Water Quality Data Report
For
The Norwalk River Watershed
October 2009 through April 2010

View of Factory Pond in the Norwalk River

Submitted by:

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Funded by:
The Fairfield County Community Foundation, The Wilton Inland Wetlands Commission, King Industries, Norwalk River Watershed Association, Inc., NRG-Manresa, Town of Ridgefield, Norm Bloom, Leslie Miklovich, and Trout Unlimited

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To: The Fairfield County Community Foundation, The Wilton Inland Wetlands Commission, King Industries, Norwalk River Watershed Association, Inc., NRG-Manresa, Town of Ridgefield, Norm Bloom, Leslie Miklovich, and Trout Unlimited

From: Dick Harris, Principal Investigator, Earthplace, Harbor Watch/River Watch Program

Date: June 10, 2010

Subject: The Norwalk River Watershed Project Water Quality Report for the period of October 2009 through April 2010

I. Introduction:

Purpose of Study: The Earthplace Harbor Watch/River Watch (HW/RW) Program was funded by the Connecticut Department of Environmental Protection (CT DEP) to conduct water quality monitoring on the Norwalk River for six years, June 1998 through June 2005. HW/RW collected and analyzed water samples for both fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria at a total of 12 sites, eleven of them along the main stem of the Norwalk River and one on the Silvermine River (Figure A2).

Background: From June 1998 through May 1999, HW/RW conducted a first-year water quality monitoring study in the Norwalk River Watershed. This study was funded by the CT DEP and was intended to provide water quality information in support of the Norwalk River Watershed Initiative. The purpose of the study was to obtain data on the levels of fecal coliform bacteria, dissolved oxygen, and conductivity at selected locations in the Norwalk River and in its major tributaries (Silvermine River, Comstock Brook and Cooper Brook). The study indicated that fecal coliform bacteria levels frequently exceeded the state's water quality criterion for Class B water at a number of sites along the Norwalk River. Most sites met the dissolved oxygen level CT DEP criterion for Class B waters. The first year study also showed that conductivity levels were consistently higher in the upper reaches of the watershed than in the lower watershed. Based upon the water quality data collected, HW/RW determined that the water quality in the Norwalk River Watershed was moderately impaired.

The CT DEP and HW/RW executed a contract for the second year funding in September 1999; the second year monitoring period was from September 1, 1999 through November 30, 2000. HW/RW was authorized to begin testing for *E. coli* bacteria in November 1999. Sampling took place at 12 sites along the Norwalk River. Monthly reports were prepared and submitted to the CT DEP and disseminated to the seven towns comprising the Norwalk River Watershed as well as the Norwalk River Watershed Initiative Advisory Committee.

Funding was then made available by the CT DEP to continue testing on the Norwalk River for a third summer (April 1 to September 30, 2001) based on a continuing interest by Norwalk River Watershed Advisory Committees and the CT DEP. The same testing protocols used in 2000 by HW/RW were again used under the original QAPP, which was extended on April 25, 2001 to September 30, 2001 by the EPA's Office of Environmental Measurement and Evaluation.

During 2002, the CT DEP switched to *E. coli* bacteria as the "preferred" indicator species for freshwater. *E.* coli is one of the two bacteria components of the fecal coliform bacteria group, and it is a more specific indicator of fecal material arising from humans and other warm-blooded animals. For recreational waters, the US EPA recommends the use of *E. coli* because it is a better indicator of a human health risk from water contact than fecal coliform bacteria (Table 1).

Additional 319 funding was allocated to continue the HW/RW testing regime on the Norwalk River for twenty-three months beginning July 2002 and ending June 30, 2004. The last contract with the CT DEP expired on 6/30/05. Renewed testing of the Norwalk River and its tributaries began on May 1, 2005 based on the interest and generosity of the Town of Wilton, The Norwalk River Watershed Association, King Industries, and NRG Inc. at Manresa. Going forward, The Fairfield County Community Foundation, The Wilton Inland Wetlands Commission, King Industries, Norwalk River Watershed Association, Inc., NRG-Manresa, Town of Ridgefield, Norm Bloom, Leslie Miklovich, and Trout Unlimited have continued to provide additional funds to support the 2009/2010 monitoring season.

Although these monthly reports are submitted to the CT DEP for review and comment, Harbor Watch/River Watch is solely responsible for the collection, analysis and interpretation of the water quality data.

II. Methods and Procedures:

Water monitoring is carried out under protocols of an EPA approved and revised EPA Quality Assurance Project Plan (QAPP). Monitoring teams leave the Earthplace in Westport between 9:30AM and 10:00AM, and return in early afternoon. Each team is comprised of an experienced leader and one or two trained volunteers. Water samples are collected at 12 (Figure A2) monitoring sites within the watershed (QAPP Appendix A1.1). These sites, which represent the more impacted areas, were selected in concert with the CT DEP, because results from the first year's study consistently demonstrated elevated fecal coliform bacteria counts at these locations. In addition to focusing monitoring efforts at these sites, it was determined to analyze for both fecal coliform and *E. coli* bacteria.

The following tests are run *in situ*: dissolved oxygen (QAPP Appendix A3.1) and conductivity (QAPP Appendix A3.5). Water and air temperatures, as well as general observations and storm events are also recorded at each site visit. Observations are recorded (QAPP Appendix 5) on the HW/RW Data Sheet.

Upon return to the lab, fecal coliform and *E. coli* bacteria membrane filtration tests (QAPP Appendix A3.10) are performed and analyzed according to Standard Methods, 21st edition (9222D & 9222G) and recorded (QAPP Appendix 5) on the HW/RW bacteria log. The frequency of which water quality monitoring for bacteria concentrations occurs is separated into two seasonal testing periods. For the period when the three wastewater treatment plants (WTP) are required to disinfect their wastewater effluent (April 1st to October 30th) monitoring is done four times per month. For the period when effluent disinfection is not required (November1st to March 31st) monitoring is done monthly.

E. coli bacteria will be evaluated using the criteria published in the CT DEP Surface Water Quality Standards, 12/17/02. The CT DEP *E. coli* criteria for Class AA, A, and B water are established at three levels (Table 1).

Table 1 CT DEP criterion for *E. coli* bacteria levels as applied to recreational use, effective 12/17/02

Designated Use Recreation	Class	Indicator	Criteria
Designated Swimming	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 235 CFUs/100mLs
Non-designated Swimming	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 410 CFUs/100mLs
All Other Recreational Uses	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 576 CFUs/100mLs

The Norwalk River is classified by the CT DEP for "all other recreational uses" because the river is too shallow with the exception of a few impoundments. The report will focus on *E. coli* bacteria levels, because it is the indicator bacteria of choice by the CT DEP. Fecal coliform bacteria levels are reported on Table B1 only as additional data for those who may be interested.

