APPENDIX I

TMDL Load Analysis for the Mill River

A Total Maximum Daily Load Analysis for the Mill River, Rooster River, and Sasco Brook

Final - March 3, 2005

This document has been established pursuant to the requirements of Section 303(d) of the Federal Clean Water Act

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INTRODUCTION

A Total Maximum Daily Load (TMDL) analysis was completed for indicator bacteria in the Mill River, Rooster River, and Sasco Brook (Figure 1). These waterbodies are included on the *2004 List of Connecticut Waterbodies Not Meeting Water Quality Standards*[1] (2004 *List*) due to exceedences of the indicator bacteria criteria contained within the State *Water Quality Standards* (WQS)[2]. Under section 303(d) of the Federal Clean Water Act (CWA), States are required to develop TMDLs for waters impaired by pollutants that are included on the 2004 *List* for which technology-based controls are insufficient to achieve water quality standards. In general, the TMDL represents the maximum loading that a waterbody can receive without exceeding the water quality criteria, which have been adopted into the WQS for that parameter. In this TMDL, loadings are expressed as the average percent reduction from current loadings that must be achieved to meet water quality standards. Federal regulations require that the TMDL analysis identify the portion of the total loading which is allocated to point source discharges (termed the Wasteload Allocation or WLA) and the portion attributed to nonpoint sources (termed the Load Allocation or LA), which contribute that pollutant to the waterbody. In addition, TMDLs must include a Margin of Safety (MOS) to account for uncertainty in establishing the relationship between pollutant loadings and water quality. Seasonal variability in the relationship between pollutant loadings and WQS attainment was also considered in these TMDL analyses.

The Mill River, Rooster River, and Sasco Brook are located within municipalities (Bridgeport, Fairfield, Westport) with urban areas, as defined by the US Census Bureau[3] (Figure 2). Such municipalities are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 permit). The general permit is applicable to municipalities that contain designated urban areas (or MS4 communities) and discharge stormwater via a separate storm sewer system to surface waters of the state. The permit requires municipalities to develop a program aimed at reducing the discharge of pollutants, as well as to protect water quality. The permit includes a provision requiring towns to focus their stormwater plans on waterbodies for which TMDLs have been developed. Such a program must include the following six control measures: public education and outreach; public participation; illicit discharge detection and elimination; construction stormwater management (greater than 1 acre); post-construction stormwater management; and pollution prevention and good housekeeping. Specific requirements have been developed within each of these control measures. Additional information regarding the general permit can be obtained on the Department of Environmental Protection (DEP) website at http://www.dep.state.ct.us/wtr/stormwater/ms4index.htm.

TMDLs that have been established by States are submitted to the Regional Office of the Federal Environmental Protection Agency (EPA) for review. The EPA can either approve the TMDL or disapprove the TMDL and act in lieu of the State. TMDLs provide a scientific basis for developing and implementing a Water Quality Management Plan or TMDL Implementation Plan (Plan), which describes the control measures necessary to achieve acceptable water quality conditions. Therefore,

Plans derived from TMDLs typically include an implementation schedule and a description of ongoing monitoring activities to confirm that the TMDL will be effectively implemented and that WQS are achieved and maintained. Public participation during development of the TMDL analysis and subsequent preparation of the Plans is vital to the success of resolving water quality impairments.

TMDL analyses for indicator bacteria in the Mill River, Rooster River, and Sasco Brook are provided herein. As required in a TMDL analysis, load allocations have been determined, a margin of safety has been included, and seasonal variation has been considered. This document also includes recommendations for a water quality monitoring plan, as well as a discussion of the TMDL Implementation Plan.

PRIORITY RANKING

Table 1. The status of impairment for each of the subject waterbodies as well as the TMDL development priority based on the 2004 *List*.

Waterbody Name	Waterbody Segment ID	Waterbody Segment Description	303(d) Listed (Yes/No)	Impaired Use Cause	Priority
Mill River	CT7108-00_02	From the upper end of Samp Mortar Reservoir (Fairfield) upstream to Easton Reservoir (Easton).	Yes	Contact Recreation Indicator Bacteria	T
Rooster River	CT7106-00_01	From the mouth at Ash Creek (Fairfield - Bridgeport line) upstream to the headwaters (Fairfield).	Yes	Contact Recreation Indicator Bacteria	T
Sasco Brook	CT7109-00_01 CT7109-00_02	From Bulkley Pond dam (Westport - Fairfield line) upstream to the headwaters (Fairfield).	Yes	Contact Recreation Indicator Bacteria	T

"T" indicates that the waterbody was currently under study at the time the list was last revised and a TMDL was planned for development within two years of list revision if warranted.

DESCRIPTION OF THE WATERBODY

See "Site Specific Information" in Appendix A

POLLUTANT OF CONCERN AND POLLUTANT SOURCES

Sources of indicator bacteria include point and nonpoint sources, such as stormwater runoff, combined sewer overflows, domestic animal waste (horses, farm animals), pet waste (dogs) natural sources (wildlife), illicit discharges, and failed or inadequate septic systems. Potential sources that have been tentatively identified, based on land-use for each of the waterbodies are presented in Table 2.

Table 2. Potential sources of bacteria for each of the subject waterbodies.

Waterbody Name	Nonpoint sources	Point Sources
Mill River	Source Unknown, Urban Runoff/Storm Sewers	Regulated Urban Runoff/Storm Sewers
Rooster River	Collection System Failure, Source Unknown, Urban Runoff/Storm Sewers	Combined Sewer Overflow, Regulated Urban Runoff/Storm Sewers
Sasco Brook	Grazing Related Sources, Onsite Wastewater Systems (Septic Tanks), Source Unknown, Urban Runoff/Storm Sewers	Regulated Urban Runoff/Storm Sewers

APPLICABLE SURFACE WATER QUALITY STANDARDS

Connecticut's WQS establish criteria for bacterial indicators of sanitary water quality that are based on protecting recreational uses such as swimming (a distinction is made between designated and non-designated), kayaking, wading, water skiing, fishing, boating, aesthetic enjoyment and others. Indicator bacteria criteria are used as general indicators of sanitary quality based on the results of EPA research[4] conducted in areas with known human fecal material contamination. The EPA established a statistical correlation between levels of indicator bacteria and human illness rates, and set forth guidance for states to establish numerical criteria for indicator bacteria organisms so that recreational use of the water can occur with minimal health risks. However, it should be noted that the correlation between indicator bacteria densities and human illness rates varies greatly between sites and the presence of indicator bacteria does not necessarily indicate that human fecal material is present since indicator bacteria occur in all warm-blooded animals.

The applicable water quality criteria for indicator bacteria to the Mill River, Rooster River, and Sasco Brook are presented in Table 3. These criteria are applicable to all other recreational uses established for these waters. There are no designated swimming or non-designated swimming areas located in these waterbody segments.

Table 3. Applicable indicator bacteria criteria for the subject waterbodies.

Waterbody	Class	Bacterial Indicator	Criteria
Mill River	A	*Escherichia coli* (*E. coli*)	Geometric Mean less than 126/100ml Single Sample Maximum 576/100ml
Rooster River	A, B/A		
Sasco Brook	A		

NUMERIC WATER QUALITY TARGET

TMDL calculations were performed consistent with the analytical procedure presented in *Guidelines for Development of TMDLs for Indicator Bacteria Using the Cumulative Distribution Function Method* [5]. All data used in the analysis and the results of all calculations are presented in Appendix A. The results are summarized in Table 4 below.

Table 4. Summary of TMDL analysis.

Waterbody Segment ID	Waterbody Segment Description	Monitoring Site	Average Percent (%) Reduction to Meet Water Quality Standards			
			TMDL	WLA	LA	MOS
Mill River CT7108-00_02	From the upper end of Samp Mortar Reservoir (Fairfield) upstream to Easton Reservoir (Easton).	M2S	19	31	11	implicit
		M3	55	52	57	implicit
Rooster River CT7106-00_01	From the mouth at Ash Creek (Fairfield - Bridgeport line) up-stream to the headwaters (Fairfield).	R1	91	92	91	implicit
Sasco Brook CT7109-00_01 CT7109-00_02	From Bulkley Pond dam (Westport - Fairfield line) upstream to the headwaters (Fairfield).	S1	58	65	54	implicit
		S2	33	44	26	implicit

MARGIN OF SAFETY

TMDL analyses are required to include a margin of safety (MOS) to account for uncertainties regarding the relationship between load and wasteload allocations, and water quality. The MOS may

be either explicit or implicit in the analysis.

The indicator bacteria criteria used in this TMDL analysis were developed exclusively from data derived from studies conducted at high use public bathing areas (EPA 1986)[4]. Therefore, the criteria provide an additional level of protection when applied to water not designated for high use bathing. As a result, achieving the criteria results in an "implicit MOS". Additional explanation concerning the implicit MOS incorporated into the analysis is provided in *Guidelines for Development of TMDLs for Indicator Bacteria Using the Cumulative Distribution Function Method*[(5)] included as Appendix B.

SEASONAL ANALYSIS

The TMDLs presented in this document are applicable during the typical disinfection (summer) season from May 1 to September 30. Previous investigations by the DEP into seasonal trends of indicator bacteria densities in surface waters impacted solely by non-point sources indicates that the summer months typically exhibit the highest densities of any season (*Water Quality* Summary)[6]. This occurrence is likely due to the enhanced ability of indicator bacteria to survive in surface waters and sediment when ambient temperatures more closely approximate those of warm-blooded animals, from which the bacteria originate. In addition, resident wildlife populations are likely to be more active during the warmer months and more migratory species are present during the summer. These factors combine to make the summer, recreational period representative of "worst-case" conditions. Achieving consistency with the TMDLs during the summer months will likely result in achieving full support of recreational uses throughout the year.

TMDL IMPLEMENTATION PLAN

The percent reductions established in this TMDL can be achieved by implementing control actions that are designed to reduce *E. coli* loading from nonpoint sources (Load Allocation) and point source (Waste Load Allocation). These actions may be taken by State and Local government, educational programs, and volunteer citizens groups or individuals to promote effective watershed management.

Point Sources of *E. coli* to the Mill River, Rooster River, and Sasco Brook include regulated stormwater, and combined sewer overflows (CSO) to Rooster River. CSOs will be addressed in a management plan developed by the City of Bridgeport. Control actions for regulated stormwater include the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 Permit). Under this permit, municipalities are required to implement minimum control measures in their Stormwater Management Plans to reduce the discharge of pollutants, protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act. The six minimum control measures are:

- Public Education and Outreach
- Public Participation/Involvement

- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-construction Runoff Control
- Pollution Prevention/Good Housekeeping

The minimum control measures include a number of Best Management Practices (BMP) for which an implementation schedule must be developed and submitted to the DEP as Part B Registration. Under the MS4 permit, all minimum control measures must be implemented by January 8, 2009. Information regarding Connecticut's MS4 permit can be found on the DEP's website at http://www.dep.state.ct.us/pao/download.htm#MS4GP. In addition, the EPA has developed fact sheets, which provide an overview of the Phase II final rule and MS4 permit, and provide detail regarding the minimum control measures, as well as optional BMPs not required in Connecticut's MS4 permit. The fact sheets can be found on the EPA's website at: http://cfpub.epa.gov/npdes/stormwater/swphases.cfm. Some of the information includes guidance for the development and implementation of Stormwater Management Plans, as well as guidance for establishing measurable goals for BMP implementation.

It is recommended that municipalities focus their stormwater management plans on the TMDL waterbodies for Section 6(a)(1)(A)(i) - implement public education program, Section 6(a)(3)(A)(i, ii, iii) and 6(a)(3)(A)(i, ii, iii, iv) - illicit discharge detection, Section 6(a)(6)(A)(iv) - stormwater structures cleaning, and Section 6(a)(6)(A)(v) - prioritize stormwater structures for repair or upgrade, of the MS4 permit.

The TMDLs establish a benchmark to measure the effectiveness of BMP implementation. Achievement of the TMDLs is directly linked to incorporation of the provisions of the MS4 permit by municipalities, as well as the implementation of other BMPs to address nonpoint sources. Other BMPs for the management of nonpoint sources include septic system testing and maintenance, nuisance wildlife control plans, and pet waste ordinances. As progress is made implementing BMPs, the "percent reduction" needed to meet criteria will decrease.

Guidance to local municipalities for the management of septic systems can be found on the EPA's website at http://cfpub.epa.gov/owm/septic/guidelines.cfm#7478. Additional general information regarding septic systems can be found at http://cfpub.epa.gov/owm/septic/home.cfm. Nuisance wildlife information can be found on the DEP's website at http://www.dep.state.ct.us/burnatr/wildlife/problem.htm.

In addition, the DEP's watershed coordinator will continue to provide technical and educational assistance to the local municipalities and other stakeholders, as well as identify funding sources for implementation of the TMDL and monitoring plan.

WATER QUALITY MONITORING PLAN

A comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts. The monitoring program should be designed to accomplish two objectives; source detection to identify specific sources of bacterial loading and direct BMP implementation efforts with fixed station monitoring to quantify progress in achieving TMDL established goals. The MS4 Permit that is the basis of TMDL implementation efforts in MS4 communities includes the following monitoring requirement:

> *"Stormwater monitoring shall be conducted by the Regulated Small MS4 annually starting in 2004. At least two outfalls apiece shall be monitored from areas of primarily industrial development, commercial development and residential development, respectively, for a total of six (6) outfalls monitored. Each monitored outfall shall be selected based on an evaluation by the MS4 that the drainage area of such outfall is representative of the overall nature of its respective land use type."*

This type of monitoring may be referred to as event monitoring because it is scheduled to coincide with a stormwater runoff event. Event monitoring can present numerous logistical difficulties for municipalities and may not be the most efficient way to measure progress in achieving water quality standards. This is particularly true for streams draining urbanized watersheds where many sources contribute to excursions above water quality criteria. However, the municipality may request written approval from the DEP for an alternative monitoring program:

> *"The municipality may submit a request to the Commissioner in writing for implementation of an alternate sampling plan of equivalent or greater scope. The Commissioner will approve or deny such a request in writing.*

The DEP encourages municipalities faced with implementing a TMDL to request approval for an alternative monitoring program. Monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. The program must include sampling to address both objectives (source detection and progress quantification). Source detection monitoring may include such activities as visual inspection of storm sewer outfalls under dry weather conditions, event sampling of individual storm sewer outfalls, and monitoring of ambient (in-stream) conditions at closely spaced intervals to identify "hot spots" for more detailed investigations leading to specific sources of high bacteria loads.

