CONNECTICUT RIVER NUTRIENT SAMPLING PROJECT
MONITORING RESULTS
SUMMER 2017

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Introduction

As part of the Long Island Sound Nitrogen study, the U.S Environmental Protection Agency (EPA) and its contractor are analyzing embayments in the Sound to develop nitrogen thresholds to protect the designated uses of the receiving waters. As part of this project existing monitoring data from each of the embayments was compiled. During this process, it was found that there was little data in the estuarine portion of the Connecticut River. The purpose of this project is to collect nutrient samples in the estuarine portion of the Connecticut River to allow better characterization of existing conditions.

Sampling Methods

Field sampling followed the Quality Assurance Project Plan (QAPP), and the Standard Operating Procedures (SOPs) referred to therein, for the Connecticut River Nutrient Sampling Project dated July 2017.

Sampling was performed at 7 locations. Grab samples were collected and analyzed for total nitrogen, ammonia, nitrate/nitrite, total suspended solids, total phosphorus, orthophosphate, and chlorophyll 'a'. Samples were collected at a depth of 1 meter using a Wildco 4-liter beta bottle. One set of duplicate samples for each parameter was taken on each sampling event. Duplicate samples were taken at a different sampling station for each event and were taken from the same grab sample as the station sample. Water clarity was measured at each monitoring location using a 20 cm Secchi Disk. Additionally, temperature, pressure, dissolved oxygen (% saturation and concentration), pH, temperature, conductivity, and salinity were measured at each location using a YSI EXO 2 data sonde. All sampling was performed on the last half of an ebbing tide. On each event, sampling began at station CTR07 which is the furthest downstream station and progressed upstream to station CTR01.

Sampling Locations and Dates

The coordinates and description of each monitoring locations are shown below in Table 1. A map showing the sampling locations is shown in Attachment A.

Table 1 – Monitoring Station Locations

Station ID	Station Description	Latitude	Longitude
CTR01	United States Geological Survey Gaging station at Connecticut River Museum Pier	41° 21.091'	72° 23.060'
CTR02	Just downstream of green marker #25 downstream of outlet from South Cove and Essex Mooring field	41° 20.678'	72° 22.556'
CTR03	Connecticut Department of Energy and Environmental Protection monitoring site downstream of Nott Island	41° 20.604'	72° 21.994'
CTR04	Off Ferry Point Marsh Wildlife Area	41° 19.721'	72° 21.362'
CTR05	Between Goose and Calves Islands	41° 19.891'	72° 20.912'
CTR06	United States Geological Survey Gaging Station at Old Lyme. Attached to Connecticut Department of Energy and Environmental Protection Pier	41° 18.746'	72° 20.786'
CTR07	Mouth of Lieutenant River	41° 18.417'	72° 20.800'

Sampling was performed on the dates shown below in Table 2. Sampling occurred as planned, other than on August 28 when the project team experienced mechanical issues with the boat and were only able to take samples at stations CTR01 and CTR06 which were accessible by piers.

Table 2 – Sampling Dates

Event	Sampling Date
1	August 14, 2017
2	August 28, 2017
3	September 11, 2017
4	September 25, 2017

Results

Grab sample times for each parameter and date are shown below in Table 3. Duplicate samples were taken at station CTR07 on August 14, station CTR06 on August 28, station CTR04 on September 11, and at station CTR02 on September 25. With the exception of the duplicates, all samples were taken from one grab using the Wildco 4-liter beta bottle. Duplicate and station samples were taken from the same grab sample. Therefore, in instances where duplicates and grab samples were taken, 3 grabs samples were taken with the beta bottle (once for total nitrogen, nitrate/nitrite, ammonia and phosphorus; once for total suspended solids and orthophosphate; and once for chlorophyll 'a').