III. Results:

With the exception of Site NR22 (Ridgefield waste water treatment plant discharge) all monitoring sites on the Norwalk River met the CT DEP geometric mean criterion for a Class B river (Table 1, Table 2, Figure 1). Nevertheless, due to a large storm on 12/3 where 0.73 inches of rain (Table B1) fell just prior to the morning testing period all monitoring sites exceeded the CT DEP single sample maximum (55 µS) criterion of < 576 CFU/ 100 mLs[11].

All observed dissolved oxygen (DO) means and all observed individual values met the CT DEP criterion of 5 mg/L for a Class B river (Figure 2).

Observed conductivity means vary from a maximum of 837 µS at Site NR22 to a minimum of 259 µS at Site SM3 (Figure 3, Table 4). Individual site ranges (a measure of stability) were a maximum of 707 µS at Site NR22 to a minimum of 141 µS at Site SM3.

Table 2 October 22, 2009 through April 8, 2010 *E. coli* bacteria concentrations, geometric means and % frequency exceeding 576 colonies/100 mLs at 12 sampling sites in the Norwalk River Watershed for the period of time when the two Ridgefield and the Georgetown wastewater treatment facilities are not required by NPDES permits to disinfect effluent discharges

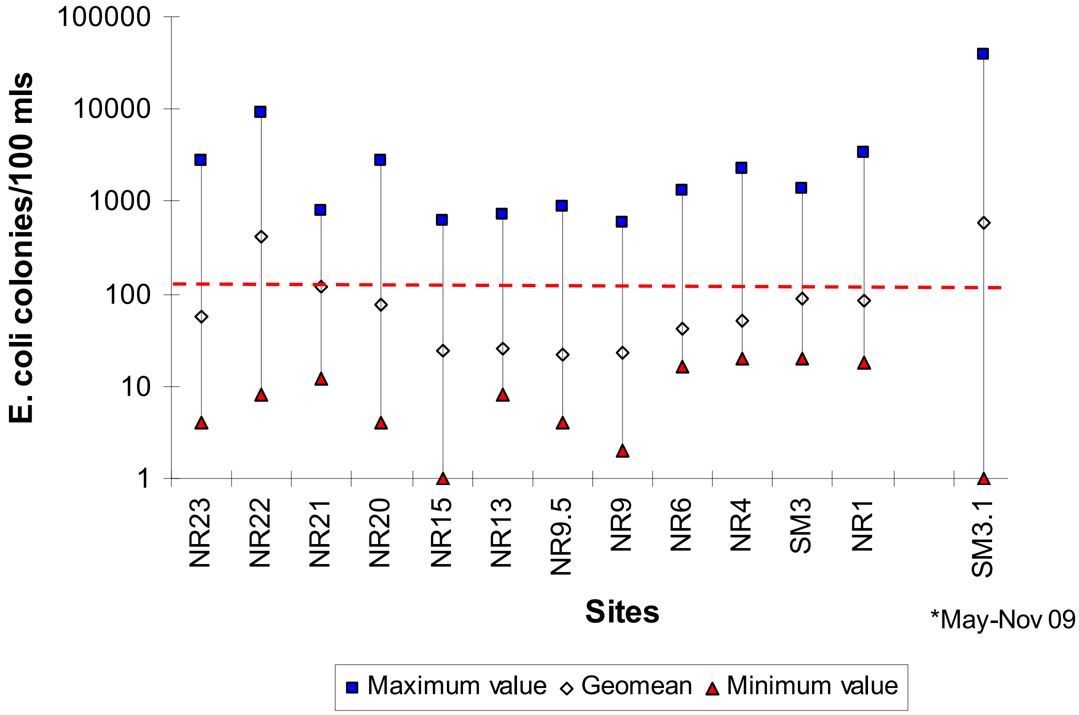
	Dates								
Sites	10/22/2009	11/5/2009	12/3/2009	1/7/2010	3/4/2010	3/18/2010	4/8/2010	**Geomean**	%frequency over 576 colonies/100mLs
NR23	72	4	2800	180	300	6	8	**58**	14.29%
NR22	10		9000	5400	1400	8	900	**412**	66.67%
NR21	12	44	800	500	56	740	42	**120**	28.57%
NR20	24	4	2800	360	72	40	54	**76**	14.29%
NR15	28	20	630	28	18	1	26	**24**	14.29%
NR13	8	40	710	10	12	12	20	**25**	14.29%
NR9.5	4	20	890	24	8	10	18	**22**	14.29%
NR9	36	24	600	14	22	10	2	**23**	14.29%
NR6	28	16	1300	20	40	20	24	**42**	14.29%
NR4	32	20	2300	44	20	28	26	**51**	14.29%
SM3.1	1000	38000							
SM3	52	1000	1400	30	20	32	36	**91**	28.57%
NR1	92	40	3400	140	44	26	18	**86**	14.29%
Rainfall (in.)	0.58	0.02	0.73	0.02	0.09	3.69*	0.00		
Days prior	4	4	0	6	1	4	7		

Table 3 Maximum, minimum, mean and site range conductivity values (µS) at 12 monitoring sites on the Norwalk River from 10/22/09 to 4/8/10

Site	NR23	NR22	NR21	NR20	NR15	NR13	NR9.5	NR9	NR6	NR4	SM3	NR1
Max	1145	913	779	748	683	542	505	445	442	451	398	403
Min	639	206	305	230	368	255	201	206	222	208	207	192
Mean	837	697	599	531	506	380	360	296	318	322	259	521
Range	506	707	469	518	315	287	304	239	220	243	141	211

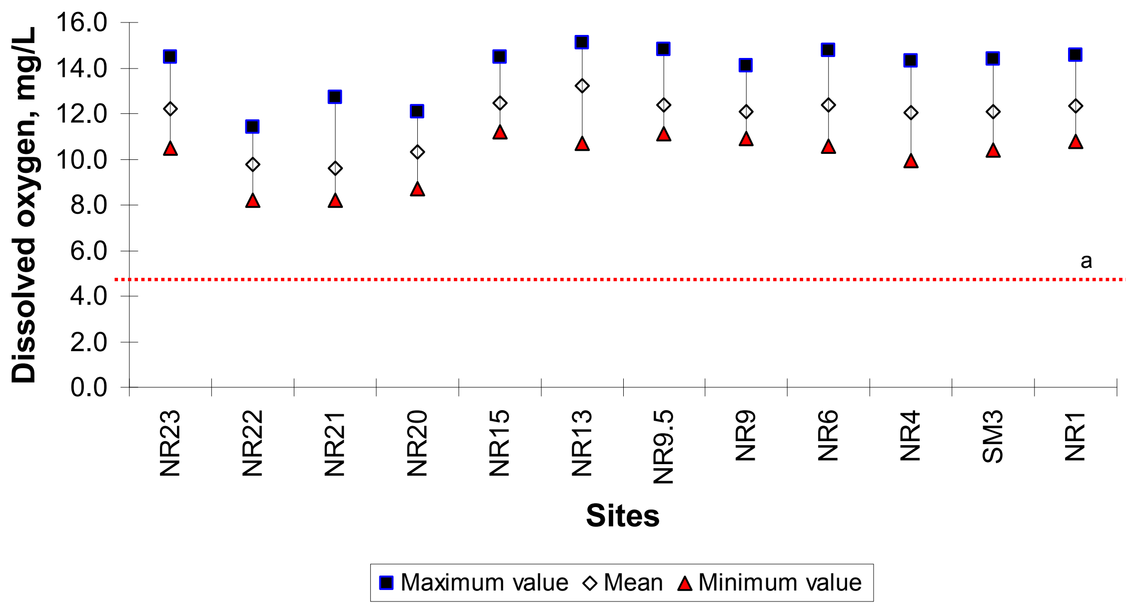
[1] If more than 10% of all data points for a single site exceed the SSM the site exceeds the CT DEP criterion for a Class B river.

