversity assessment using the 0.5 m² transect quadrant. We performed six transects twice a month at the project site throughout the monitoring season (please visit the web site for assessment images).

3. Duck Creek: How many oysters do we need to improve nitrogen content in the Duck Creek area?

   We draw imaginary lines around the Duck Creek area (about 50 acres) that are about 550m x 350m x 2m (estimated depth at high tide the deepest areas are maybe 2m, and go to zero pretty quickly). On average, we expect that an actual volume of water in this area is about 385,000 cubic meters of water (100 million gallons) or 50-100 million if we use a range that includes the lower levels depth.

   It is likely that a minimum population between 7.5 and 8 million oysters in the Duck Creek basin will be required to achieve sustainability and water quality goals, providing a 'nitrogen sink' of about 4,000kgN/year (8,800 lbs).

   At this population, productivity would increase dramatically due to the much larger number of spawning oysters. Along with additional cultching, this area could produce by itself, sustainable commercial harvest of a million + oysters. Those numbers are similar to the entire commercial harvest reported in 2007, but by establishing and maintaining this oyster sanctuary it will provide ecoservices and improve water quality to meet state guidelines while increasing a net harvest. The exact magnitude of benefits needs to be closely assessed and monitored over the next few years and based on project efforts to reach optimal oyster numbers.

4. Mayo Creek: Removing of the duckbill valve and opening of the Mayo Creek based on the recent Woods Hole Group restoration study assessment would add ~ **20 acres** of intertidal salt marsh, which would provide additional ecoservices for nitrogen and carbon sink as well as accretion of sediment. Mayo Creek is a missing link in a nutrient equation and calculations – this is how nature used to function and maintain resiliency – and there was an obvious reason for the symbiotic relationship between the marsh there and oysters here and eel grasses in deeper waters – in a natural transect – this must be reestablished in order to restore and maintain the resiliency and sustainability of the Wellfleet Harbor (Frankic et all, 2011). Common sense? Yes. Common science? Not yet.

   Based on the literature review, an optimal and healthy salt marsh would sink about 21 gram of nitrogen per square meter annually! However, estimates show that nitrogen values differ from marsh to marsh: 5-20gN/m2/y and 0.05-0.3 gP/m2/y (Nixon, 1980).

   Therefore, 20 acres (80,940 m^2) of Mayo Creel salt marsh would optimally sink about 1.7million grams of nitrogen/year (1,700kgN/year) (3,748 lbs/yr).

   In addition, benefits from the salt marsh are sediment accretion that measures vertical accretion rates in coastal marshes in average between 0.2 and 1.35 cm/year (DeLune 1981; Harrison and Bloom 1974). This would help stabilize muddy sediment in the Duck Creek, and improve circulation patterns, water quality and nutrient flux.

   The ecosystem based approach to minimize eutrophication in WH, as well as low oxygen levels, can only be achieved by restoring all three key stone habitats in WH: salt marsh (the Mayo Creek marshes need to be restored by opening up the duckbill in support of hydraulic exchange and circulation of salt water), oyster reefs (continue with the oyster propagation project in Duck Creek), and eventually establish the eel grass beds as the water quality and clarity improves.

5. Future Cultching: based on our field assessments and observations – our recommendation is to consider expansion of the site and to fill in with cultch all the areas that are still exposed as mud; this will provide more suitable hard substrates for spat settlement and improve the conditions for oyster survival. Even when settled on cultch, oysters are exposed to soft, muddy and anoxic bottom sediment that cause oyster, juvenile and adult, mortality by basically suffocating them.
6. Sea lettuce and algae removal – in late August and during September the project site area was covered with excessive amounts of *Ulva latuca* (sea lettuce); during the low tide the green mass of sea lettuce were just lying on the cultch and oysters, and during the high tide they were dispersed in the water column above the project site. Our assumption is that removal would enhance oyster survival and reduce nutrient loading.
7. Future monitoring – in order to understand nitrogen/nutrient flux and nexus between two key stone habitats (salt marsh and oyster beds) we propose to establish additional monitoring

sites on the inside of the Mayo creek (opposite of the duckbill); as well as inside of the Duck Creek – in order to understand the nitrogen flux throughout the area. We also propose a nitrogen monitoring site near adult oyster reef to understand and test our assumption regarding nitrogen sink by adult oysters. We propose to start a new monitoring season in March.