Progress in achieving TMDL established goals through BMP implementation may be most effectively gauged through implementing a fixed station ambient monitoring program. DEP strongly recommends that routine monitoring be performed at the same sites used to generate the data used to perform the TMDL calculations. Sampling should be scheduled at regularly spaced intervals during the recreational season. In this way the data set at the end of each season will include ambient values for both "wet" and "dry" conditions in relative proportion to the number of "wet" and "dry" days that

occurred during that period. As additional data is generated over time it will be possible to repeat the TMDL calculations and compare the percent reductions needed under "dry" and "wet" conditions to the percent reductions needed at the time of TMDL adoption.

All pollutant parameters must be analyzed using methods prescribed in Title 40, CFR, Part 136 (1990). Electronic submission of data to DEP is highly encouraged. Results of monitoring that indicate unusually high levels of contamination or potentially illegal activities should be forwarded to the appropriate municipal or State agency for follow-up investigation and enforcement. Consistent with the requirements of the MS4 permit, the following parameters should be included in any monitoring program:

pH (SU)
Hardness (mg/l)
Conductivity (umos)
Oil and grease (mg/l)
Chemical Oxygen Demand (mg/l)
Turbidity (NTU)
Total Suspended Solids (mg/l)
Total Phosphorous (mg/l)
Ammonia (mg/l)
Total Kjeldahl Nitrogen (mg/l)
Nitrate plus Nitrite Nitrogen (mg/l)
E. coli (col/100ml)
precipitation (in)

DEP will continue to explore ways to provide funding support for monitoring efforts linked to TMDL implementation or other activities that exceed the minimum requirements of the MS4 permit. DEP is also committed to providing technical assistance in monitoring program design and establishing procedures for electronic data submission.

REASONABLE ASSURANCE

The MS4 Permit is a legally enforceable document that will provide reasonable assurance that the municipalities will take steps towards achieving the target TMDLs and reducing point sources of stormwater containing bacteria.

PROVISIONS FOR REVISING THE TMDL

The DEP reserves the authority to modify the TMDL as needed to account for new information made available during the implementation of the TMDL. Modification of the TMDL will only be made following an opportunity for public participation and be subject to the review and approval of the EPA. New information, which will be generated during TMDL implementation includes monitoring data, new

or revised State or Federal regulations adopted pursuant to Section 303(d) of the Clean Water Act, and the publication by EPA of national or regional guidance relevant to the implementation of the TMDL program. The DEP will propose modifications to the TMDL analysis only in the event that a review of the new information indicates that such a modification is warranted and is consistent with the anti-degradation provisions in Connecticut Water Quality Standards. The subject waterbodies of this TMDL analysis will continue to be included on the *List of Connecticut Water bodies Not Meeting Water Quality Standards* until monitoring data confirms that recreational uses are fully supported.

PUBLIC PARTICIPATION

The Mill River, Rooster River, Sasco Brook TMDL document was noticed for public comment in the Bridgeport Post on November 26, 2004. In addition, the City of Bridgeport and Towns of Fairfield and Westport, as well as several interested parties were notified by mail of the comment period. As of the end of the public review period (December 30, 2004), no comment letters were received by the DEP.

REFERENCES

(1) Connecticut Department of Environmental Protection, 2004. *List of Connecticut Water bodies Not Meeting Water Quality Standards*. Bureau of Water Management, 79 Elm Street, Hartford, CT 06106-5127.

(2) Connecticut Department of Environmental Protection, 2002. *Connecticut Water Quality Standards*. Bureau of Water Management, 79 Elm Street, Hartford, CT 06106-5127.

(3) U.S. Census Bureau, March 2002. www.census.gov/geo/www/ua/ua_2k.html.

(4) United States Environmental Protection Agency, 1986. *Ambient Water Quality Criteria for Bacteria -1986*. EPA 440/5-84-002.

(5) Connecticut Department of Environmental Protection, 2004. *Guidelines for Development of TMDLs for Indicator Bacteria Using the Cumulative Distribution Function Method*. Bureau of Water Management, 79 Elm Street, Hartford, CT 06106-5127.

(6) Connecticut Department of Environmental Protection, 2002. *Water Quality Summary Report for Sasco Brook, Mill River, Rooster River, Fairfield County Connecticut*. November 2002.

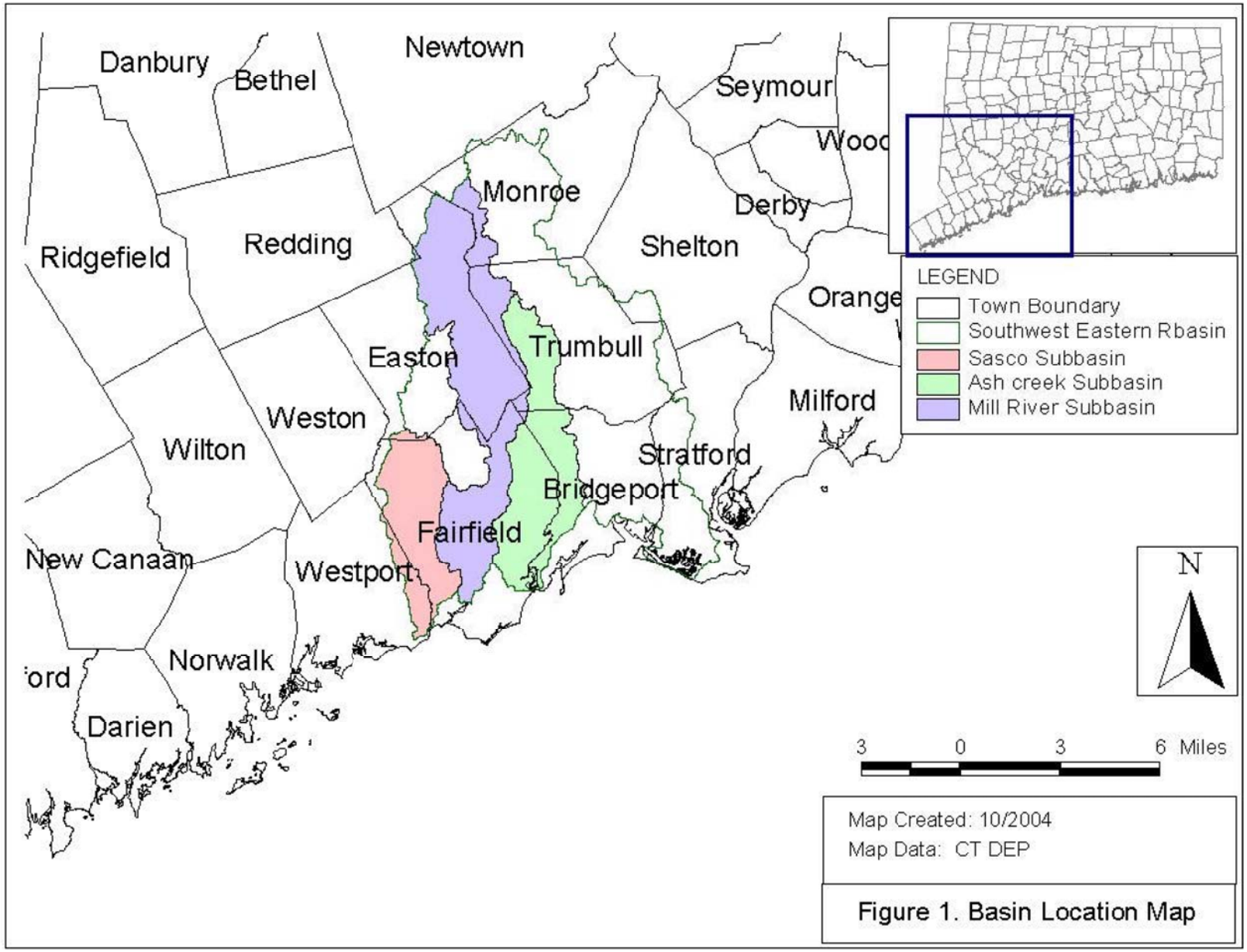


Figure 1. Basin Location Map

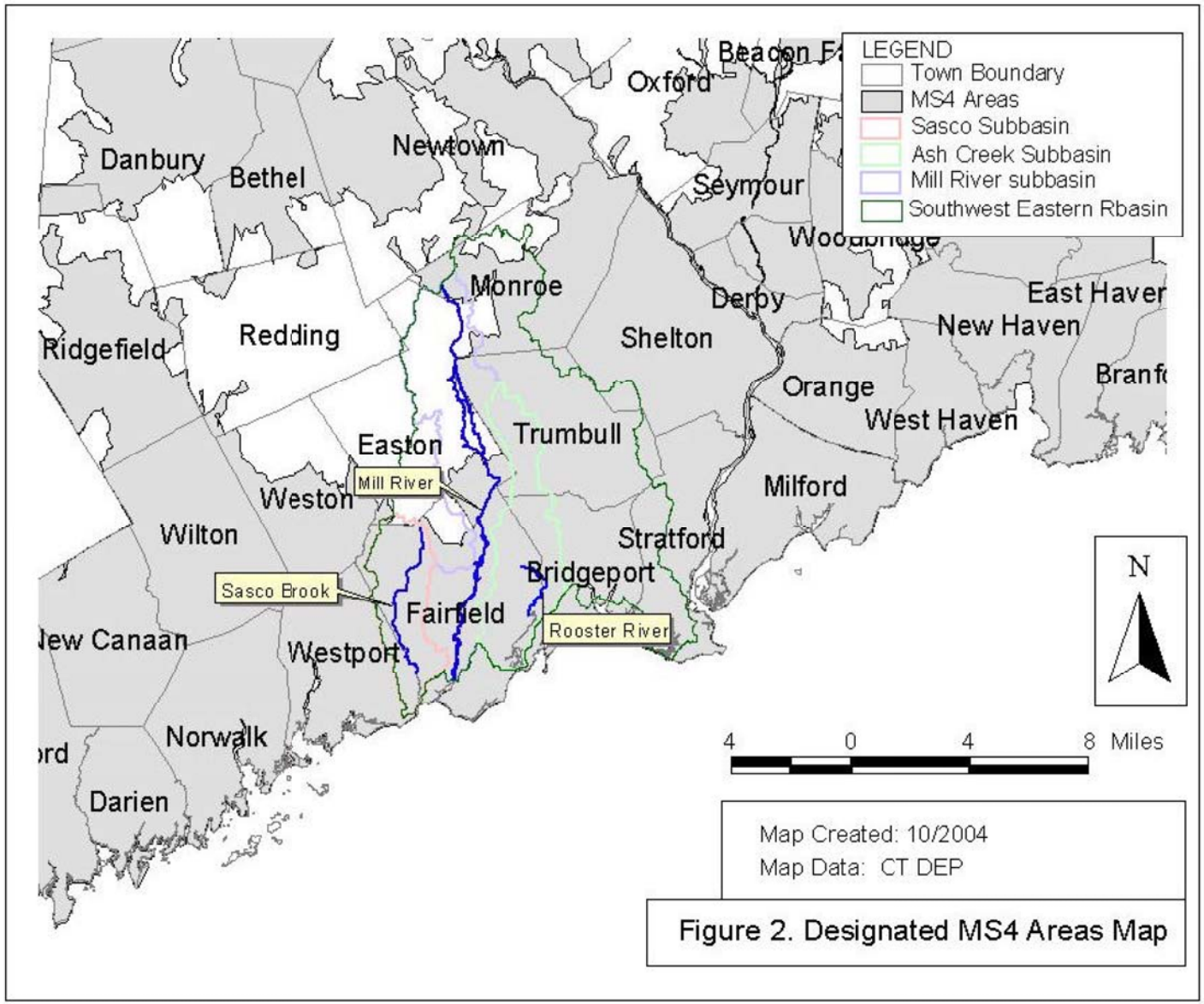


Figure 2. Designated MS4 Areas Map

Appendix A

Appendix A-1
Mill River
Waterbody specific information

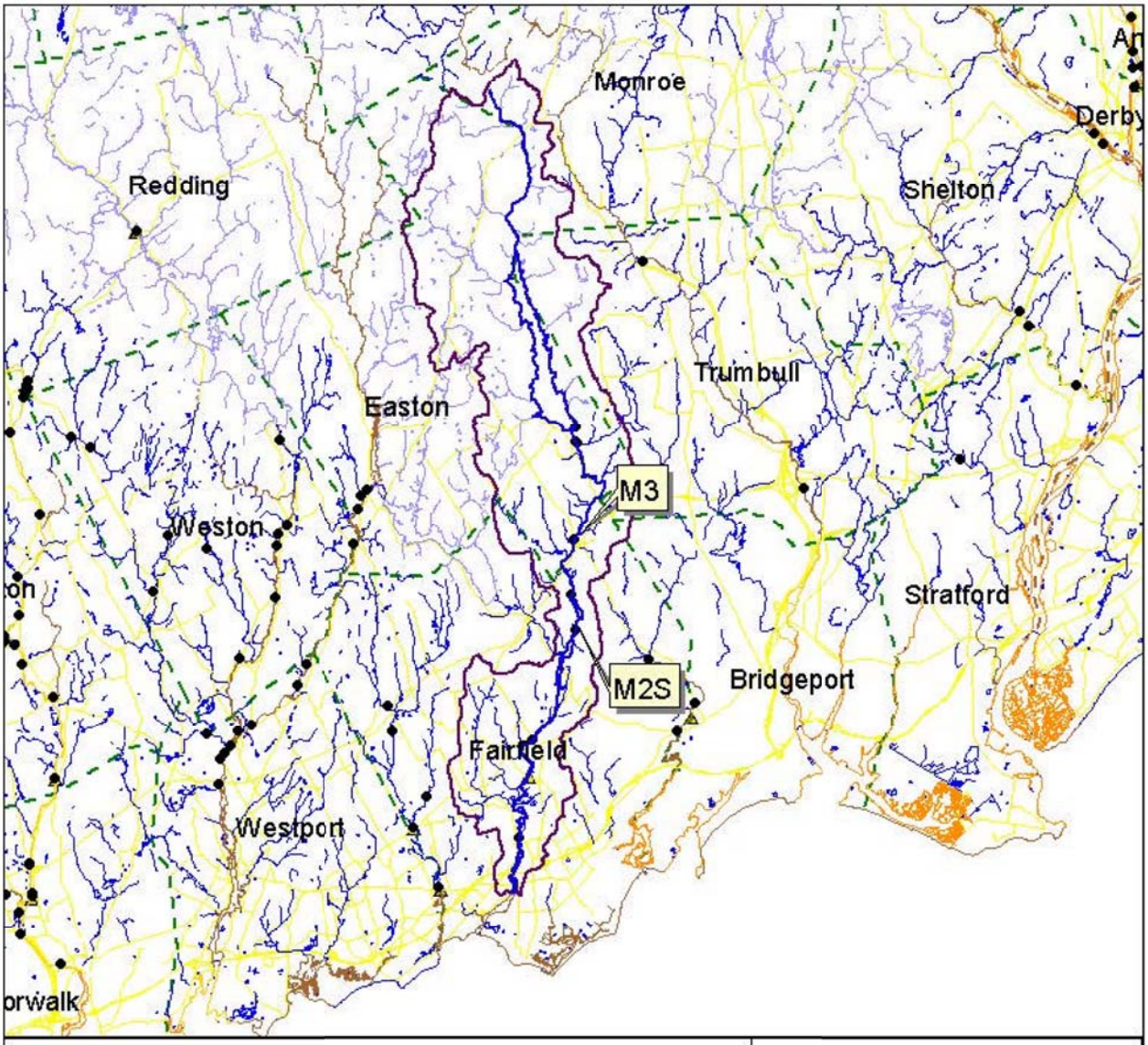
Impaired Waterbody
Waterbody Name: Mill River
Waterbody Segment ID: CT7108-00_02
Waterbody Segment Description: From the upper end of Samp Mortar Reservoir (Fairfield) upstream to Easton Reservoir (Easton).