Figure 1 Maximum, geometric means, and minimum values of *E. coli* bacteria concentrations at 12 monitoring sites in the Norwalk River Watershed from October 22, 2009 through April 8, 2010 when the two Ridgefield and one Georgetown wastewater treatment facilities are not required by NPDES permits to disinfect sewage effluent



[a]CT DEP geomean maximum value for a Class B river

Figure 2 Maximum, mean and minimum values for dissolved oxygen at 12 sampling sites on the Norwalk River Watershed from October 22, 2009 through April 8, 2010



[a]CT DEP minimum value for a Class B river

Figure 3 Maximum, mean and minimum value for conductivity at 12 sampling sites in the Norwalk River Watershed from October 22, 2009 through April 8, 2010

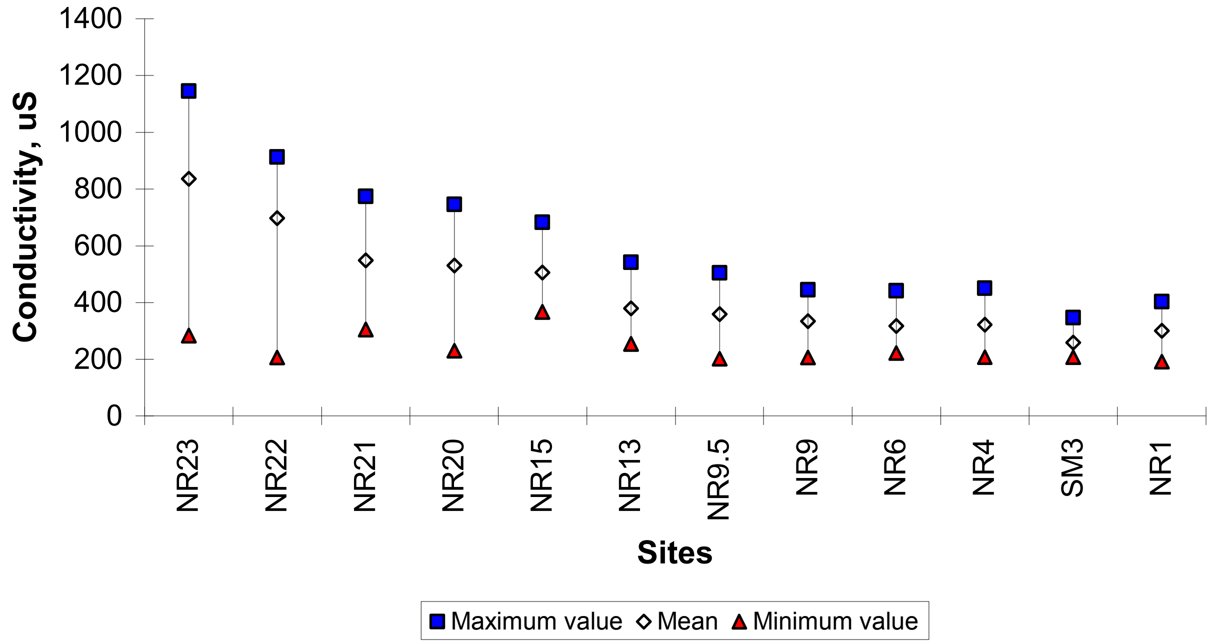
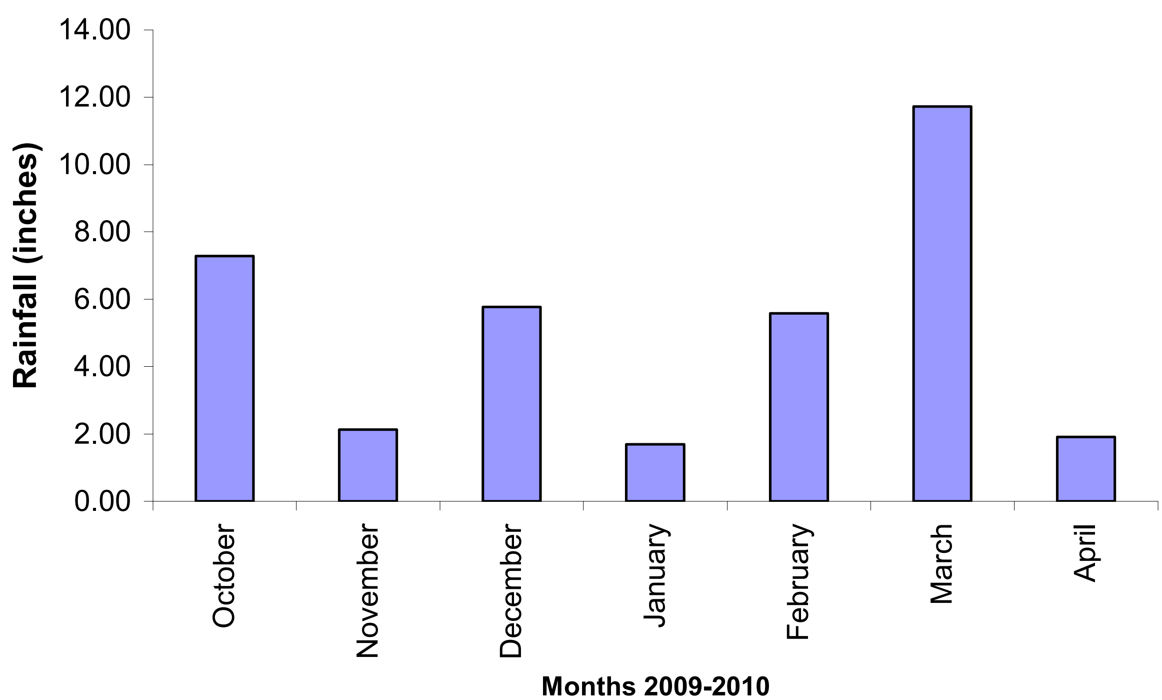


Figure 4 Monthly rainfall (inches) from October 22, 2009 to April 8, 2010



IV. Discussion:

Rainfall during the period was light during the months of November ’09, January ’10, and April ’10 at two inches or less. Alternatively rainfall was heavy during October ’09, December ’09 and February ’10 with a record eleven inches falling in March ’10 (Figure 4). Because the Norwalk River is monitored once a month during the winter only, 12/3/09 showed the immediate effect of a heavy rain with 0.73 inches falling just before testing began (Table B1). Due to the storm, all monitored sites exceed the CT DEP SSM (Table 2). The Ridgefield WTP kept its UV lights on for the month of October and November in an unusual move to demonstrate their effectiveness to a visiting group of students and municipal employees (Table 2). Cold weather also played a role in reducing the bacteria count for March 2010 (Table 2). This was not enough to keep the effluent discharge from exceeding the CT DEP geometric mean of <126 CFU/100 mLs (Table 2).