8. Town of Wellfleet nitrogen loading and management – based on the MassDEP/DPH 2007/2011, the class A waters standard regarding nitrogen, is a recommended value of 0.35 mg/l; our monitoring results were showing increased values up to 0.9 mgN/l; which means that nitrogen sinking could be achieved through salt marsh and oyster ecological services within a few years and the project plan design should show measurable water quality improvements.

9. Wellfleet marina and its piers should be a possible site for constructing floating or suspended oyster populations on the north side of the marina complex, at the floating docks. This area has shown low DO, high turbidity and high sediment deposition, while oysters have been settling along the marina riprap, showing high survival and growth where they are not exposed to the bottom sediment. We recommend placing suspended oysters on the floating docks so that oysters would be able to move with tides on the docks, and contribute with additional ecoservices.

Figure 1. Duck Creek oyster propagation project in Wellfleet Harbor, MA.

APPENDIX E

TOWN OF WELLFLEET

Comprehensive Wastewater Management Planning Committee

PROPOSED BAKER FIELD/MAYO BEACH BATHHOUSE FACILITIES

Problem:

- Marina Bathrooms over 4 times design load
- Excess Nitrogen entering harbor waters from Marina
- Legal Requirement of Baker Trust has not yet been met
- Inadequate facilities for Residents and poor image for Tourism

Solution:

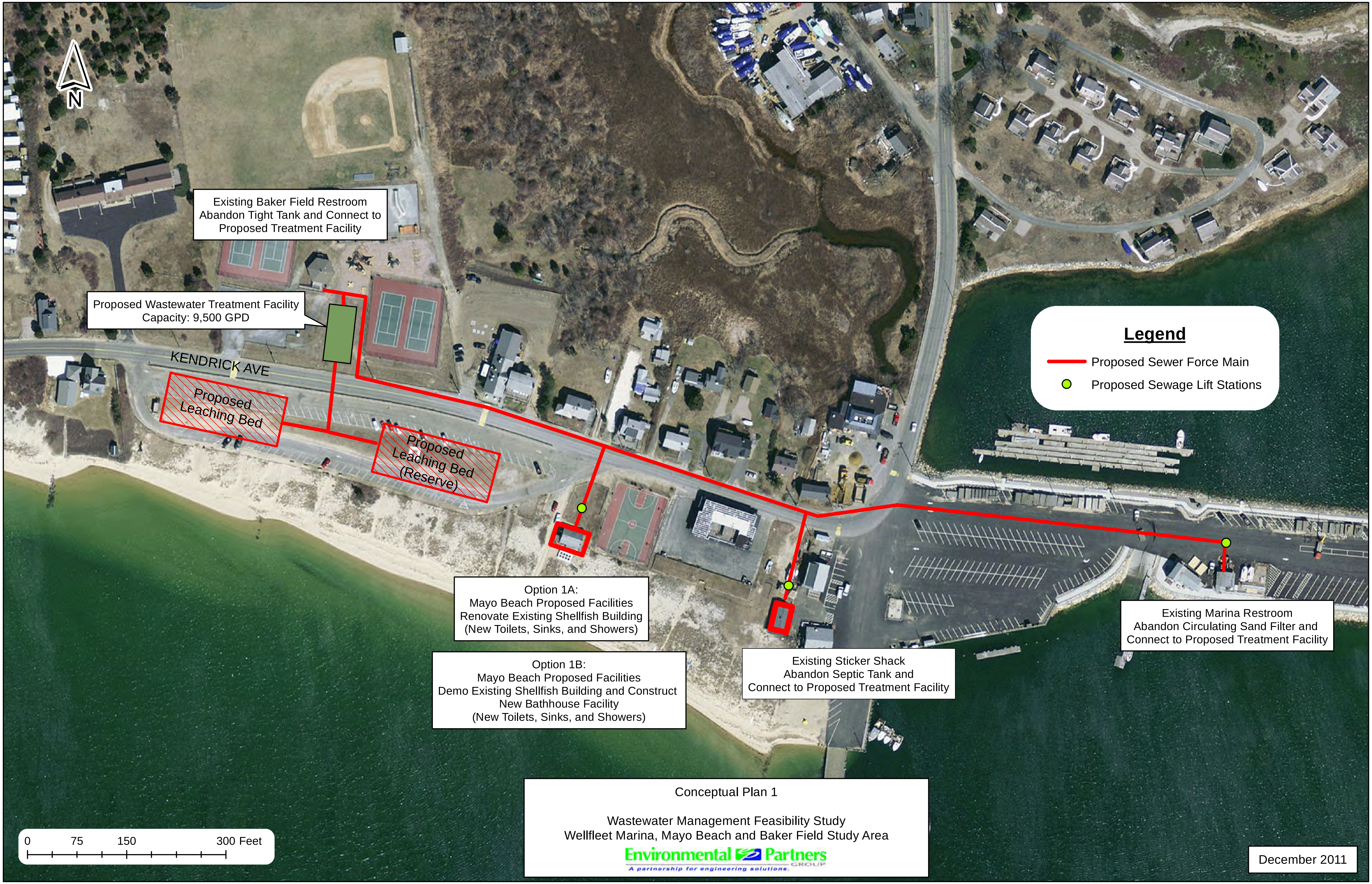
1. Baker Field year round composting bathroom facility (4 female/4 male)
2. Mayo Beach Bathhouse (summer only) (3 female/3 male;outside rinse stations)