Impairment Description:
Designated Use Impairment: Contact Recreation
Size of Impaired Segment: 4.0 linear miles
Surface Water Classification: Class A

Watershed Description:
Drainage Basin Area: 24.89 square miles
Tributary To: Southport Harbor
Subregional Basin Name & Code: Mill River 7108
Regional Basin: Southwest Eastern
Major Basin: Southwest Coast
Watershed Towns: Fairfield, Trumbull, Easton, Monroe
Phase II GP applicable? Fairfield-yes, Trumbull-yes, Easton-yes, Monroe-yes
Applicable Season: Recreation Season (May 1 to September 30)
Landuse:

Land Use Category	Percent Composition
Forested	54.0 %
Urban/Developed	29.4 %
Open Space	11.2 %
Water/Wetland	4.3 %
Agriculture	1.1 %

Data Source: Connecticut Land Use Land Cover Data Layer LANDSTAT (1995) Thematic Mapper Satellite Imagery.



Mill River Layout with Sampling Locations

Map Data: CT DEP
Map Created: 8/2004

Mill River

CT 7108-00 02

Data Used in the Analysis

Monitoring Site: M3, Mill River at Congress Street

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/21/99	0.06	0.21	0.21	DRY	1900	30.0	0.9677	576	70
7/6/99	0.00	0.06	0.46	DRY	2000	31.0	1.0000	576	71
7/19/99	0.03	0.03	0.03	DRY	830	27.0	0.8710	357	57
8/2/99	0.00	0.00	0.00	DRY	180	8.5	0.2742	72	60
8/16/99	0.00	1.06	1.44	**WET**	360	21.0	0.6774	193	47
8/30/99	0.00	0.00	0.43	DRY	160	7.0	0.2258	63	61
9/14/99	0.00	0.00	0.00	DRY	280	17.5	0.5645	146	48
9/27/99	0.00	0.00	0.02	DRY	230	13.0	0.4194	104	55
5/8/00	0.40	0.40	0.25	**WET**	86	3.0	0.0968	38	56
5/22/00	0.01	0.27	1.33	**WET**	62	2.0	0.0645	31	50
6/7/00	2.67	2.71	2.82	**WET**	1300	29.0	0.9355	510	61
6/20/00	0.01	0.07	0.14	DRY	150	5.5	0.1774	54	64
7/5/00	0.00	0.07	0.07	DRY	220	10.5	0.3387	86	61
7/12/00	0.00	0.01	0.05	DRY	290	19.0	0.6129	164	43
7/19/00	0.00	0.00	3.21	**WET**	330	20.0	0.6452	178	46
8/9/00	0.00	0.00	0.15	DRY	260	15.0	0.4839	121	53
9/6/00	0.00	0.00	1.03	DRY	680	26.0	0.8387	313	54
9/20/00	1.55	1.55	1.55	**WET**	1000	28.0	0.9032	417	58
5/2/01	0.00	0.00	0.00	DRY	52	1.0	0.0323	23	56
5/16/01	0.00	0.04	0.07	DRY	500	24.0	0.7742	252	50
5/30/01	0.20	0.20	1.88	**WET**	270	16.0	0.5161	131	52
6/13/01	0.11	0.15	0.15	**WET**	390	23.0	0.7419	229	41
6/28/01	0.00	0.00	0.00	DRY	230	13.0	0.4194	104	55
7/11/01	0.00	0.00	0.25	DRY	370	22.0	0.7097	210	43
7/25/01	0.00	0.00	0.00	DRY	180	8.5	0.2742	72	60
8/8/01	0.00	0.00	0.05	DRY	230	13.0	0.4194	104	55
8/22/01	0.00	0.39	0.50	**WET**	610	25.0	0.8065	279	54
9/5/01	0.00	0.00	0.00	DRY	120	4.0	0.1290	44	63
9/19/01	0.00	0.00	0.00	DRY	150	5.5	0.1774	54	64
5/1/02	0.36	0.36	0.36	**WET**	280	17.5	0.5645	146	48
5/15/02	1.60	2.64	2.64	**WET**	220	10.5	0.3387	86	61

Statistics

# Samples DRY	**20**
# Samples WET	**11**
# Samples Total	**31**
Geomean	**299**
Log std deviation	**0.3845**

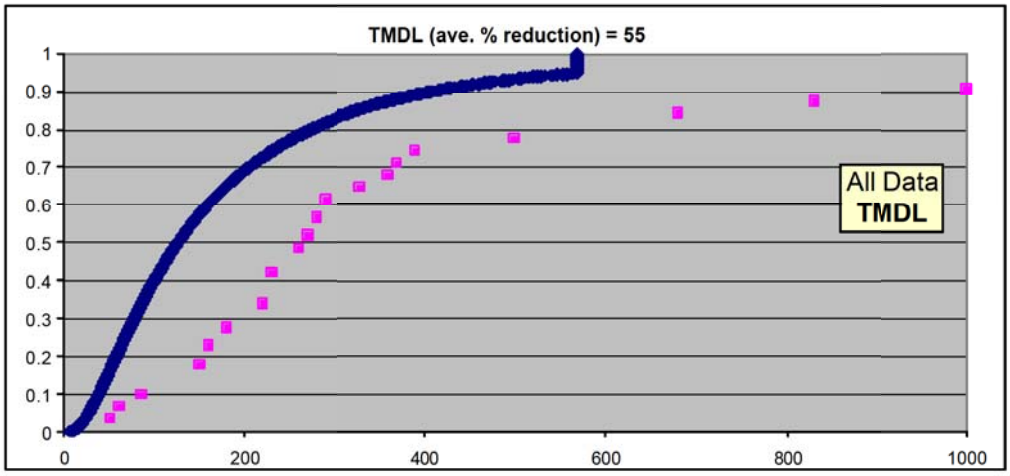
Avg % Reduction

Wet (WLA)	**52**
Dry (LA)	**57**
Total (TMDL)	**55**

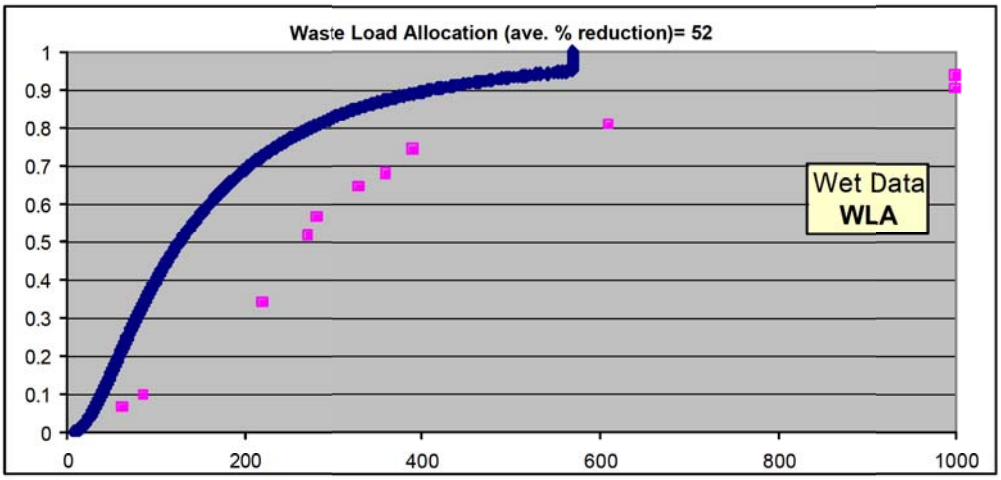
Precipitation and E. coli data provided by the Town of Fairfield.

WET Condition defined as greater than 0.1" precipitation in 24 hours, or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

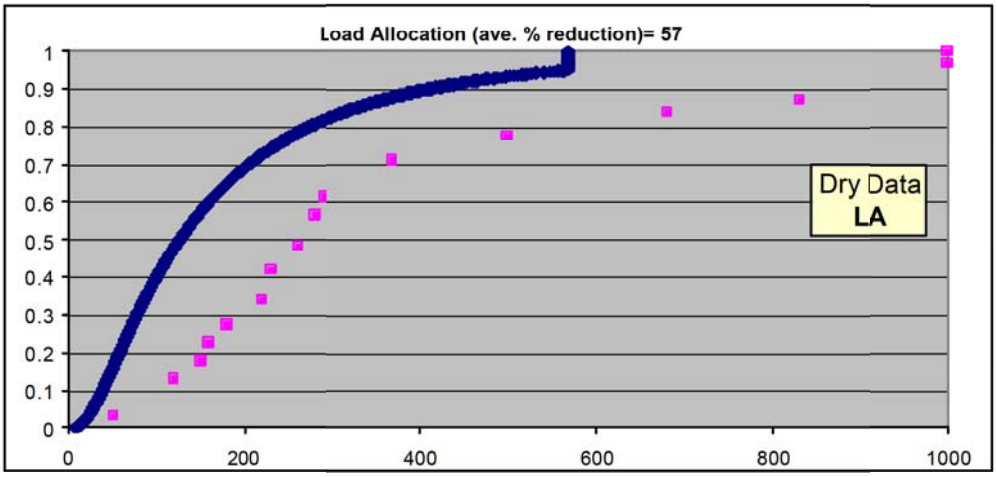
Mill River Criteria Curve for Monitoring Site M3



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Mill River

CT 7108-00_02

Data Used in the Analysis

Monitoring Site: M2S, Mill River between Lake Mohegan and Samp Mortar Resevoir

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
8/30/99	0.00	0.00	0.43	DRY	52	12.0	0.4615	115	0
9/14/99	0.00	0.00	0.00	DRY	2100	24.0	0.9231	469	78
9/27/99	0.00	0.00	0.02	DRY	10	2.5	0.0962	38	0
5/8/00	0.40	0.40	0.61	**WET**	20	5.5	0.2115	60	0
5/22/00	0.01	0.27	1.33	**WET**	52	12.0	0.4615	115	0
6/7/00	2.67	2.71	2.82	**WET**	760	23.0	0.8846	380	50
6/20/00	0.01	0.07	0.14	DRY	52	12.0	0.4615	115	0
7/5/00	0.00	0.07	0.07	DRY	41	9.5	0.3654	92	0
7/12/00	0.00	0.01	0.05	DRY	31	7.5	0.2885	75	0
7/19/00	0.00	0.00	3.21	**WET**	84	14.0	0.5385	138	0
8/9/00	0.00	0.00	0.15	DRY	110	16.0	0.6154	165	0
9/6/00	0.00	0.00	1.03	DRY	120	17.0	0.6538	181	0
9/20/00	1.55	1.55	1.55	**WET**	3400	25.0	0.9615	576	83
5/2/01	0.00	0.00	0.00	DRY	10	2.5	0.0962	38	0
5/16/01	0.00	0.04	0.07	DRY	10	2.5	0.0962	38	0
5/30/01	0.20	0.20	1.88	**WET**	160	18.0	0.6923	200	0
6/13/01	0.11	0.15	0.15	**WET**	470	20.0	0.7692	248	47
6/28/01	0.00	0.00	0.00	DRY	41	9.5	0.3654	92	0
7/11/01	0.00	0.00	0.25	DRY	8700	26.0	1.0000	576	93
7/25/01	0.00	0.00	0.00	DRY	10	2.5	0.0962	38	0
8/8/01	0.00	0.00	0.05	DRY	20	5.5	0.2115	60	0
8/22/01	0.00	0.39	0.50	**WET**	490	21.0	0.8077	281	43
9/5/01	0.00	0.00	0.00	DRY	31	7.5	0.2885	75	0
9/19/01	0.00	0.00	0.00	DRY	97	15.0	0.5769	151	0
5/1/02	0.36	0.00	0.00	**WET**	440	19.0	0.7308	222	50
5/15/02	1.60	2.64	2.64	**WET**	520	22.0	0.8462	322	38