During late November 2009, a HW/RW team discovered a major breakout of raw sewage in the Silvermine River at a pipe[2] (Site 3.1) just upstream from the James Street Bridge (Table 2). The pipe, which was originally thought to be tied into the James Street storm drain system, was found, upon inspection, to be an overflow pipe for a dam in the Silvermine River just to the north of the James Street Bridge. When a home on James Street got a new septic system in 2007, the installer laid the new tank on top of the pipe and crushed it. The City of Norwalk quickly followed up on the HW/RW information and the problem was solved with yet another new septic system and rerouting of the pipe.

All observed dissolved oxygen (DO) means and observed individual readings met the CT DEP DO criterion of 5 mg/L or greater (Figure 2).

Observed conductivity values show the usual pattern for the river with elevated conductivity means at the headwaters (Site NR23 to Site NR20) being diluted down to progressively lower values as Cooper Brook (confluence above Site NR15), Bennett’s Brook (confluence above Site NR9.5), Comstock Brook (confluence above Site SM6) and the Silvermine River (confluence above Site NR1) all join the main stream (Figure 3). The elevated conductivity means at the headwaters are due to the presence of limestone beds which raise the ionic strength of the river. The minimum observed conductivity values observed by HW/RW occurred with the heavy rain on 12/3/09 (Table B1, Figure 3). The maximum observed conductivity values occurred on 10/22/09 during a dry period (Table B1, Figure 3). What is not understood is why observed conductivity values at the headwaters of the Norwalk River have such a wide conductivity range (Figure 3) where impervious surfaces and housing density is far less than what is found in Norwalk. Norwalk testing sites show greatly reduced conductivity ranges which does not equate with increased housing density and impervious surface area (Figure 3).

V. Conclusion

Although the data presented here shows an improved river with lower bacteria counts, it must be remembered that only one major storm hit the area during the monitoring days as can be observed on 12/3/2009 (Table 2). The problem of extensive runoff cannot be disregarded (Table 2).

Also to be noted when the Ridgefield WTP leaves its UV lights on into the winter months, as was done in October and November of 2009, there is a remarkable reduction of bacteria in the upper river. HW/RW does not understand why UV lights can not be utilized on a year round basis on what is a minimal cost. This question has been raised many times by many people with no results to date.

[2] This drainage pipe had been under surveillance by HW/RW during the summer months of 2009. Repetitive E. coli tests showed elevated bacteria on a sporadic basis. It took the breakout to confirm that a sewage problem existed.

VI. Index of Figures, Tables, and Appendices:

VII. References

Belluci, C., M.B. Beauchene, and M. Becker. 2009. Physical, Chemical and Biological attributes of least disturbed watersheds in Connecticut, CT Department of Environmental Protection, Bureau of Water Protection and Land Reuse, Planning Standards Division, Hartford, CT, 2009

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Harris, R. B. and P. J. Fraboni: Quality Assurance/Quality Control Plan for the Norwalk River Watershed Monitoring Project (QA No. CT00162) (re-approved October 2001 and extending to September 2002).

Harris, R. B. and P. J. Fraboni. 2006. Water Quality Data Final Report for the Norwalk River Watershed (June 2006 –May 2006).

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Howe, B.L., J.S. Ramsey, and S.W. Kelley. 2002. Nitrogen Modeling to Support Watershed Managers: Comparison of Approaches and Sensitivity Analysis

US Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria, US EPA 440/5-84-002, Washington, DC.

VIII. Reporting Period

Summary report for a seven month monitoring period, October 2009 through April 2010

Monthly and Quarterly progress reports are available from June 1998 through September 2009

cc: Norwalk River Watershed Initiative Committee Co-Chairs
Norwalk River Watershed Association
Norwalk River Watershed Towns- Conservation Commissions- Norwalk, Wilton, Ridgefield, and Redding