Table 3 - Sampling Times							
	CTR01	CTR02	CTR03	CTR04	CTR05	CTR06	CTR07
Aug. 14, 2017							
TN, NO2/3, NH3, TP	10:37	10:15	10:02	9:48	9:32	9:00	8:38
OP, TSS	10:37	10:15	10:02	9:48	9:32	9:00	8:42
Chl 'a'	10:37	10:15	10:02	9:48	9:32	9:00	8:34
Aug. 28, 2017							
TN, NO2/3, NH3, TP	10:12	---	---	---	---	9:34	---
OP, TSS	10:12	---	---	---	---	9:32	---
Chl 'a'	10:12	---	---	---	---	9:29	---
Sept. 11, 2017							
TN, NO2/3, NH3, TP	9:44	9:25	9:02	8:42	8:22	7:48	7:28
OP, TSS	9:44	9:25	9:02	8:45	8:22	7:48	7:28
Chl 'a'	9:44	9:25	9:02	8:39	8:22	7:48	7:28
Sept. 25, 2017							
TN, NO2/3, NH3, TP	9:28	9:11	8:45	8:29	8:14	7:50	7:35
OP, TSS	9:28	9:15	8:45	8:29	8:14	7:50	7:35
Chl 'a'	9:28	9:09	8:45	8:29	8:14	7:50	7:35

Nutrients

Results for total nitrogen, nitrate/nitrite, total phosphorus and orthophosphate are shown below in Tables 4 through 8. Total nitrogen results ranged from 330 ug/l at station CTR07 on Sept. 25 to 610 ug/l at station CTR04 on Sept. 11 with a median of 470 ug/l. Nitrate/nitrite results ranged from 87 ug/l at station CTR01 on Aug. 14 to 360 ug/l at station CTR02 on Sept.11 with a median of 190 ug/l. Ammonia as N results were below the reporting limit of 66 ug/l with the exception of CTR01 where ammonia ranged from non-detect to 120 ug/l. Total phosphorus results ranged from 29 ug/l at station CTR04 on Aug. 14 to 63 ug/l at station CTR04 on Sept. 11 with a median of 43 ug/l. And orthophosphate results ranged from 8.9 ug/l at station CTR01 on Aug. 14 to 37 ug/l at station CTR05 on Sept. 11 with a median of 15 ug/l.

Table 4 - Total Nitrogen Results (ug/l)				
Station	Aug. 14, 2017	Aug. 28, 2017	Sept. 11, 2017	Sept. 25, 2015
CTR01	420	500	490	500
CTR02	510	---	500	530
CTR03	470	---	540	470
CTR04	410	---	610	410
CTR05	430	---	590	440
CTR06	430	400	580	430
CTR07	360	---	530	330

Table 5 - Combine Nitrate and Nitrite Results (ug/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	87	170	330	240
CTR02	170	---	360	260
CTR03	150	---	340	220
CTR04	140	---	320	180
CTR05	130	---	330	190
CTR06	140	160	300	200
CTR07	110	---	280	140

Table 6 - Ammonia as N Results (ug/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	120	66	ND	74
CTR02	ND	---	ND	ND
CTR03	ND	---	ND	ND
CTR04	ND	---	ND	ND
CTR05	ND	---	ND	ND
CTR06	ND	ND	ND	ND
CTR07	ND	---	ND	ND

ND = Non-Detect
Reporting Level = 66 ug/l

Table 7 - Total Phosphorus Results (ug/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	45	41	56	39
CTR02	43	---	52	45
CTR03	44	---	54	41
CTR04	29	---	63	43
CTR05	43	---	51	37
CTR06	34	30	52	37
CTR07	32	---	53	34

Table 8 - Ortho Phosphate Results (ug/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	8.9	12	28	11
CTR02	12	---	30	14
CTR03	16	---	29	15
CTR04	15	---	34	19
CTR05	14	---	37	13
CTR06	12	16	32	14
CTR07	15	---	36	21

Chlorophyll 'a'

Results for chlorophyll 'a' samples are shown in Table 9 below. Chlorophyll 'a' results ranged from 1.7 ug/l at station CTR02 on Sept. 11 to 29 ug/l at station CTR05 on Aug. 14 with a median of 7.6 ug/l.

Table 9 - Chlorophyll 'a' Results (ug/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	17	8.8[1]	3.3	10
CTR02	16	---	1.7	15
CTR03	28	---	2.3	12
CTR04	24	---	2.9	7.6
CTR05	29	---	2.1	5.4
CTR06	14	5.8[1]	3.8	2.5
CTR07	8	---	4.8	6

1. Estimated values because samples associated with out of range Continuing Calibration Verification (CCV).

Total Suspended Solids

Results for total suspended solids samples are shown below in Table 10. Total suspended solids results ranged from 4.8 mg/l at station CTR04 on Aug. 14 to 21 mg/l at station CTR04 on Sept. 25 with a median of 10 mg/l.