Statistics

# Samples DRY	**16**
# Samples WET	**10**
# Samples Total	**26**
Geomean	**105**
Log std deviation	**0.8140**

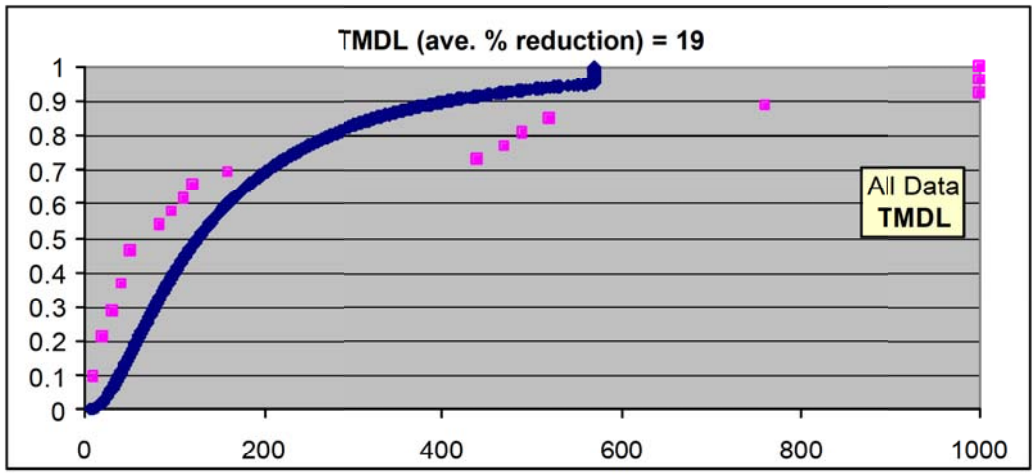
Avg % Reduction

Wet (WLA)	**31**
Dry (LA)	**11**
Total (TMDL)	**19**

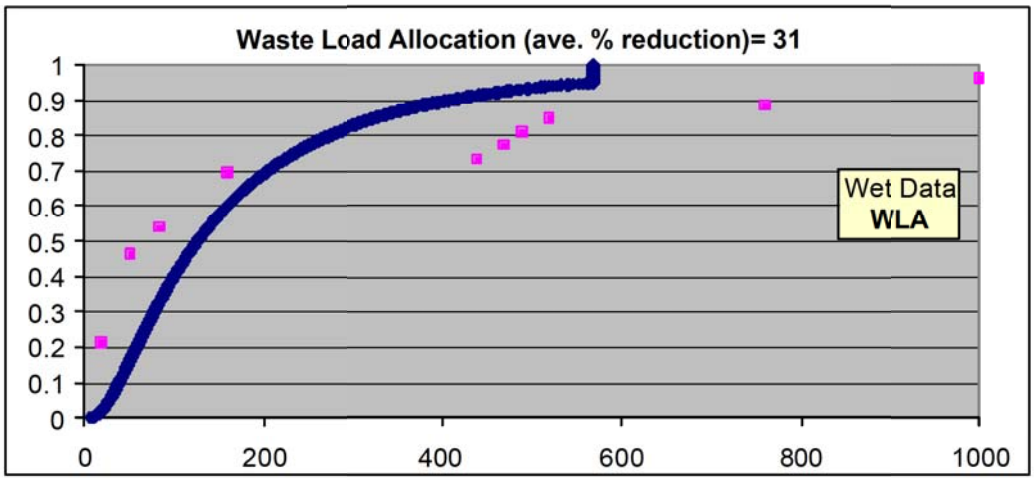
Precipitation and E. coli data provided by the Town of Fairfield.

WET Condition defined as greater than 0.1" precipitation in 24 hours or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

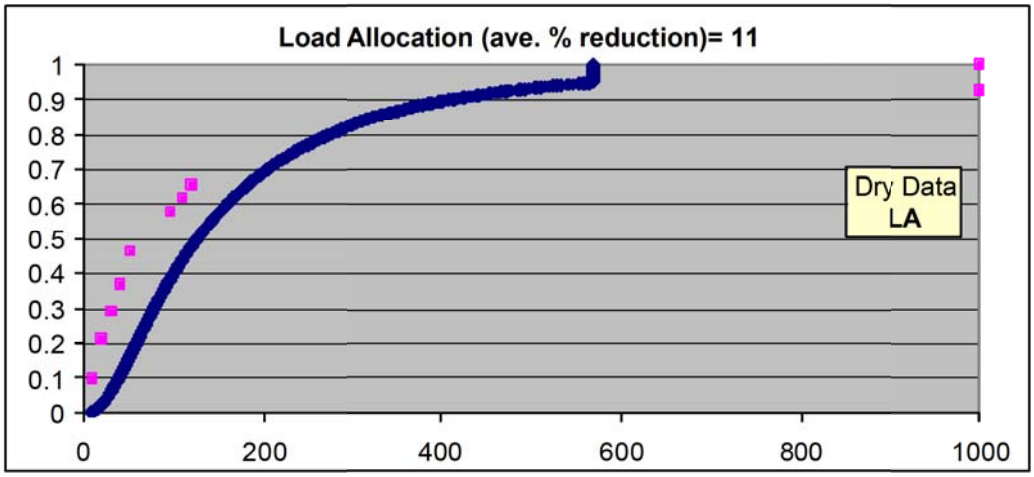
Mill River Criteria Curve for Monitoring Site M2S



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Appendix A-1
Mill River
TMDL Summary

The TMDL analysis for the Mill River was conducted at two sites, which are representative of two river segments. The analysis indicates that site M3, located along the border with Easton and Fairfield is almost equally influenced by sources of bacteria active under both wet weather and dry weather conditions. The Waste Load Allocation (WLA) is applicable to regulated stormwater and was determined to require a 52% reduction. This type of reduction can be achieved through the installation of engineered controls to improve water quality and reduce the surge of stormwater to the river. The Load Allocation (LA) of 57% at site M3 indicates that illegal sanitary discharges to the storm sewer may be present in the area. In comparison, the WLA at site M2S is greater than the LA. Based on this, it appears that water quality at site M2S is more strongly influenced by regulated stormwater. It is important to note that the percent reduction required for both the WLA and LA are lower at site M2S than M3. This may be attributed to the fact that Lake Mohegan, located just upstream of site M2S may act has a retention and settling basin for bacteria associated with particulate material.

Appendix A-2
Rooster River
Waterbody specific information

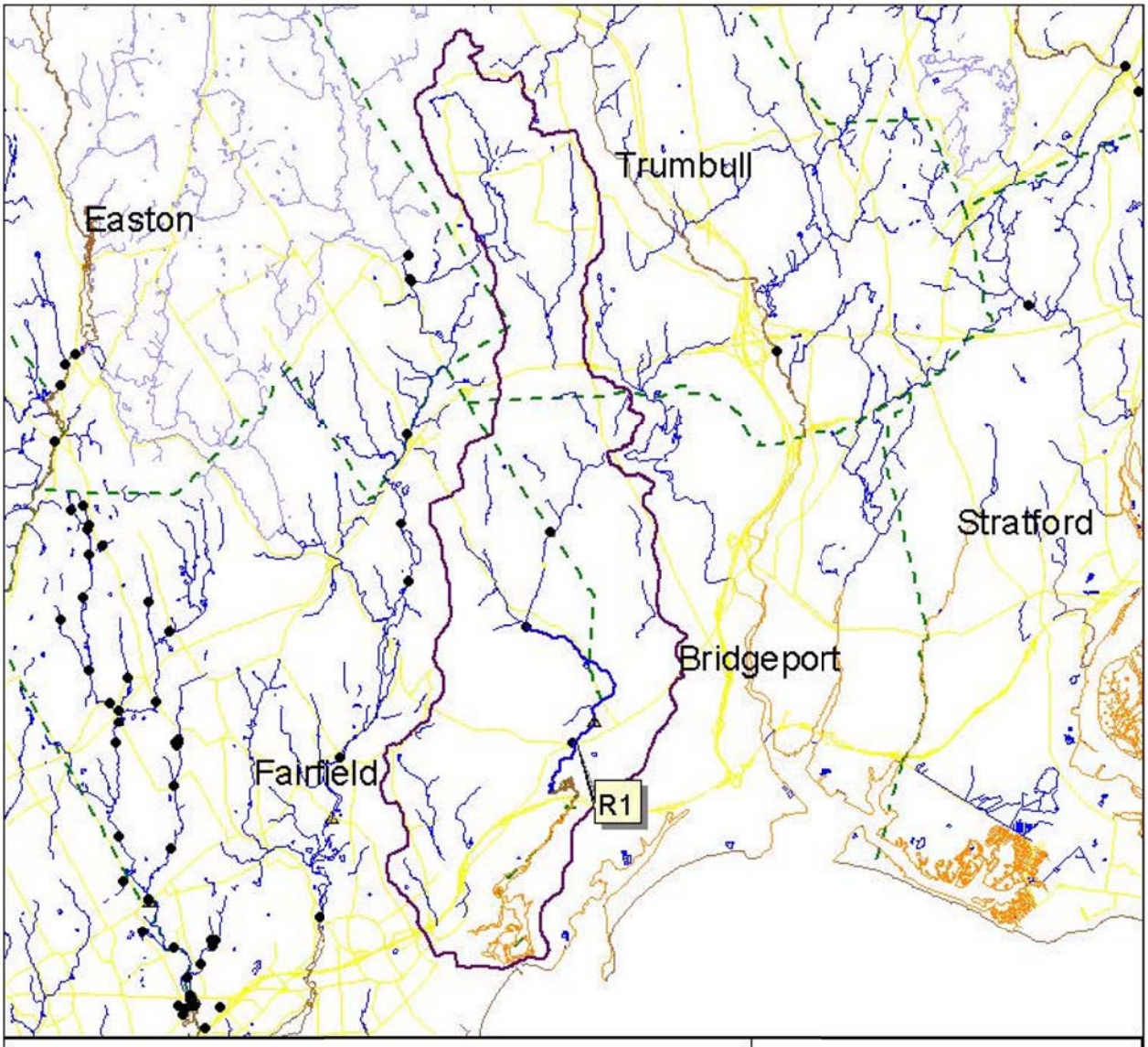
Impaired Waterbody
Waterbody Name: Rooster River
Waterbody Segment ID: CT7106-00_01
Waterbody Segment Description: From the mouth at Ash Creek (Fairfield-Bridgeport), upstream to the headwaters (Fairfield).

Impairment Description:
Designated Use Impairment: Contact Recreation
Size of Impaired Segment: 5.4 linear miles
Surface Water Classification:
from headwaters downstream to Post Road - class A
from Post Road downstream to Ash Creek - class B/A

Watershed Description:
Drainage Basin Area: 15.33 square miles
Tributary To: Ash Creek to Black Rock Harbor
Subregional Basin Name & Code: Ash Creek 7106
Regional Basin: Southwest Eastern
Major Basin: Southwest Coast
Watershed Towns: Fairfield, Bridgeport, Trumbull
Phase II GP applicable? Fairfield-yes, Bridgeport-yes, Trumbull-yes
Applicable Season: Recreation Season (May 1 to September 30)
Landuse:

Land Use Category	Percent Composition
Forested	8.9 %
Urban/Developed	87.0 %
Open Space	2.2 %
Water/Wetland	1.6 %
Agriculture	0.3 %

Data Source: Connecticut Land Use Land Cover Data Layer LANDSTAT (1995) Thematic Mapper Satellite Imagery.



N

0.8 0 0.8 1.6 2.4 Miles

LEGEND
Rooster River
Ash Creek Subbasin
Sampling Locations
WQ Classifications
A, SA
AA, A/AA
B, B*, SB
B/A, B/AA, C/A, SB/SA, SC/SA, SD/SA
C/B, D/B, SC/SB, SD/SB
Change of Class
State
County
Town
Coastline
Primary & Secondary Routes
USGS gage

Rooster River Layout with Sampling Locations

Map Data: CT DEP
Map Created: 8/2004

Rooster River

CT 7106-00_01

Data Used in the Analysis

Monitoring Site: R1, Rooster River at Route 1

Date	Precip.(in)[1]			Condition[2]	E. coli	Rank	Proportion	Criteria Value	% Reduction
	24h	48h	96h	(WET/DRY)	(col./100 ml)				
8/16/99	0.00	1.06	1.44	DRY	2000	16.5	0.6111	163	92
8/30/99	0.00	0.00	0.43	DRY	1700	12.5	0.4630	116	93
9/14/99	0.00	0.00	0.00	DRY	63	1.0	0.0370	24	61
9/27/99	0.00	0.00	0.02	DRY	2100	18.0	0.6667	187	91
5/8/00	0.40	0.40	0.61	**WET**	540	3.5	0.1296	45	92
5/22/00	0.01	0.63	1.33	**WET**	540	3.5	0.1296	45	92
6/7/00	2.67	2.82	2.82	**WET**	6100	25.0	0.9259	477	92
6/20/00	0.01	0.14	0.14	DRY	1200	8.0	0.2963	77	94
7/5/00	0.00	0.07	0.07	DRY	2000	16.5	0.6111	163	92
7/12/00	0.00	0.05	0.05	DRY	700	6.0	0.2222	62	91
7/19/00	0.00	0.00	3.21	**WET**	1400	9.0	0.3333	85	94
8/9/00	0.00	0.15	0.15	DRY	2600	20.0	0.7407	228	91
9/6/00	0.00	0.00	1.03	DRY	1700	12.5	0.4630	116	93
9/20/00	1.55	1.55	1.55	**WET**	2900	21.5	0.7963	270	91
5/2/01	0.00	0.00	0.00	DRY	470	2.0	0.0741	33	93
5/16/01	0.00	0.04	0.07	DRY	650	5.0	0.1852	55	92
5/30/01	0.20	0.27	1.88	**WET**	880	7.0	0.2593	70	92
6/13/01	0.11	0.15	0.15	**WET**	1500	10.0	0.3704	93	94
6/28/01	0.00	0.00	0.00	DRY	1900	15.0	0.5556	143	92
7/11/01	0.00	0.00	0.25	DRY	24000	27.0	1.0000	576	98
7/25/01	0.00	0.00	0.00	DRY	1700	12.5	0.4630	116	93
8/8/01	0.00	0.00	0.05	DRY	3100	23.0	0.8519	330	89
8/22/01	0.00	0.50	0.50	**WET**	2400	19.0	0.7037	206	91
9/5/01	0.00	0.00	0.00	DRY	2900	21.5	0.7963	270	91
9/19/01	0.00	0.00	0.00	DRY	1700	12.5	0.4630	116	93
5/1/02	0.36	0.36	0.36	**WET**	9800	26.0	0.9630	576	94
5/15/02	1.60	2.64	2.64	**WET**	4900	24.0	0.8889	388	92