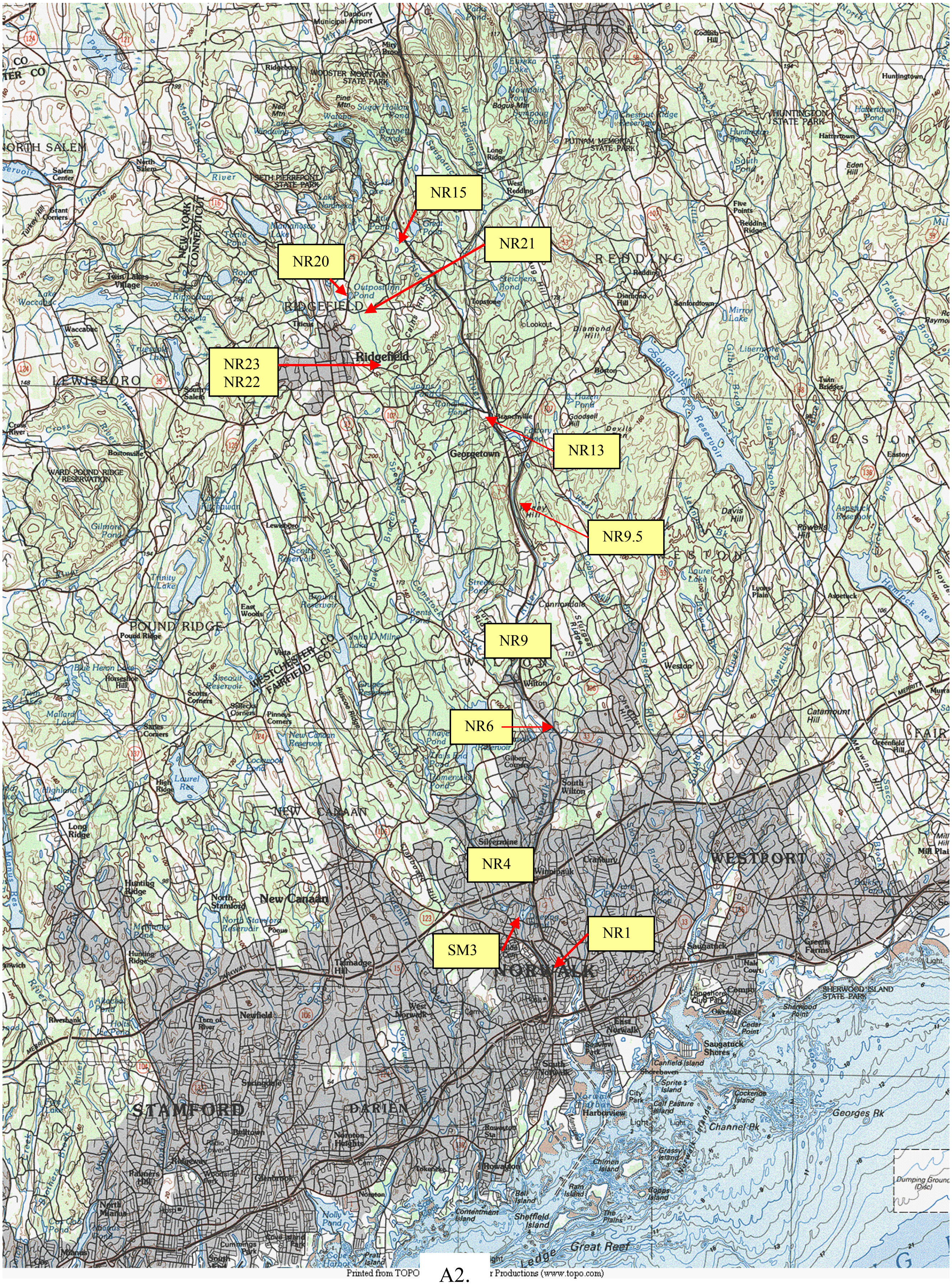
Appendix A

Table A1 Site number identification, site location and town for sampling and testing (headwaters to mouth), *=tributary to the Norwalk River

Site No.	Site Area	Town	GPS Coordinates
NR21	Farmingville Road at the Great Swamp outlet	Ridgefield	Latitude: N 41° 17’ 40.2” Longitude: W 73° 29’ 18.5”
NR20	Route 35 at Fox Hill Condos	Ridgefield	Latitude: N 41° 17’ 52.1” Longitude: W 73° 29’ 32.2”
NR15	Stonehenge Road at the top of the dam	Ridgefield	Latitude N 41° 18’ 32.0” Longitude: W 73° 28’ 8.3”
NR13	Branchville at the railroad station (Route 7)	Ridgefield/Wilton	Latitude: N 41° 15’ 55.8” Longitude: W 73° 26’ 27.2”
NR 9.5	Downstream of the Georgetown Wastewater Treatment Plant -- Old Mill Road	Wilton	Latitude: N 41° 14’ 46.0” Longitude: W 73° 26’ 2.5”
NR9	School Road	Wilton	Latitude: N 41° 12’ 15.3” Longitude: W 73° 25’ 51.6”
NR6	Near Wolfpit Road in back of the Wilton Corporate Office Complex	Wilton	Latitude: N 41° 11’ 0.1” Longitude: W 73° 25’ 18.4”
NR4	Upstream of Route 15 (Glover Avenue) and downstream of the Merritt 7 Office Complex	Norwalk	Latitude: N 41° 8’ 3.5” Longitude: W 73° 25’ 35.8”
SM3*	James Street (on the Silvermine River)	Norwalk	Latitude: N 41° 8’ 10.3” Longitude: W 73° 26’ 4.0”
NR1	Post Road (US Route 1) adjacent to the Ash Creek Grille Restaurant	Norwalk	Latitude: N 41° 7’ 10.8” Longitude: W 73° 25’ 1.3”

Site No.	Site Area	Town	GPS Coordinates
NR23	Steep Brook next to South Street WTP	Ridgefield	Latitude: N 41° 17’ 24.3” Longitude: W 73° 29’ 35.6”
NR22	South Street WTP outfall	Ridgefield	Latitude: N 41° 17’ 26.8” Longitude: W 73° 29’ 29.6”

Figure A2 Location of sampling sites located in the Norwalk River Watershed



Appendix B

Table B1 Site, date, time, air temperature, water temperature, dissolved oxygen, conductivity, fecal coliform bacteria, *E. coli* bacteria, amount of rainfall, days prior to sampling, and QAQC activity in the Norwalk River Watershed October 2009 to April 2010