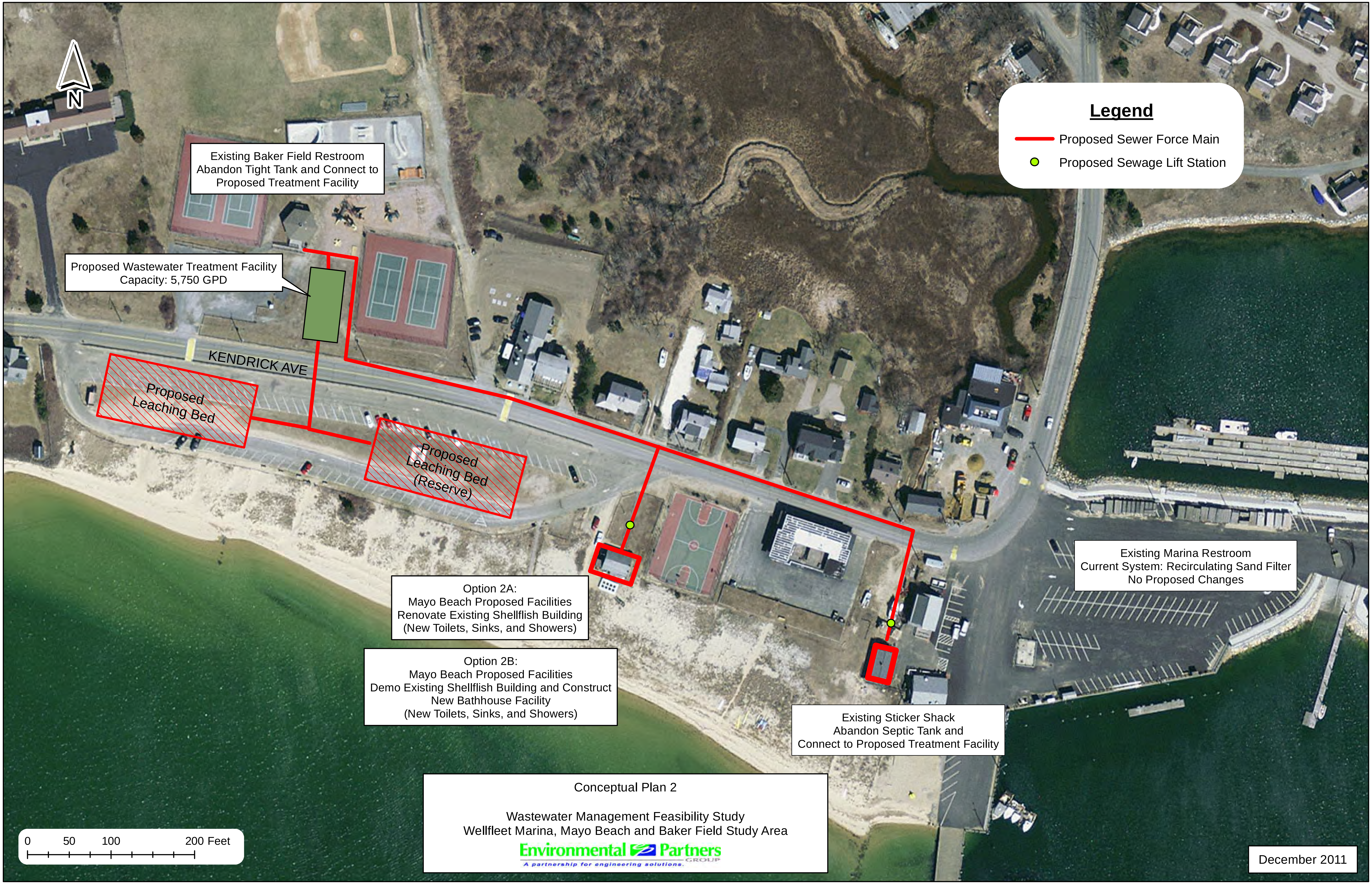
Benefits:

- Meets legal requirements of Baker Trust and 2002 Town Meeting
- Alleviates overloading at Marina and pressure on Bookstore, Sol, Pearl
- 100% removal of Nitrogen is part of area-wide nutrient reduction program
- Less than ½ the cost of traditional toilet and septic facilities
- Meets peak loads at Mayo Beach and Baker field with options for growth
- Seasonal shut-down of Mayo Beach saves money while Baker continues to provide needed service
- Annual system maintenance estimated at $3,000 per year
- Saves $5,000/yr in Porta-potty rentals and tight tank pumping

Conceptual Plan
Proposed Baker Field/Mayo Beach
Bathhouse Facilities

Environmental Partners GROUP
A partnership for engineering solutions.


N
Existing Baker Field Restroom
Abandon Tight Tank and Connect to
Proposed Treatment Facility
Proposed Wastewater Treatment Facility
Capacity: 9,500 GPD
KENDRICK AVE
Proposed
Leaching Bed
Proposed
Leaching Bed
(Reserve)
Legend
Proposed Sewer Force Main
Proposed Sewage Lift Stations
Option 1A:
Mayo Beach Proposed Facilities
Renovate Existing Shellfish Building
(New Toilets, Sinks, and Showers)
Option 1B:
Mayo Beach Proposed Facilities
Demo Existing Shellfish Building and Construct
New Bathhouse Facility
(New Toilets, Sinks, and Showers)
Existing Sticker Shack
Abandon Septic Tank and
Connect to Proposed Treatment Facility
Existing Marina Restroom
Abandon Circulating Sand Filter and
Connect to Proposed Treatment Facility
0 75 150 300 Feet
Conceptual Plan 1
Wastewater Management Feasibility Study
Wellfleet Marina, Mayo Beach and Baker Field Study Area
Environmental Partners Group
A partnership for engineering solutions.
December 2011


N
Legend
Proposed Sewer Force Main
Proposed Sewage Lift Station
Existing Baker Field Restroom
Abandon Tight Tank and Connect to
Proposed Treatment Facility
Proposed Wastewater Treatment Facility
Capacity: 5,750 GPD
KENDRICK AVE
Proposed Leaching Bed
Proposed Leaching Bed (Reserve)
Existing Marina Restroom
Current System: Recirculating Sand Filter
No Proposed Changes
Option 2A:
Mayo Beach Proposed Facilities
Renovate Existing Shellfish Building
(New Toilets, Sinks, and Showers)
Option 2B:
Mayo Beach Proposed Facilities
Demo Existing Shellfish Building and Construct
New Bathhouse Facility
(New Toilets, Sinks, and Showers)
Existing Sticker Shack
Abandon Septic Tank and
Connect to Proposed Treatment Facility
0 50 100 200 Feet
Conceptual Plan 2
Wastewater Management Feasibility Study
Wellfleet Marina, Mayo Beach and Baker Field Study Area
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December 2011


Existing Baker Field Restroom
Current System: Tight Tank
No Proposed Changes
KENDRICK AVE
N
Option 3B:
Renovate Existing Shellfish Building with Clivus Units
and Graywater System
(waterless toilets, sinks, outside showers, leaching field)
Option 3A:
Mayo Beach Proposed Facilities
4 Clivas Prefabricated Units
(waterless toilets, no sinks)
Existing Marina Restroom
Current System: Recirculating Sand Filter
No Proposed Changes
Existing Sticker Shack Restroom
Retrofit with Clivus Unit and Graywater System
0
50
100
200 Feet
Conceptual Plan 3
Wastewater Management Feasibility Study
Wellfleet Marina, Mayo Beach and Baker Field Study Area
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Environmental Partners GROUP

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