Statistics

# Samples DRY	**17**
# Samples WET	**10**
# Samples Total	**27**
Geomean	**1686**
Log std deviation	**0.4790**

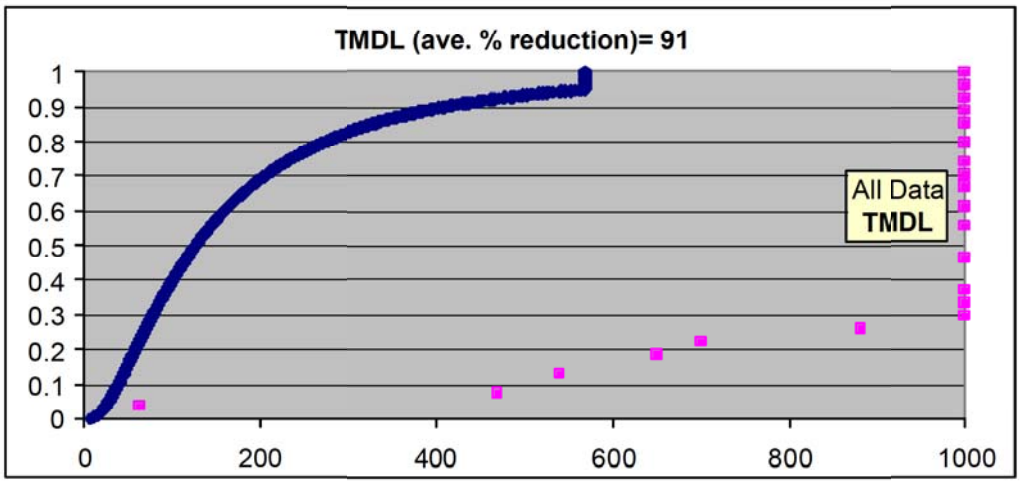
Avg % Reduction

Wet (WLA)	**92**
Dry (LA)	**91**
Total (TMDL)	**91**

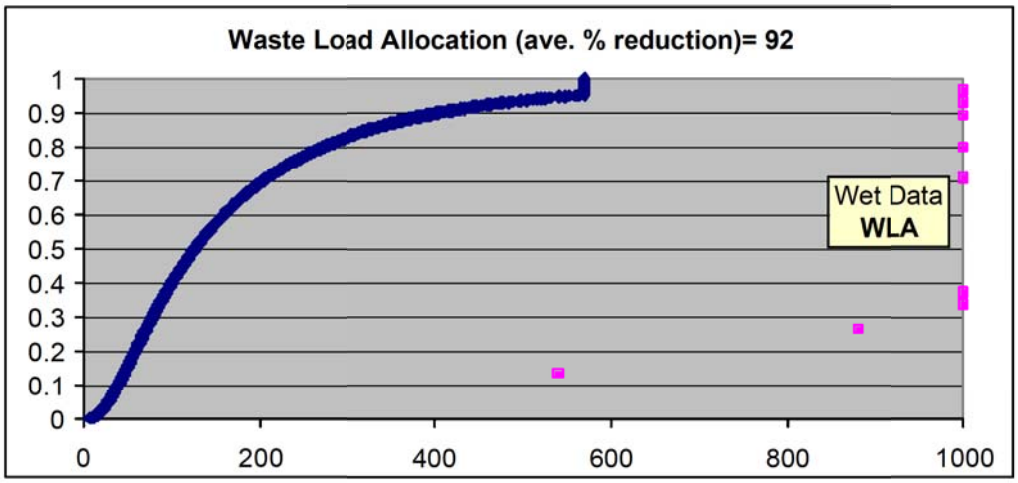
Precipitation and E. coli data provided by the Town of Fairfield.

WET Condition defined as greater than 0.1" precipitation in 24 hours or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

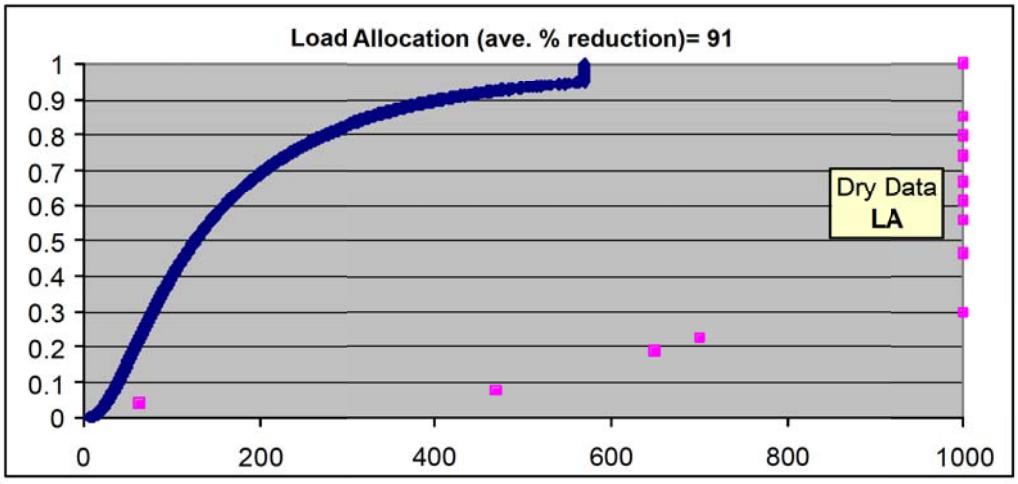
Rooster River Criteria Curve for Monitoring Site R1



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Appendix A-2
Rooster River
TMDL Summary

The TMDL analysis for the Rooster River was conducted at one site, which is representative of one river segment. The total percent reduction required is distributed equally between both the Waste Load Allocation (WLA) and Load Allocation (LA). The WLA is applicable to regulated stormwater and was determined to require a 92% reduction. The occurrence of combined sewer overflows during wet conditions may be contributing to such a high percent reduction. The installation of engineered controls to improve water quality and reduce the surge of stormwater to the river, as well as implementation of a plan to remove combined sewer overflows to the river may be necessary in order to achieve the required reduction in indicator bacteria levels. The Load Allocation (LA) of 91% indicates that illegal sanitary discharges to the storm sewer may be present in the area. It is important to note that this analysis indicates a correlation between land use categories and water quality. The Rooster River watershed, which is 87% urban/developed, requires a higher percent reduction than the Mill River (29.4% urban/developed) and Sasco Brook (36.9% urban/developed).

Appendix A-3
Sasco Brook
Waterbody specific information

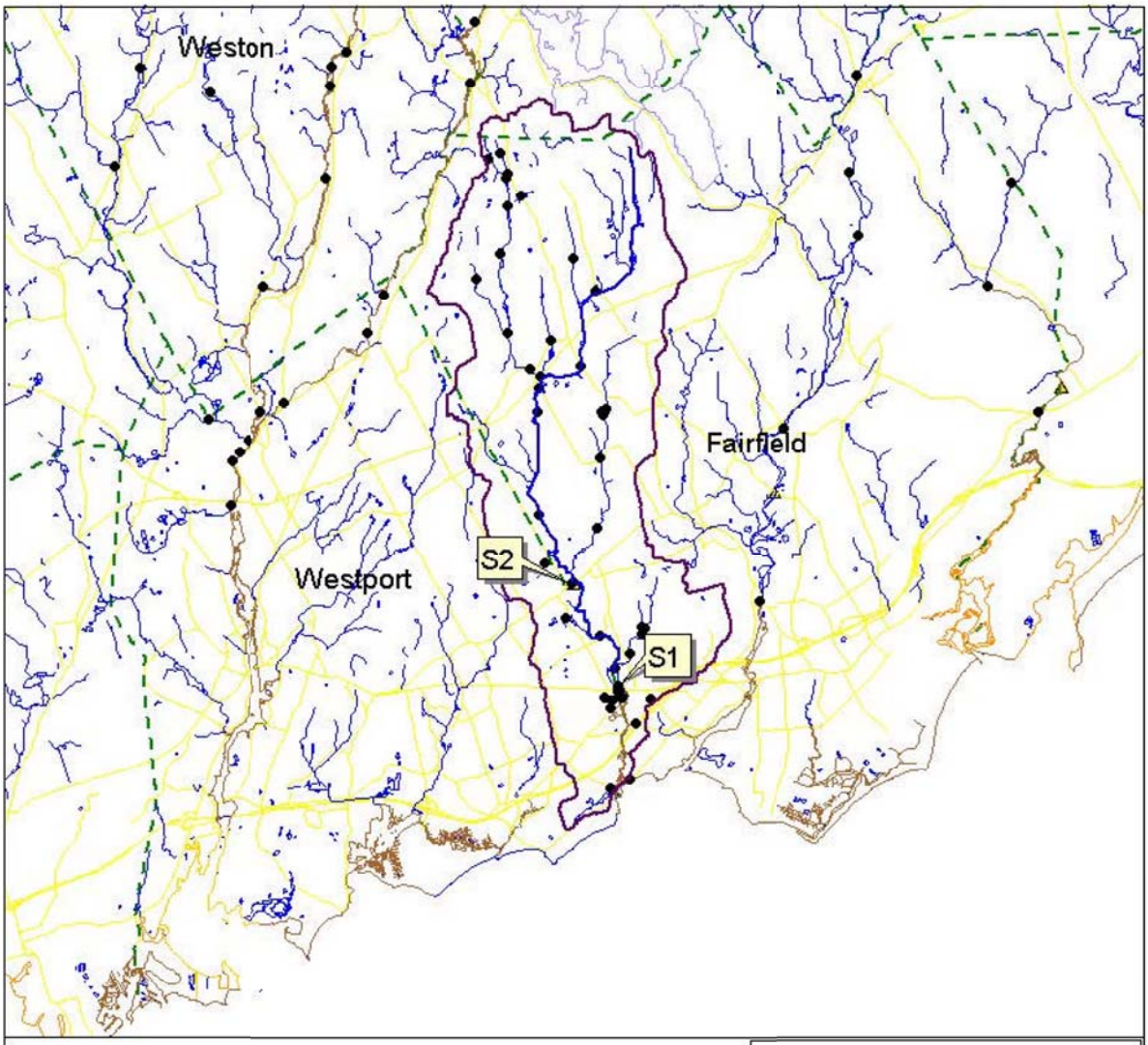
Impaired Waterbody
Waterbody Name: Sasco Brook
Waterbody Segment ID: CT7109-00_01 & CT7109-00_02
Waterbody Segment Description: From the Bulkley Pond dam (Westport), upstream to the headwaters (Fairfield).

Impairment Description:
Designated Use Impairment: Contact Recreation
Size of Impaired Segment: 6.1 linear miles
Surface Water Classification: Class A

Watershed Description:
Drainage Basin Area: 10.21 square miles
Tributary To: Sasco Creek and Southport Harbor
Subregional Basin Name & Code: Sasco Brook 7109
Regional Basin: Southwest Eastern
Major Basin: Southwest Coast
Watershed Towns: Fairfield, Westport
Phase II GP applicable? Fairfield-yes, Westport-yes
Applicable Season: Recreation Season (May 1 to September 30)
Landuse:

Land Use Category	Percent Composition
Forested	41.2 %
Urban/Developed	36.7 %
Open Space	19.8 %
Water/Wetland	1.2 %
Agriculture	1.0 %

Data Source: Connecticut Land Use Land Cover Data Layer LANDSTAT (1995) Thematic Mapper Satellite Imagery.



N

0.7 0 0.7 1.4 Miles

LEGEND
Sasco Brook
Sasco Brook Subbasin
Sampling Locations
WQ Classifications
A, SA
AA, A/AA
B, B*, SB
B/A, B/AA, C/A, SB/SA, SC/SA, SD/SA
C/B, D/B, SC/SB, SD/SB
Change of Class
State
County
Town
Coastline
Primary & Secondary Roads
USGS gage