Site	Date	Time	Air Temp. ° C	Water Temp. ° C	D.O. mg/L	COND. umho/cm	Fecal Coliform. CFU/100 mL	E. coli CFU/100 mL	Amount of rain (in)	Days prior to sampling	QA/QC	Fecal Coliform. CFU/100 mL
NR 23	10/22/2009	1037	20.0	9.6	10.5	1145	76	72	0.58	4	Replicate	80
NR 22	10/22/2009	1050	17.0	13.7	8.2	880	11	10	0.58	4		
NR 21	10/22/2009	1057	17.0	8.8	8.2	774	12	12	0.58	4	Field Blank	0
NR 20	10/22/2009	1105	18.0	8.8	9.4	746	24	24	0.58	4		
NR 15	10/22/2009	1114	18.0	8.5	11.2	683	28	28	0.58	4		
NR 13	10/22/2009	1138	18.0	8.7	11.8	542	8	8	0.58	4	Duplicate	4
NR 9.5	10/22/2009	1133	24.0	9.8	11.2	505	4	4	0.58	4		
NR 9	10/22/2009	1120	22.0	10.3	11.2	445	36	36	0.58	4		
NR 6	10/22/2009	1104	22.0	10.5	10.6	442	28	28	0.58	4		
NR 4	10/22/2009	1040	20.0	11.3	11.3	451	40	32	0.58	4	Field Blank	0
SM 3.1	10/22/2009	1037	sample only				1000	1000	0.58	4		
SM 3	10/22/2009	1036	17.0	10.1	10.5	296	52	52	0.58	4	Replicate	56
NR 1	10/22/2009	1015	16.0	10.7	11.6	403	132	92	0.58	4		
NR 23	11/5/2009	1048	12.0	8.9	11.1	639	4	4	0.02	4		
NR 22	11/5/2009	1055	10.0	8.5	11.4	558	0	0	0.02	4	Field Blank	0
NR 21	11/5/2009	1038	9.5	7.7	9.2	430	52	44	0.02	4	Replicate	28
NR 20	11/5/2009	1104	9.0	7.2	10.2	400	8	4	0.02	4		
NR 15	11/5/2009	1112	9.0	8.1	11.6	368	32	20	0.02	4	Duplicate	20
NR 13	11/5/2009	1125	11.0	8.5	12.1	258	44	40	0.02	4		
NR 9.5	11/5/2009	1224	14.0	9.3	12.2	357	24	20	0.02	4		
NR 9	11/5/2009	1204	11.0	9.1	11.5	342	24	24	0.02	4	Replicate	12
NR 6	11/5/2009	1147	13.0	9.2	11.9	344	20	16	0.02	4	Duplicate	16
NR 4	11/5/2009	1140	14.0	9.3	11.8	343	20	20	0.02	4		
SM 3.1	11/5/2009						40000	38000	0.02	4	Field Blank	0
SM 3	11/5/2009	1032	15.0	9.5	11.5	348	1000	1000	0.02	4		
NR 1	11/5/2009	1017	12.0	9.5	11.8	311	70	40	0.02	4		
NR 23	12/3/2009	1100	18.0	11.4	10.9	284	2800	2800	0.73	0	Duplicate	4400
NR 22	12/3/2009	1110	18.0	13.3	9.6	610	9400	9000	0.73	0	Field Blank	0
NR 21	12/3/2009	1118	19.0	10.4	8.3	305	900	800	0.73	0	Replicate	1500
NR 20	12/3/2009	1120	18.0	10.2	8.7	230	3700	2800	0.73	0		
NR 15	12/3/2009	1137	18.5	9.8	11.3	389	710	630	0.73	0		
NR 13	12/3/2009	1150	17.0	9.8	10.7	255	770	710	0.73	0		
NR 9.5	12/3/2009	1131	19.0	9.7	11.3	201	1100	890	0.73	0	Duplicate	960
NR 9	12/3/2009	1115	19.0	9.6	11.0	206	900	600	0.73	0	Field Blank	0
NR 6	12/3/2009	1058	20.0	9.2	11.9	222	1500	1300	0.73	0	Replicate	1500
NR 4	12/3/2009	1042	22.0	9.8	9.9	208	2100	2300	0.73	0		
SM 3.1	12/3/2009	N/A							0.73	0		
SM 3	12/3/2009	1027	19.0	9.1	11.4	207	1400	1400	0.73	0		
NR 1	12/3/2009	1010	19.0	9.7	10.8	192	3600	3400	0.73	0		
NR 23	1/7/2010	1055	5.0	8.0	14.5	1063	200	180	0.02	6	Field Blank	0
NR 22	1/7/2010	1105	5.0	2.3	9.7	882	5700	5400	0.02	6		
NR 21	1/7/2010	1038	5.0	1.2	10.2	720	500	500	0.02	6		
NR 20	1/7/2010	1120	4.0	0.8	10.4	712	360	360	0.02	6	Duplicate	400
NR 15	1/7/2010	1132	5.0	1.0	14.5	650	28	28	0.02	6	Replicate	32
NR 13	1/7/2010	1146	5.0	1.0	15.1	488	10	10	0.02	6		
NR 9.5	1/7/2010	1132	6.0	1.0	14.8	400	24	24	0.02	6		
NR 9	1/7/2010	1118	6.0	1.4	14.1	366	16	14	0.02	6	Replicate	26
NR 6	1/7/2010	1102	5.0	1.0	14.8	333	20	20	0.02	6	Duplicate	20
NR 4	1/7/2010	1046	9.0	1.4	14.3	338	44	44	0.02	6	Field Blank	0
SM 3.1	1/7/2010	1036	pipe was no longer present due to installation of a new by pass system						0.02	6		
SM 3	1/7/2010	1035	1.0	0.8	14.4	271	34	30	0.02	6		
NR 1	1/7/2010	1021	4.0	1.1	14.6	324	172	140	0.02	6		
NR 23	3/4/2010	1025	5.0	4.2	14.0	1038	320	300	0.09	1		
NR 22	3/4/2010	1036	6.0	7.9	10.5	913	1400	1400	0.09	1		
NR 21	3/4/2010	1043	6.5	1.3	12.7	584	56	56	0.09	1	Replicate	44
NR 20	3/4/2010	1051	6.0	2.0	11.9	636	76	72	0.09	1	Duplicate	n/g
NR 15	3/4/2010	1104	7.0	4.0	14.3	556	30	18	0.09	1	Field Blank	0
NR 13	3/4/2010	1123	7.0	3.4	14.9	408	28	12	0.09	1		
NR 9.5	3/4/2010	1131	10.0	3.7	14.0	388	10	8	0.09	1		
NR 9	3/4/2010	1117	11.0	4.3	13.8	362	22	22	0.09	1		
NR 6	3/4/2010	1104	7.0	4.0	14.0	323	44	40	0.09	1	Field Blank	0
NR 4	3/4/2010	1048	9.0	4.0	13.8	330	20	20	0.09	1		
SM 3.1	3/4/2010		pipe replaced with new dam bypass						0.09	1		
SM 3	3/4/2010	1037	7.0	3.6	13.8	254	22	20	0.09	1	Duplicate	40
NR 1	3/4/2010	1018	9.0	4.0	13.8	316	48	44	0.09	1	Replicate	52
NR 23	3/18/2010	1052	15.0	7.8	13.8	944	6	6	3.69*	4	Duplicate	4
NR 22	3/18/2010	1111	17.0	9.2	10.4	834	16	8	3.69*	4	Field Blank	0
NR 21	3/18/2010	1122	17.0	7.8	10.3	520	1100	740	3.69*	4		
NR 20	3/18/2010	1132	16.0	8.4	9.6	451	60	40	3.69*	4		
NR 15	3/18/2010	1144	17.0	8.5	12.9	429	8	0	3.69*	4		
NR 13	3/18/2010	1158	16.0	8.2	14.7	328	14	12	3.69*	4		
NR 9.5	3/18/2010	1217	16.0	8.5	12.3	317	16	10	3.69*	4	Replicate	12
NR 9	3/18/2010	1204	15.0	8.6	12.0	300	12	10	3.69*	4		
NR 6	3/18/2010	1150	14.5	8.3	12.1	269	20	20	3.69*	4	Field Blank	0
NR 4	3/18/2010	1131	14.1	8.2	12.1	282	46	28	3.69*	4	Duplicate	38
SM 3	3/18/2010	1117	22.0	7.2	12.7	228	34	32	3.69*	4		
NR 1	3/18/2010	1058	21.5	7.6	12.4	270	40	26	3.69*	4		
NR 23	4/8/2010	1054	30.0	14.3	10.6	745	8	8	0.00	7		
NR 22	4/8/2010	1105	31.0	12.9	8.6	206	1300	900	0.00	7	Field Blank	0
NR 21	4/8/2010	1113	31.0	18.0	8.3	510	50	42	0.00	7		
NR 20	4/8/2010	1130	33.0	17.9	12.1	544	66	54	0.00	7		
NR 15	4/8/2010	1140	31.0	18.3	11.5	469	34	26	0.00	7	Duplicate	34
NR 13	4/8/2010	1212	37.0				22	20	0.00	7	Replicate	18
NR 9.5	4/8/2010	1143	27.0	17.2	11.1	352	18	18	0.00	7	Replicate	8
NR 9	4/8/2010	1129	25.0	16.4	10.9	322	2	2	0.00	7		
NR 6	4/8/2010	1114	25.0	15.9	11.4	296	28	24	0.00	7		
NR 4	4/8/2010	1055	25.0	15.7	11.0	304	26	26	0.00	7	Field Blank	0
SM 3	4/8/2010	1045	20.0	15.6	10.4	215	50	36	0.00	7		
NR 1	4/8/2010	1031	20.5	16.0	11.2	288	22	18	0.00	7		

Table B2 Results of fecal coliform bacteria counts (colonies/100 mLs) inter-laboratory services with the Norwalk Public Health Laboratory (NPHL)