Table 10 - Total Suspended Solids Results (mg/l)				
Station	**Aug. 14, 2017**	**Aug. 28, 2017**	**Sept. 11, 2017**	**Sept. 25, 2015**
CTR01	11	5.2	13	14
CTR02	8.8	---	8.8	10
CTR03	5.7	---	8.3	10
CTR04	4.8	---	13	21
CTR05	7.3	---	8.3	14
CTR06	7.7	6	12	10
CTR07	15	---	20	7.8

Secchi Disk

Results for secchi disk readings are shown below in Table 11. Secchi disk readings were not taken on August 28 due to boat problems. Grab samples were collected for stations CTR01 and CTR06 from piers on this date, however due to the height of the piers, secchi disk reading were not taken. The maximum and minimum secchi disk readings were 1.50 and 0.88 m, respectively.

Table 11 - Secchi Disk Reading Results						
	Aug. 14, 2017		Sept. 11, 2017		Sept. 25, 2017	
	Total Depth (ft)	**Secchi Disk (m)**	**Total Depth (ft)**	**Secchi Disk (m)**	**Total Depth (ft)**	**Secchi Disk (m)**
CRT01	2.2	0.91	2.3	0.88	2.6	0.98
CTR02	5.9	1.08	6.8	1.50	7.2	1.24
CTR03	1.6	1.30	1.7	1.28	1.6	1.12
CTR04	2.7	1.20	2.7	1.10	3.0	1.25
CTR05	2.2	1.10	2.4	1.28	2.3	1.25
CTR06	5.4	1.10	4.4	1.26	4.5	1.29
CTR07	2.6	1.28	3.0	1.10	3.4	1.30

Data Sonde Grab Results

At each station instantaneous samples of water quality data were recorded using a YSI EXO2 data sonde (property tag # B27852) provided and operated by EPA Atlantic Ecology Division. The sonde recorded temperature, pressure, dissolved oxygen (% saturation and concentration), specific conductivity, salinity, pH, and the depth at which the readings were taken. A summary of sonde data is provided below in tables 12 – 15.

Table 12 – Sonde Grab Data - August 14, 2017							
	CTR01	**CTR02**	**CTR03**	**CTR04**	**CTR05**	**CTR06**	**CTR07**
Arrival at Station	10:33	10:12	9:59	9:46	9:28	8:54	8:16
Total Depth[1] (ft)	7.1	19.4	5.3	8.9	7.3	17.8	8.5
Total Depth (m)	2.2	5.9	1.6	2.7	2.2	5.4	2.6
Sample Time	10:37	10:15	10:02	9:48	9:32	9:00	8:34
Sonde Grab Data							
Temp (degrees C)	24.282	24.724	24.619	24.174	24.118	23.984	25.56
Pressure (mmHg)	762.8	762.9	763	762.9	763.1	762.9	762.9
D.O. (% saturation)	88.3	100.4	104.9	99.1	98.9	97.1	94.6
D.O. (mg/l)	7.33	8.27	8.57	8.03	8.06	7.88	7.61
Specific Conductivity (us/cm)	2371	2678	6350	10927	9339	10579	16203
Salinity (ppt)	1.25	1.31	3.51	6.19	5.18	5.99	9.72
pH (s.u.)	7.55	7.68	7.74	7.65	7.65	7.65	7.58
Depth of Sonde (m)	1.012	0.984	1.037	1.02	1.207	1.075	1.07