Sasco Brook Layout with Sampling Locations

Map Data: CT DEP
Map Created: 8/2004

Sasco Brook

CT 7109-00 01

Data Used in the Analysis

Monitoring Site: S1, Fairfield Site, Route 1 - Above Dam

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
9/27/99	0.00	0.00	0.02	DRY	20	1.0	0.0200	19	5
5/8/00	0.40	0.40	0.61	**WET**	320	27.0	0.5400	138	57
5/22/00	0.01	0.27	1.33	**WET**	320	27.0	0.5400	138	57
6/7/00	2.67	2.71	2.82	**WET**	6900	48.0	0.9600	576	92
6/20/00	0.01	0.07	0.14	DRY	130	9.0	0.1800	54	58
7/5/00	0.00	0.07	0.07	DRY	41	3.0	0.0600	30	27
7/12/00	0.00	0.01	0.05	DRY	63	5.0	0.1000	39	39
7/19/00	0.00	0.00	3.21	**WET**	110	7.0	0.1400	47	58
8/9/00	0.00	0.00	0.15	DRY	500	34.0	0.6800	194	61
9/6/00	0.00	0.00	1.03	DRY	370	32.0	0.6400	175	53
9/20/00	1.55	1.55	1.55	**WET**	24000	50.0	1.0000	576	98
5/2/01	0.00	0.00	0.00	DRY	63	5.0	0.1000	39	39
5/16/01	0.00	0.04	0.07	DRY	190	15.0	0.3000	78	59
5/30/01	0.20	0.20	1.88	**WET**	820	43.0	0.8600	341	58
6/13/01	0.11	0.15	0.15	**WET**	200	17.0	0.3400	86	57
6/28/01	0.00	0.00	0.00	DRY	52	4.0	0.0800	35	34
7/11/01	0.00	0.00	0.25	DRY	360	31.0	0.6200	167	54
7/25/01	0.00	0.00	0.00	DRY	31	2.0	0.0400	25	19
8/8/01	0.00	0.00	0.05	DRY	710	39.0	0.7800	257	64
8/22/01	0.00	0.39	0.50	**WET**	700	38.0	0.7600	241	66
9/5/01	0.00	0.00	0.00	DRY	170	12.0	0.2400	66	61
9/19/01	0.00	0.00	0.00	DRY	250	20.0	0.4000	100	60
5/1/02	0.36	0.36	0.36	**WET**	350	30.0	0.6000	159	55
5/15/02	1.60	2.64	2.64	**WET**	560	36.0	0.7200	216	62
6/11/02	0.00	0.00	0.07	DRY	190	15.0	0.3000	78	59
6/25/02	0.00	0.00	0.00	DRY	290	24.0	0.4800	120	59
7/16/02	0.00	0.00	0.00	DRY	1000	46.0	0.9200	460	54
7/30/02	0.00	0.02	0.02	DRY	220	19.0	0.3800	95	57
8/13/02	0.00	0.00	0.00	DRY	6000	47.0	0.9400	528	91
8/27/02	0.00	0.00	0.30	DRY	650	37.0	0.7400	228	65
9/10/02	0.00	0.00	0.00	DRY	300	26.0	0.5200	132	56
9/24/02	0.00	0.00	0.02	DRY	460	33.0	0.6600	184	60
5/29/03	0.00	0.05	2.06	**WET**	280	23.0	0.4600	115	59
6/9/03	0.00	0.66	0.66	**WET**	200	17.0	0.3400	86	57
6/23/03	0.37	1.50	1.50	**WET**	790	41.0	0.8200	293	63
7/7/03	0.32	0.32	0.32	**WET**	520	35.0	0.7000	204	61
7/21/03	0.30	0.30	0.30	**WET**	340	29.0	0.5800	152	55
8/2/03	0.25	0.35	0.42	**WET**	12000	49.0	0.9800	576	95
8/23/03	0.00	0.00	0.00	DRY	120	8.0	0.1600	50	58
9/10/03	0.00	0.00	0.00	DRY	160	10.0	0.2000	58	64
9/29/03	0.56	0.69	0.69	**WET**	800	42.0	0.8400	315	61
5/17/04	0.02	0.02	0.26	DRY	270	22.0	0.4400	110	59
6/14/04	0.02	0.02	0.02	DRY	184	13.0	0.2600	70	62
7/1/04	0.00	0.00	0.35	DRY	160	10.0	0.2000	58	64
7/12/04	2.16	2.16	2.16	**WET**	188	14.0	0.2800	74	61
7/26/04	0.00	0.00	0.71	DRY	296	25.0	0.5000	126	57
8/9/04	0.00	0.00	0.00	DRY	256	21.0	0.4200	105	59
8/23/04	0.00	0.00	1.07	DRY	940	45.0	0.9000	410	56
9/2/04	0.00	0.00	0.03	DRY	720	40.0	0.8000	274	62
9/21/04	0.00	0.00	2.33	**WET**	860	44.0	0.8800	372	57

Statistics

# Samples DRY	**31**
# Samples WET	**19**
# Samples Total	**50**
Geomean	**344**
Log std deviation	**0.5917**

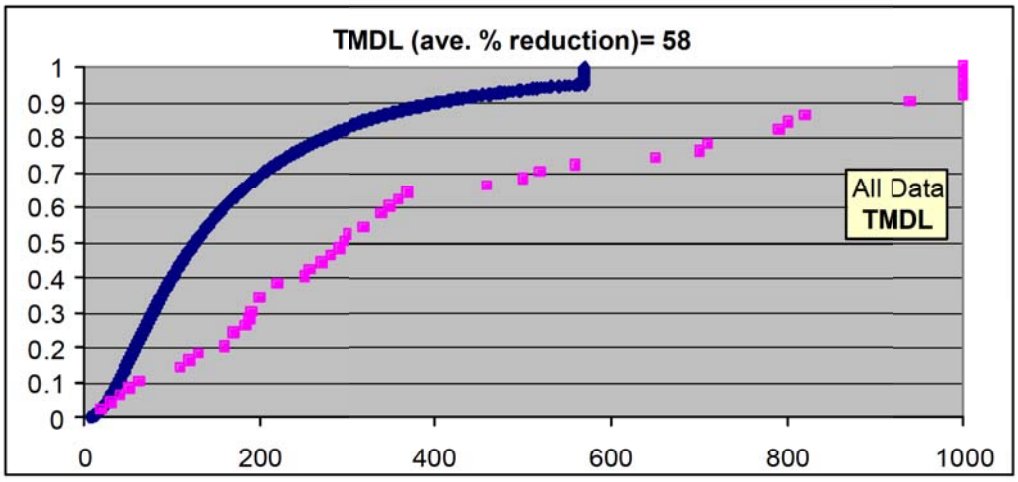
Avg % Reduction

Wet (WLA)	**65**
Dry (LA)	**54**
Total (TMDL)	**58**

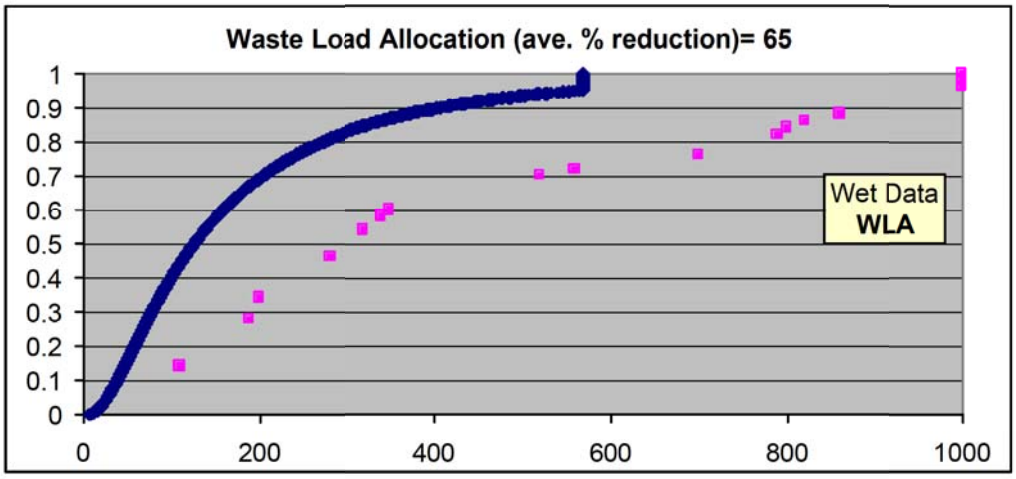
Precipitation and E. coli data provided by the Town of Fairfield.

WET Condition defined as greater than 0.1" precipitation in 24 hours or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

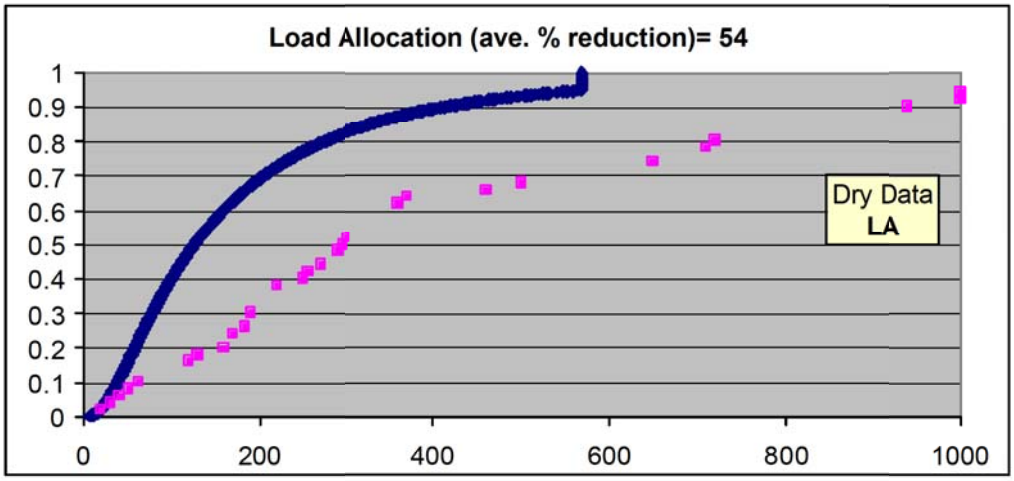
Sasco Brook Criteria Curve for Monitoring Site S1



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Sasco Brook

CT 7109-00 02

Data Used in the Analysis

Monitoring Site: S2, Fairfield Site, Wakeman Lane

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
5/8/00	0.40	0.40	0.61	**WET**	52	2.5	0.0500	28	47
5/22/00	0.01	0.27	1.33	**WET**	170	28.0	0.5600	145	15
6/7/00	2.67	2.71	2.82	**WET**	7700	48.0	0.9600	576	93
6/20/00	0.01	0.07	0.14	DRY	330	35.0	0.7000	204	38
7/5/00	0.00	0.07	0.07	DRY	120	22.0	0.4400	110	9
7/12/00	0.00	0.01	0.05	DRY	160	27.0	0.5400	138	14
7/19/00	0.00	0.00	3.21	**WET**	300	33.0	0.6600	184	39
8/9/00	0.00	0.00	0.15	DRY	110	21.0	0.4200	105	5
9/6/00	0.00	0.00	1.03	DRY	480	42.0	0.8400	315	34
9/20/00	1.55	1.55	1.55	**WET**	39000	50.0	1.0000	576	99
5/2/01	0.00	0.00	0.00	DRY	63	5.5	0.1100	41	35
5/16/01	0.00	0.04	0.07	DRY	52	2.5	0.0500	28	47
5/30/01	0.20	0.20	1.88	**WET**	200	30.0	0.6000	159	20
6/13/01	0.11	0.15	0.15	**WET**	400	39.0	0.7800	257	36
6/28/01	0.00	0.00	0.00	DRY	140	26.0	0.5200	132	6
7/11/01	0.00	0.00	0.25	DRY	1700	46.0	0.9200	460	73
7/25/01	0.00	0.00	0.00	DRY	31	1.0	0.0200	19	39
8/8/01	0.00	0.00	0.05	DRY	98	16.5	0.3300	84	14
8/22/01	0.00	0.39	0.50	**WET**	370	36.5	0.7300	222	40
9/5/01	0.00	0.00	0.00	DRY	63	5.5	0.1100	41	35
9/19/01	0.00	0.00	0.00	DRY	52	2.5	0.0500	28	47
5/1/02	0.36	0.36	0.36	**WET**	410	40.0	0.8000	274	33
5/15/02	1.60	2.64	2.64	**WET**	390	38.0	0.7600	241	38
6/11/02	0.00	0.00	0.07	DRY	78	9.5	0.1900	56	28
6/25/02	0.00	0.00	0.00	DRY	78	9.5	0.1900	56	28
7/16/02	0.00	0.00	0.00	DRY	72	8.0	0.1600	50	30
7/30/02	0.00	0.02	0.02	DRY	98	16.5	0.3300	84	14
8/13/02	0.00	0.00	0.00	DRY	92	12.5	0.2500	68	26
8/27/02	0.00	0.00	0.30	DRY	104	18.5	0.3700	93	11
9/10/02	0.00	0.00	0.00	DRY	128	23.0	0.4600	115	10
9/24/02	0.00	0.02	0.02	DRY	92	12.5	0.2500	68	26
5/29/03	0.00	0.05	2.06	**WET**	188	29.0	0.5800	152	19
6/9/03	0.00	0.66	0.66	**WET**	134	24.0	0.4800	120	10
6/23/03	0.37	1.50	1.50	**WET**	650	43.0	0.8600	341	48
7/7/03	0.32	0.32	0.32	**WET**	680	44.0	0.8800	372	45
7/21/03	0.30	0.30	0.30	**WET**	300	33.0	0.6600	184	39
8/2/03	0.25	0.35	0.42	**WET**	4400	47.0	0.9400	528	88
8/23/03	0.14	0.28	0.56	**WET**	64	7.0	0.1400	47	27
9/10/03	0.00	0.00	0.00	DRY	88	11.0	0.2200	62	30
9/29/03	0.56	0.69	0.69	**WET**	370	36.5	0.7300	222	40
5/3/04	0.60	0.60	0.60	**WET**	22000	49.0	0.9800	576	97
5/17/04	0.02	0.02	0.03	DRY	106	20.0	0.4000	100	6
6/14/04	0.02	0.02	0.02	DRY	240	32.0	0.6400	175	27
7/1/04	0.00	0.00	0.35	DRY	104	18.5	0.3700	93	11
7/12/04	2.16	2.16	2.16	**WET**	136	25.0	0.5000	126	7
7/26/04	0.00	0.00	0.71	DRY	216	31.0	0.6200	167	23
8/9/04	0.00	0.00	0.00	DRY	96	15.0	0.3000	78	19
8/23/04	0.00	0.00	1.07	DRY	700	45.0	0.9000	410	41
9/2/04	0.00	0.00	0.03	DRY	92	12.5	0.2500	68	26
9/21/04	0.00	0.00	2.33	**WET**	460	41.0	0.8200	293	36

Statistics

# Samples DRY	**29**
# Samples WET	**21**
# Samples Total	**50**
Geomean	**227**
Log std deviation	**0.6436**

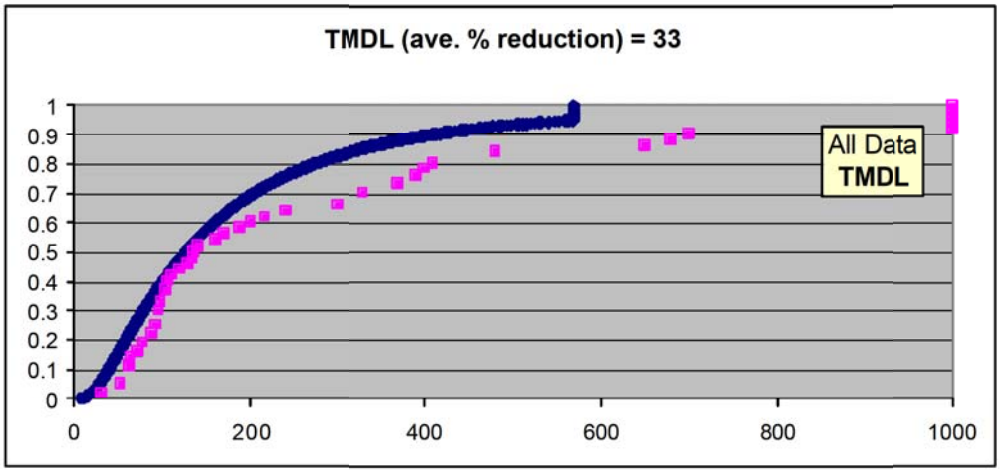
Avg % Reduction

Wet (WLA)	**44**
Dry (LA)	**26**
Total (TMDL)	**33**

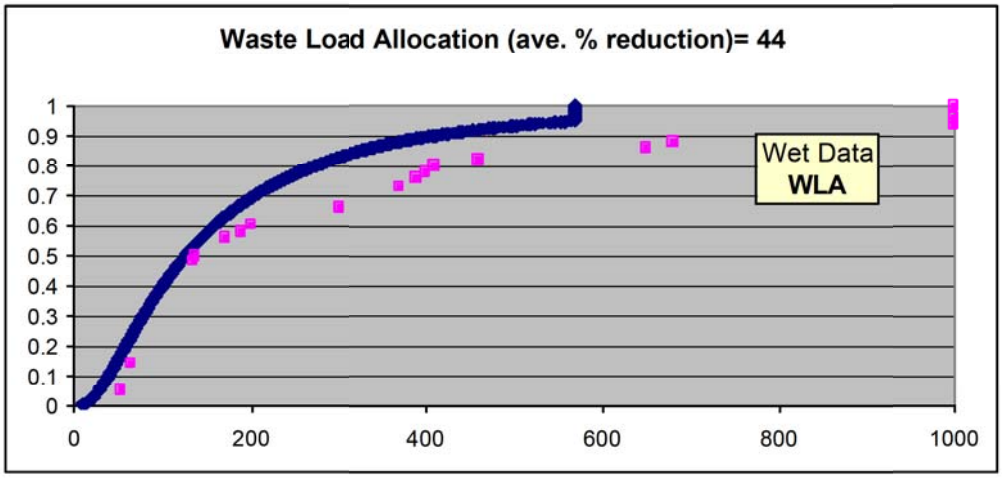
Precipitation and E. coli data provided by the Town of Fairfield.