Date	Site	Fecal coliform bacteria counts (NPHL)	Fecal coliform bacteria counts HW/RW Lab
10/22/2009	NR13	8	8/4
10/22/2009	NR1	72	132
11/5/2009	NR15	n/a	32/20
11/5/2009	NR6	n/a	20/16
12/3/2009	NR23	n/a	2800
12/3/2009	NR9.5	n/a	1100/960
1/7/2010	NR20	n/a	360/400
1/7/2010	NR6	n/a	20/20
3/4/2010	NR20	n/a	76/ng
3/4/2010	SM3	n/a	22/40
3/18/2010	NR23	n/a	6/4
3/18/2010	NR4	n/a	46/38
4/8/2010	NR15		34/34
4/8/2010	NR6		28

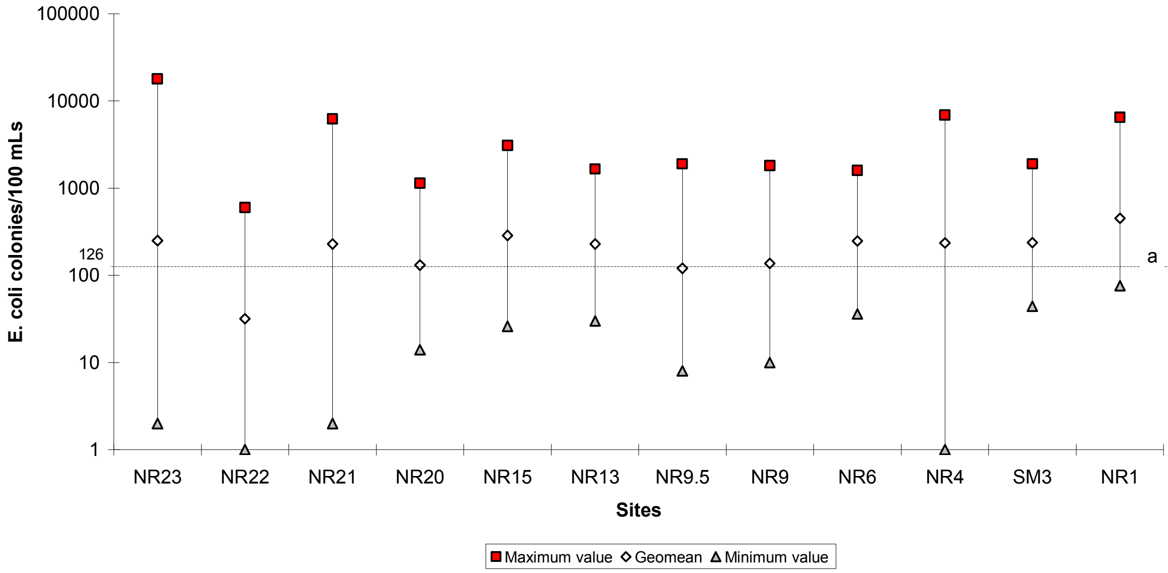
Appendix C

How to read the graphs in this report:

Monitoring data are presented in this report with graphs and tables. Selected Figures and Tables are used to highlight critical parameters of the Norwalk River's water quality on either a monthly or total project basis. The following are some examples of the types of graphs and how to read them.

Graphs of Physical and Bacteria Data
Physical and bacteria data are graphed in the following way:
During a sampling period (usually a three month period) the *E. coli* colony concentration, the dissolved oxygen level and the conductivity are graphed by displaying the maximum value, the minimum value, and the mean or geomean value for each sampling site. The graph below is an example of a graph displaying *E. coli* counts

An example of a graph for maximum, geometric means, and minimum values of *E. coli* bacteria concentrations at 12 monitoring sites in the Norwalk River Watershed when the two Ridgefield and one Georgetown wastewater treatment facilities are required by NPDES permits to disinfect sewage effluent

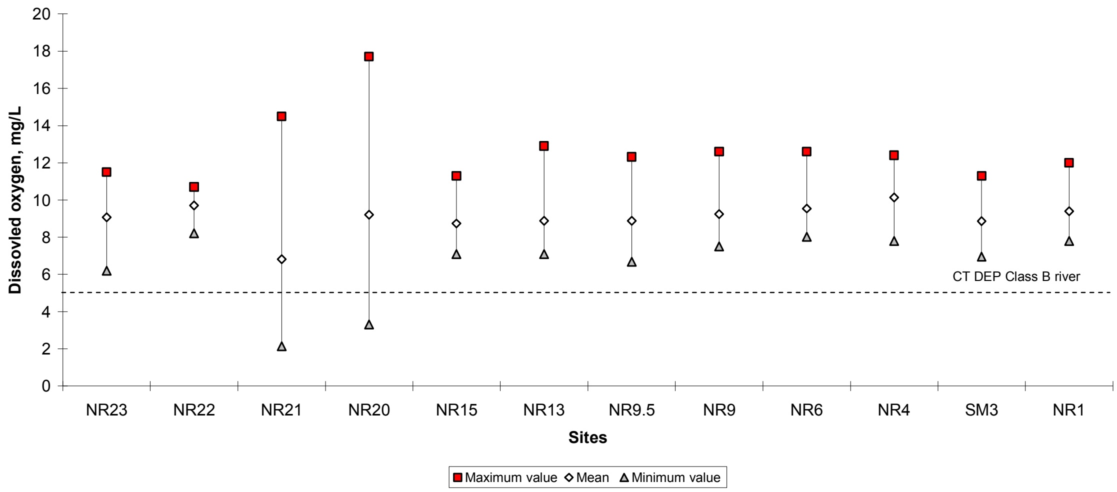


Upstream to Downstream

[a]CT DEP water quality geometric mean limit for *E. coli* bacteria level for Class B rivers

The previous graph shows the results for *E. coli* bacteria for the Norwalk River watershed. The sample sites are arranged along the bottom (X-axis), upstream to downstream, left to right. The concentration of *E. coli* bacteria forming units (CFUs) per 100 mLs is arranged on the logarithmic scale along the left (Y-axis). The dashed horizontal line at 126 colonies/100 mLs (left Y-axis) indicates the geomean *E. coli* criterion in the Connecticut Department of Environmental Protection (CT DEP) Water Quality Standards (WQS) that are set for Class B surface waters. The geometric mean presents results of all sample runs in a way that minimizes the impact on the entire data set by very high or very low individual results An *E. coli* geometric mean marker extending above this line exceeds the criterion. For example, every site except NR22 exceeded the geomean criterion