1. Total depth taken from Raymarine A70b GPS/Sounder unit.

Table 13 – Sonde Grab Data - August 28, 2017							
	CTR01	CTR02	CTR03	CTR04	CTR05	CTR06	CTR07
Arrival at Station	10:09	---	---	---	---	9:25	---
Total Depth (ft)	7.9	---	---	---	---	15.6	---
Total Depth[1] (m)	2.4	---	---	---	---	4.8	---
Sample Time	10:12	---	---	---	---	9:29	---
Sonde Grab Data							
Temp (degrees C)	23.173	---	---	---	---	23.197	---
Pressure (mmHg)	770.1	---	---	---	---	770.4	---
D.O. (% saturation)	90.8	---	---	---	---	97.3	---
D.O. (mg/l)	7.63	---	---	---	---	7.99	---
Specific Conductivity (us/cm)	4580	---	---	---	---	12185	---
Salinity (ppt)	2.44	---	---	---	---	7.07	---
pH (s.u.)	7.47	---	---	---	---	7.62	---
Depth of Sonde (m)	1.006	---	---	---	---	0.98	---

1. Depth taken with EPA Atlantic Ecology Division data sonde. YSI EXO2. Property Tag: B27852.

Table 14 – Sonde Grab Data - September 11, 2017							
	CTR01	CTR02	CTR03	CTR04	CTR05	CTR06	CTR07
Arrival at Station	9:39	9:20	8:59	8:09	8:19	7:45	7:21
Total Depth[1] (ft)	7.5	22.3	5.6	9.0	8.0	14.4	9.9
Total Depth (m)	2.3	6.8	1.7	2.7	2.4	4.4	3.0
Sample Time	9:44	9:25	9:02	8:39	8:22	7:48	7:28
Sonde Grab Data							
Temp (degrees C)	20.024	20.332	20.273	20.138	20.261	19.879	19.943
Pressure (mmHg)	769.5	769.8	770.1	769.9	769.8	770.0	769.9
D.O. (% saturation)	93	93.9	94.3	89.8	92.4	88	89
D.O. (mg/l)	8.44	8.48	8.48	8.07	8.30	7.86	7.86
Specific Conductivity (us/cm)	234.8	197.8	651	2843	2022	6230	9137
Salinity (ppt)	0.11	0.09	0.31	1.43	1.06	3.25	5.36
pH (s.u.)	7.64	7.52	7.64	7.49	7.57	7.49	7.41
Depth of Sonde (m)	1.005	1.085	0.998	1.014	1.004	0.991	0.98

1. Total depth taken from Raymarine A70b GPS/Sounder unit.

Monday, September 25, 2017							
	CTR01	CTR02	CTR03	CTR04	CTR05	CTR06	CTR07
Arrival at Station	9:25	9:01	8:41	8:25	8:09	7:46	7:32
Total Depth[1] (ft)	8.4	23.6	5.3	9.9	7.7	14.8	11.0
Total Depth (m)	2.6	7.2	1.6	3.0	2.3	4.5	3.4
Sample Time	9:28	9:09	8:45	8:29	8:14	7:50	7:35
Sonde Grab Data							
Temp (degrees C)	21.940	22.052	21.636	21.227	21.480	21.450	21.322
Pressure (mmHg)	763.8	763.8	763.5	763.5	763.5	763.2	763.1
D.O. (% saturation)	102.0	101.6	100.0	97.9	96.2	98.2	98.8
D.O. (mg/l)	8.67	8.67	8.43	8.15	8.08	8.24	8.14
Specific Conductivity (us/cm)	8892	7258	12877	18697	14804	15091	21874
Salinity (ppt)	4.98	4.04	7.39	11.00	8.62	8.99	13.45
pH (s.u.)	7.72	7.72	7.74	7.74	7.71	7.75	7.81
Depth of Sonde (m)	1.013	0.952	1.068	1.098	1.027	0.919	1.150

1. Total depth taken from Raymarine A70b GPS/Sounder unit.

Quality Assurance/Quality Control

A scoping meeting was held on July 24, 2017 with the project manager, EPA's laboratory team lead, chemists and biologists.

A project specific Quality Assurance Project Plan for the Connecticut river Nutrient Sampling Project was developed, reviewed, and approved.

Data sondes were precalibrated by EPA Atlantic Ecology Division prior to each sampling event.

Record keeping for each sampling date includes: chain of custody, laboratory results, field logbook data, and sonde calibration records.

All laboratory analytical results were reviewed by EPA laboratory leads according to the most current laboratory Quality Manual.

Attachment A – Connecticut River Nutrient Sampling Locations