WET Condition defined as greater than 0.1" precipitation in 24 hours or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

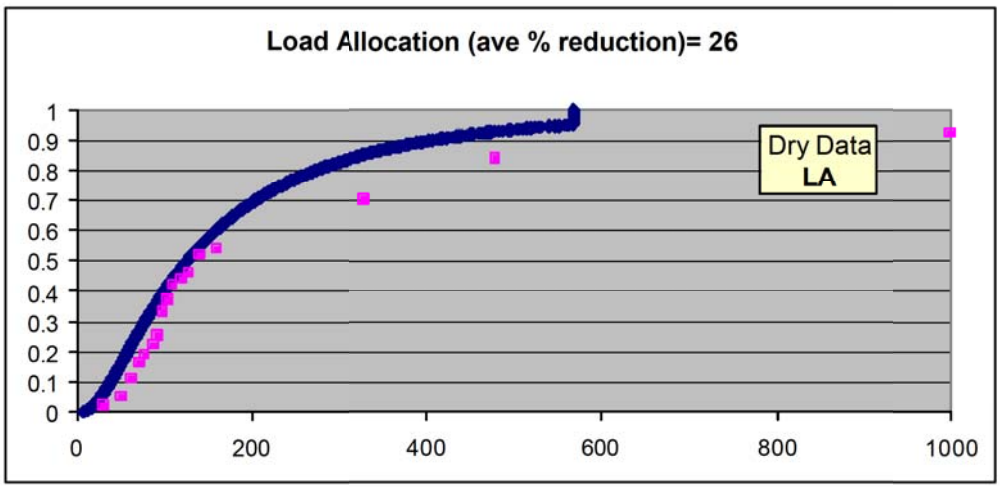
Sasco Brook Criteria Curve for Monitoring Site S2



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Appendix A-3
Sasco Brook
TMDL Summary

The TMDL analysis for Sasco Brook was conducted at two sites, which are representative of two river segments. The analysis indicates that site S1, located at the Bulkley Pond Dam requires a greater percent reduction than the upstream site, S2. The Waste Load Allocation (WLA) and Load Allocation (LA) percent reduction are 66 and 53, respectively. In this case both point stormwater and nonpoint sources are contributing to the bacteria load. It is likely that nonpoint sources include improperly functioning septic systems, agriculture/farm activities and/or wildlife. At S2, the WLA (wet weather) percent reduction is almost double the LA (dry weather). This indicates that water quality at site S2 is more strongly influenced by point source stormwater than non-point sources. The WLA reduction can be achieved through the installation of engineered controls to improve water quality and reduce the surge of stormwater to the brook. The LA reduction of 20% indicates that the bacteria load may be caused by improperly functioning septic systems or agriculture/farm activities. While it is suspected that bacteria loading to site M2S on the Mill River is somewhat reduced by the upstream presence of Lake Mohegan, it does not appear that Bulkley Pond acts in a similar fashion to significantly reduce bacteria loading in the Sasco Brook system. However, the increased bacteria load from Bulkley Pond may originate from waterflowl that use the pond.

Appendix B

Technical Support Document for the Cumulative Distribution Function Method

DEVELOPMENT OF TMDLS FOR INDICATOR BACTERIA USING THE CUMULATIVE DISTRIBUTION FUNCTION METHOD

Overview of approach

The analytical methodology presented in this document provides a defensible scientific and technical basis for establishing TMDLs to address recreational use impairments in urban watersheds. Representative ambient water quality monitoring data for a minimum of 21 sampling dates during the recreational season (May 1 – September 31) is required for the analysis. The reduction in bacteria density from current levels needed to achieve consistency with the criteria is quantified by calculating the difference between the cumulative relative frequency of the sample data set and the criteria adopted by Connecticut to support recreational use. Connecticut's adopted water quality criteria for the indicator bacteria *E. coli* (geometric mean 126 col/100ml, single sample maximum 576 col/100ml) is represented by a statistical distribution of geometric mean 126 and log standard deviation 0.4 for purposes of TMDL calculations.

TMDLs developed using this approach are expressed as the average percentage reduction from current conditions required to achieve consistency with criteria. The procedure partitions the TMDL into regulated point source wasteload allocation (WLA) and non-point source load allocation (LA) components by quantifying the contribution of ambient monitoring data collected during periods of high stormwater influence and minimal stormwater influence to the current condition. TMDLs developed using this analytical approach provide an ambient monitoring benchmark ideally suited for quantifying progress in achieving water quality goals as a result of TMDL implementation.

Applicability

The methodology is intended solely for use in developing TMDLs for urban waters that are identified (listed) as impaired on the *2004 List of Connecticut Water Bodies Not Meeting Water Quality Standards*[1]. It is expected that implementation of these TMDLs will be accomplished principally through implementing the provisions of the Small Municipal Separate Storm Sewer Systems general permit (MS4 permit)[2]. The method as described here is not proposed for use in developing TMDLs for waterbody segments that include designated bathing areas. Further, the method is not intended for use as an assessment tool for purposes of identifying use attainment status relative to listing or delisting of waterbody segments pursuant to Section 303(d) of the federal Clean Water Act. Assessment of use support is performed in accordance with the Department's guidance document, *Connecticut Consolidated Assessment and Listing Methodology (CT-CALM)*[3].

Background

TMDLs are established by the State in accordance with the requirements established in the federal Clean Water Act. Section 303(d) of the Act requires the State to perform an assessment of waters within the State relative to their ability to support designated uses including recreational use. The procedure used by the Department to assess use attainment is described in the guidance document, *Connecticut Consolidated Assessment and Listing Methodology (CT-CALM)*[3]. The list of waterbody segments in Connecticut that do not currently support recreational use is updated to

incorporate the most recent monitoring information by the Department every two years. As a result of this process, waterbodies may be added to or deleted from the list of impaired waters in accordance with the CT-*CALM* guidance. Once complete, the list is submitted to the Regional office of the federal EPA for approval. Section 303(d) of the Act requires the State to establish TMDLs for each pollutant contributing to the impairment of each waterbody segment identified on the list.

Water Quality Criteria for Indicator Bacteria (*E. coli*)

Connecticut's water quality criteria for the support of "all other recreational use" established in the State's Water Quality Standards[4] is a geometric mean density of 126 col/100 and a single sample maximum density of 576 col/100ml. The indicator bacteria, *E. coli*, is not pathogenic, rather its presence in water is an indicator of contamination with fecal material that may also contribute pathogenic organisms. Connecticut's criteria are based on federal guidance[5]. In this guidance, the basis for the criteria and the relationship between the geometric mean criterion and the single sample maximum criterion is explained in detail.

The geometric mean criterion was derived by EPA scientists from epidemiological studies at beaches where the incidence of swimming related health effects (gastrointestinal illness rate) could be correlated with indicator bacteria densities. EPA's recommended criteria reflect an average illness rate of 8 illnesses per 1000 swimmers exposed. This condition was predicted to exist based on studies cited in the federal guidance when the steady-state geometric mean density of *E. coli* was 126 col/100ml. The distribution of individual sample results around the geometric mean is such that approximately half of all individual samples are expected to exceed the geometric mean and half will be below the geometric mean.

EPA also derived a single sample maximum criterion from this same database to support decisions by public health officials regarding the closure of beaches when an elevated risk of illness exists. Because approximately half of all individual sample results for a beach where the risk of illness is considered "acceptable" are expected to exceed the geometric mean criteria of 126 col./100ml, an upper boundary to the range of individual sample results was statistically derived that will be exceeded at frequencies less than 50% based on the variability of sample data. The mean log standard deviation for *E. coli* densities at the freshwater beach sites studied by EPA was 0.4. The single sample maximum criterion of 576 col./100 adopted by Connecticut represents the 95th percentile upper confidence limit (5% exceedance frequency) for a statistical distribution of data with a geometric mean of 126 and a log standard deviation of 0.4 as recommended by EPA for waters not heavily used for swimming.

Consistent with the State's disinfection policy (Water Quality Standard #23), the critical period for application of the indicator bacteria criteria is the recreational season, defined as May 1 through September 30. For waters that do not receive point discharges of treated sewage subject to the disinfection policy, a review of ambient monitoring data contained in the State's Ambient Monitoring Database[6] confirms that bacteria densities are typically highest during the summer months. Consistency with criteria during the summer is indicative of consistency at all times of the year. Lower densities reported during other portions of the year are most likely a result of several environmental factors

including more rapid die-off of enteric bacteria in colder temperatures and reduced loadings from wildlife and domestic animal populations. Further, human exposure to potentially contaminated water is greatly reduced during the colder months, particularly exposure that results from immersion in the water since cold temperatures discourage participation in recreational activities that typically involve immersion.

As noted above, Connecticut's adopted criteria to support "all other recreational use" is expressed in the Water Quality Standards as a geometric mean *E. coli* density of 126 col/100 ml and a single sample maximum of 576 col/100ml. These values are based on federal guidance and reflect an idealized distribution of bacteria monitoring data for sites studied by EPA that can be represented by statistical distribution with a geometric mean of 126 col.100ml and a log standard deviation of 0.4. The criteria can therefore be expressed as a cumulative frequency distribution or "criteria curve" as shown in figure 1.

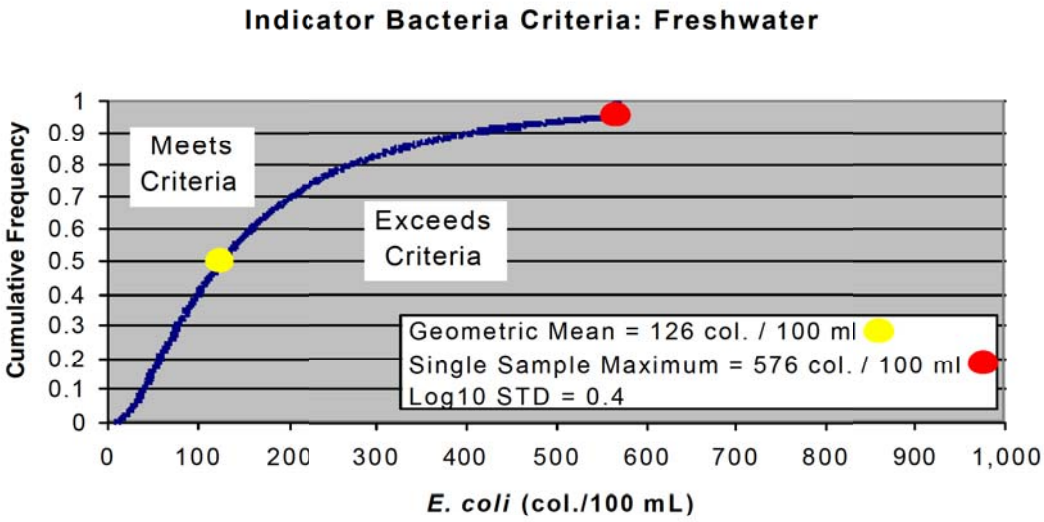


Figure 1—Cumulative Relative Frequency Distribution representing water quality criteria to support recreational use.

TMDL

As with the cumulative relative frequency curve representing the criteria shown in Figure 1, a cumulative relative frequency curve can be prepared using site-specific sample data to represent current conditions at the TMDL monitoring site. The TMDL for the monitored segment is derived by quantifying the difference between these two distributions as shown conceptually in Figure 2. This is accomplished by calculating the reduction required at representative points on the sample data cumulative frequency

distribution curve and then averaging the reduction needed across the entire range of sampling data. This procedure allows the contribution of each individual sampling result to be considered when estimating the percent reduction needed to meet a criterion that is expressed as a geometric mean.

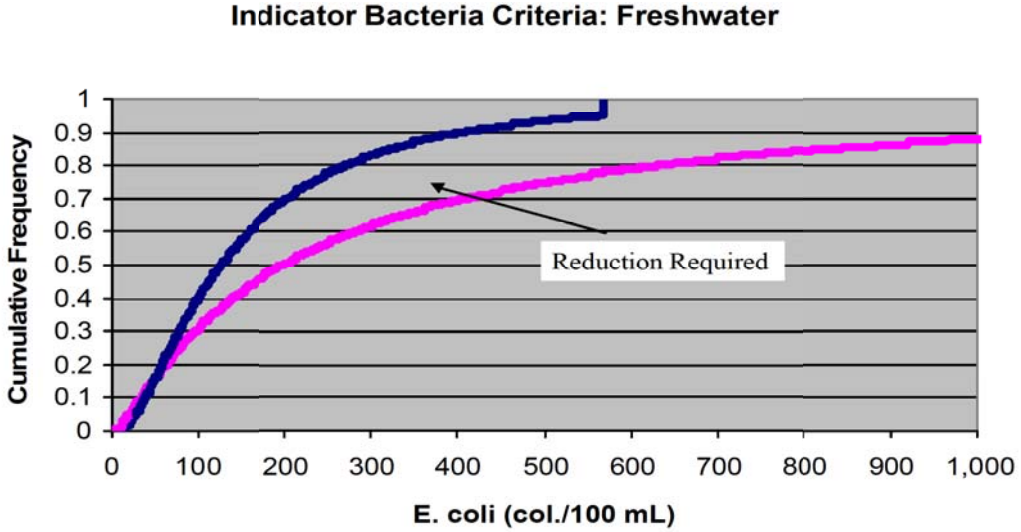


Figure 2. Reduction in indicator bacteria density needed from current condition (red line) to meet criteria (blue line) based on cumulative relative frequency distribution.