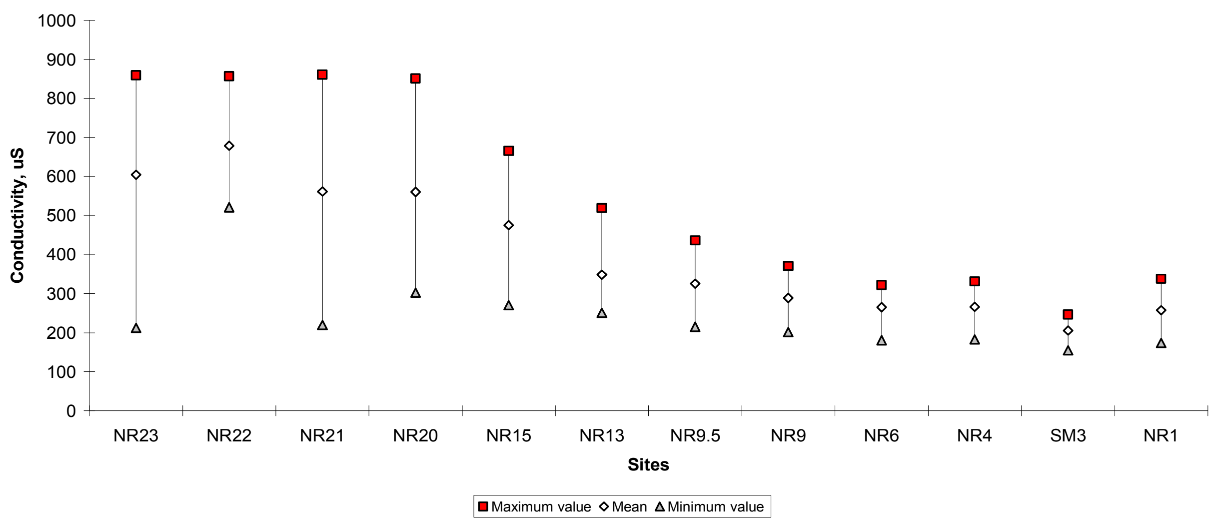
The graph below is an example of a graph showing maximum, mean and minimum values for dissolved oxygen at 12 sampling sites on the Norwalk River Watershed



5 mg/L dissolved oxygen = The CT DEP water quality standard for a Class B rivers

The graph above is read in the same way as the previous one. However, it displays the maximum, minimum values and the mean for dissolved oxygen levels for each sampling site during the sampling period. The dashed horizontal line shows the CT DEP water quality standard for dissolved oxygen for a Class B river. In the example above all mean values for dissolved oxygen meet the CT DEP Class B criterion for dissolved oxygen. However, Sites NR21 and NR20 had minimum readings below the CT DEP criterion.

An example of a Conductivity graph is below.



The line graph above again displays the conductivity range (maximum value to minimum value) with the mean for that range. The conductivity is recorded in micro-Siemens (*u*S)

Appendix D

Glossary

Dissolved oxygen: The oxygen dissolved in water and readily available to aquatic organisms expressed in milligrams per liter (mg/L) or parts per million (ppm). Connecticut's Water Quality Standards requires that the dissolved oxygen of a Class B stream shall not be less than 5 mg/L at any time.

Conductivity: Conductivity is a measure of the ability of water to pass an electrical current. Conductivity of water is positively affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate (ions that carry a negative charge) as well as sodium, magnesium, calcium, iron and aluminum (ions that carry a positive charge). Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity measurements. Significant changes in conductivity can be used as an indicator of pollution entering a stream. For example, the presence of metal trash in water and/or the use of iron pipes can increase conductivity. An elevated conductivity level can also occur from natural sources such as the presence of limestone in streambeds. Conductivity is measured in micromhos per cm, (µmhos/cm) a measure of conductance equal to one millionth of a mho/cm. While there is no CT DEP criterion for conductivity, the rivers in the United States generally range from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µmhos. Conductivity values outside this range could indicate that the water is not suitable for certain species of fish or macro invertebrates.

Fecal coliform bacteria: Fecal coliform bacteria are that portion of the coliform group that originates in the intestinal tract of man and other warm-blooded animals. Fecal bacteria are used as indicator organisms, which are not usually harmful to man. Their presence indicates that pathogens (such as cholera, salmonella, etc.) may be present in surface waters. The higher the count in colonies per 100 milliliters indicates a higher probability that pathogens are being discharged to surface waters. Fecal bacteria are used because they are more universal and survive for longer periods than pathogens in water. The Connecticut Water Quality Standards for a Class B stream are as follows: As an indicator of general sanitary quality Fecal coliform bacteria shall not exceed a geometric mean of 200 organisms/100 mLs in any group of samples nor shall 10% of the samples exceed 400 organisms/100 mLs.

E. coli **bacteria:** *Escherichia coli* (*E. coli*) bacteria are one of two organisms that comprise fecal coliform bacteria. Studies have indicated that *E. coli* alone may be a more specific indicator organism of gut level contaminants to fresh surface waters from either man or animal. The other organism comprising coliform bacteria is *Klebsiella*, which sometimes occurs in soil or leaves. The EPA recommends *E. coli* as the best indicator of health risk from water contact in recreational waters.

Quality Assurance/Quality Control (QA/QC): Analytical measures taken to assure that field and laboratory work meets the highest standards of precision and accuracy. QA is an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. QA activities involve planning quality control, quality assessment, data management and quality improvement. QC is the overall system of technical activities designed to measure quality and limit error in a product or service. A QC program
manages quality so that data meets the needs of the user as expressed in a quality assurance project plan. All scientific analysis of the Norwalk River is accomplished in accord with an EPA approved QA/QC which was re-approved on April 25, 2001 and covers the monitoring period from April 2001 through September 2001.

Water temperature: Water temperature is measured in degrees centigrade (^{o}C). Connecticut's Water Quality Standards state that no temperature increase is allowable except when the increase will not exceed the recommended limit on the most sensitive receiving water use. In no case shall the temperature exceed 85^{o}F (29.4^{o}C), or in any case raise the normal temperature of the receiving water more than 4^{o}F (2.2^{o}C).

Rainfall: Rainfall measurements used in this report follows criteria used by the CT State Health Services. The day of sampling is referred to as day zero. Days are numbered backwards from the testing date to the first rainfall in inches prior to the testing date. For example, if a test was conducted on Monday 5/25 and the previous rain of 0.2 inches occurred on 5/18, the records would indicate 0.2 inches for the amount of rain occurring seven days before the sampling date. If the rain were continuous over the time period, for example, if 0.3 inches fell on 5/17 and 0.2 more inches fell on 5/18, rainfall would be shown as 0.5 inches occurring seven days before the sampling. Rainfall is recorded at rainfall monitoring station located at the Town Hall in Norwalk.

Storm events: Storm events are classified as rainfall exceeding one inch in 24 hours. This much rain will increase surface runoff (input) and flow through the storm drain networks. Storm water runoff carries many pollutants to the river, especially during the first hour.

Observations: Observations are noteworthy occurrences in the river ecology such as the appearance of stranding blue-green algae, a flock of geese or fish kills. These observations can be incorporated into the data record sheets. These help provide a seasonal definition for water related problems which are not recorded elsewhere.

Seasonal Disinfection: Seasonal disinfection is action taken by a wastewater treatment plant to eliminate bacteria from the effluent discharge. Connecticut's Water Quality Standards require disinfection for the period of May 1st through September 30th at all Wastewater Treatment Plants discharging effluent into streams north of Route I-95. The process is carried out by chlorination or exposing the effluent to ultra violet light just prior to discharge. The period of this disinfection presently takes place when the public is deemed more likely to be fishing or bathing in the water.