WLA and LA

Stormwater runoff in an urbanized area is considered a point source subject to regulation under the NPDES permitting program. TMDLs for indicator bacteria in waters draining urbanized areas must therefore be partitioned into a WLA to accommodate point source stormwater loadings of indicator bacteria and a LA to accommodate non-point loadings from unregulated sources. This is accomplished using the same ambient monitoring data used to establish the TMDL.

One common characteristic of urbanized areas is the high percentage of impervious surface. Much of the impervious surface is directly connected to nearby surface waters through stormwater drainage systems. As a result, runoff is rapid following rain events and flow in urban streams is typically dominated by stormwater runoff during these periods. Monitoring results for samples collected under these conditions are strongly influenced by stormwater quality. During dry conditions, urban streams contain little stormwater since urban watersheds drain quickly and baseflows are reduced due to lower infiltration rates and reduced recharge of groundwater. At baseflow, urban stream water quality is dominated by non-point sources of indicator bacteria since stormwater outfalls are inactive.

The relative contribution of indicator bacteria loadings occurring during periods of high or low

stormwater influence to the geometric mean indicator density is estimated by calculating separate averages of the reduction needed to achieve consistency with criteria under "wet" and "dry" conditions. The reduction needed under "wet" conditions is assigned to the WLA and the reduction needed under "dry" conditions is assigned to the LA. Separate reduction goals are established for baseflow and stormwater dominated periods that can assist local communities in selection of best management practices to improve water quality. The technique also facilitates the use of ambient stream monitoring data to track future progress in meeting water quality goals.

The sources contributing to the WLA and LA can be further subdivided depending on knowledge of sources present in the watershed (Table 1). Some existing sources such as dry weather flows from stormwater collections systems, illegal connections to stormwater systems, and combined sewer overflows are allocated "zero" or "100% reduction" since the management goal for these sources is elimination. Permitted discharges of treated and disinfected domestic wastewater (sewage treatment plants) are allocated "zero percent reduction" since disinfection required by the NPDES permit is sufficient to reduce indicator bacteria levels to below levels of concern. Natural sources such as wildlife are also allocated a "zero percent reduction" since the management goal is to foster a sustainable natural habitat and stream corridor to the extent practicable. Management measures to control nuisance populations of some wildlife species that can result in elevated indicator bacteria densities such as Canadian geese however should be considered in developing an overall watershed management plan.

Table 1. Establishing WLA and LA Pollutant Sources

Source	Critical Conditions	Assigned To
On-Site Septic	Baseflow (DRY)	LA
Domestic Animal	Baseflow (DRY)	LA
Natural (Wildlife)	Baseflow (DRY)	LA
POTW	Baseflow (DRY)	WLA
Stormwater	Wet Weather Flow	WLA
Dry Weather Overflow	Baseflow (DRY)	None
Illegal Connection	Baseflow (DRY)	None
Combined Sewer Overflow	Wet Weather Flow	None

MOS

Federal regulations require that all TMDL analyses include either an implicit or explicit margin of safety (MOS). The analytical approach described here incorporates an implicit MOS. Factors contributing to the MOS include assigning a percent reduction of "zero" to sampling results that indicate quality better than necessary to achieve consistency with the criteria. The increase in loadings on those dates that could be assimilated by the stream without exceeding criteria is not quantified (as a negative percent reduction) and averaged with the load reductions needed on other sampling dates. Rather, this excess capacity is averaged as a zero value thereby contributing to the implicit MOS.

The means of implementing the TMDL also contributes to the MOS. The loading reductions specified in the TMDL for regulated stormwater discharges and non-point sources must be sufficient to achieve water quality standards since confirmation that these reductions have been achieved will be based on ambient monitoring data documenting that water quality standards are met. Further, achieving compliance with the requirements of the MS4 permit includes elimination of high loading sources such as illegal connections and dry weather overflows from storm sewer systems. Eliminating loads from these sources, as opposed to allocating a percent reduction equal to that given other sources, contributes to the implicit MOS. Further assurance that implementing the TMDL will meet water quality standards is provided by the iterative implementation required for compliance with the MS4 permit. This approach mandates that additional management efforts must be implemented until ambient monitoring data confirms that standards are met.

Many of the best management practices that are implemented to address either wet or dry weather sources (WLA or LA components of the TMDL) will have some degree of effectiveness in reducing loads under all conditions. For example, the TMDL allocates all the percent reduction needed to meet standards under wet weather conditions to the WLA. However, reductions resulting from best management practices implemented to reduce dry weather loads (LA) will provide some benefit during wet weather conditions as well. These reductions also contribute to the implicit MOS.

Data requirements

Ambient monitoring data for a minimum of 21 sampling dates during the recreational season (May 1 – September 30) is required. Data collected at other times during the year are excluded from the analysis. In addition to data on indicator bacteria density, precipitation data for each sampling date and the week prior to the sampling is necessary. Sampling dates should be selected to insure that representative data is available for both wet and dry conditions. This may be accomplished most easily by selecting sampling dates without prior knowledge of the meteorological conditions likely to be encountered on that date.

Data must reflect current conditions in the TMDL segment. The monitoring location where data is collected must therefore be sited in an area that can be considered representative of water quality throughout the TMDL segment. Data obtained under unusual circumstances may be excluded from the

analysis provided the reason for excluding that data is provided in the TMDL. Potential reasons for excluding data may include such things as evidence that a spill, upset in wastewater treatment, or sewer line breakage occurred that resulted in a short-term excursion from normal conditions. Data that represent conditions during an extreme storm event that resulted in widespread failure of wastewater treatment or stormwater best management practices may also be excluded. However, data for periods following typical rainfall events must be retained. Reasons for excluding any data must be provided in the TMDL Analysis.

All data must be less than 5 years old. If circumstances in any watershed suggest that conditions have changed during the most recent five-year period, the analysis may be restricted to more recent data in order to be representative of the current status provided the minimum data requirements are met.

Assurance of acceptable data quality must be provided. Typically, all data should be collected and results analyzed and reported pursuant to an EPA approved Quality Assurance Project Plan (QAPP). Data collected in the absence of a QAPP may be acceptable provided there is evidence that confirms acceptable data quality.

Analytical Procedure - TMDL

1. The *E. coli* monitoring data is ranked from lowest to highest. In the event of ties, monitoring results are assigned consecutive ranks in chronological order of sampling date. The sample proportion (p) is calculated for each monitoring result by dividing the assigned rank (r) for each sample by the total number of sample results (n):

$$p = r / n$$

2. Next, a single sample criteria reference value is calculated for each monitoring result from the statistical distribution used to represent the criteria following the procedure described in steps 3-6 below:

3. If the sample proportion is equal to or greater than .95, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (576 col/100ml).

4. If the sample proportion is less than .95, and greater than .50, the single sample criteria reference value is calculated as:

$$\text{criteria reference value} = \text{antilog}_{10} [\log_{10} 126 \text{ col/100ml} + \{F \times 0.4\}]$$

NB 126 col/100ml is the geometric mean indicator bacteria criterion adopted into Connecticut's Water Quality Standards, F is a factor determined from areas under the Normal probability curve for a probability level equivalent to the sample proportion, 0.4 is the $\log_{10}$ standard deviation used by EPA in deriving the national guidance criteria recommendations (Table 4,

reference 5).

5. If the sample proportion is equal to .50, the single sample reference criteria value is equal to the geometric mean criterion adopted into the Water Quality Standards (126 col/100ml).

6. If the sample proportion is less than .50, the single sample reference criteria value is calculated as:

$$\text{criteria reference value} = \text{antilog}_{10} [\log_{10} 126 \text{ col/100ml} - \{F \times 0.4\}]$$

7. The percent reduction necessary to achieve consistency with the criteria is then calculated following the procedure described in steps 8-9 below:

8. If the monitoring result is less than the single sample reference criteria value, the percent reduction is zero.

9. If the monitoring result exceeds the single sample criteria reference value, the percent reduction necessary to meet criteria on that sampling date is calculated as:

percent reduction = ((monitoring result – criteria reference value)/monitoring result)x100

10. The TMDL, expressed as the average percent reduction to meet criteria, is then calculated as the arithmetic average of the percent reduction calculated for each sampling date.

Analytical Procedure – WLA and LA

Precipitation data is reviewed and each sampling date is designated as a "dry" or "wet" sampling event. Although a site-specific protocol may be specified in an individual TMDL analysis, typically samples collected within 48 hours of a precipitation event of 0.25 inches or greater are designated as "wet".

The average percent reduction for all sampling events used to derive the TMDL that are designated as "wet" is computed and established as the WLA.

The average percent reduction for all sampling events used to derive the TMDL that are designated as "dry" is computed and established as the LA.

Analytical Procedure – Spreadsheet model

An Excel(tm) spreadsheet has been developed that performs all calculations necessary to derive a TMDL using this procedure. Documentation regarding the spreadsheet and example calculations is provided in Attachment A. Copies of the spreadsheet in electronic form may be obtained from DEP by contacting Mr. Thom Haze at (860) 424-3734 or by email at thomas.haze@po.state.ct.us.

References

1. 2004 List of Connecticut Water Bodies Not Meeting Water Quality Standards, Connecticut Department of Environmental Protection, Adopted April 28, 2004, approved June 24, 2004.

2. General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems. Connecticut Department of Environmental Protection. Issued January 9, 2004.

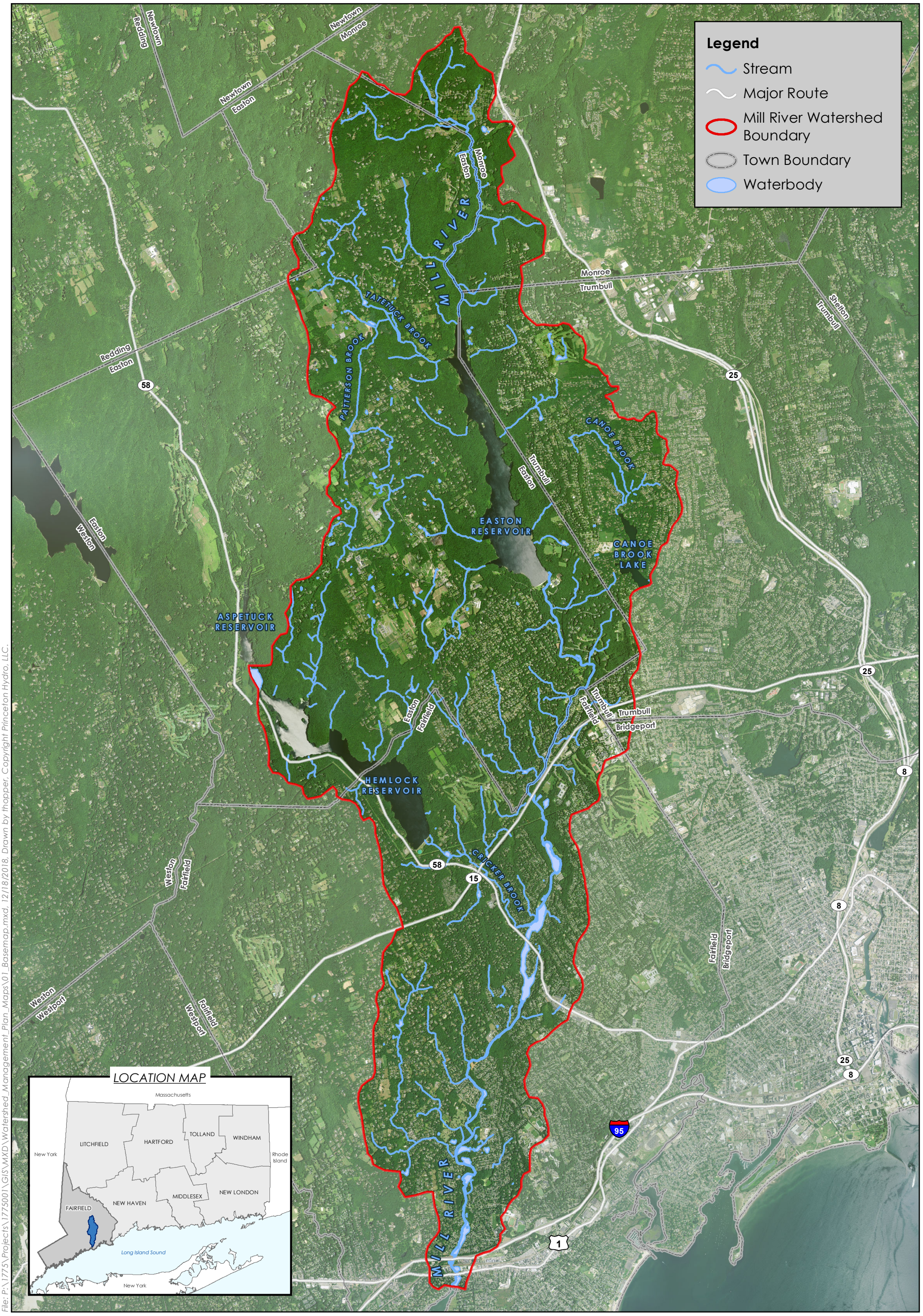
3. Connecticut Consolidated Assessment and Listing Methodology for 305(b) and 303(d) Reporting. Connecticut Department of Environmental Protection, April 2004.

4. Water Quality Standards. Connecticut Department of Environmental Protection. Effective December 17, 2002.

5. Ambient Water Quality Criteria for Bacteria – 1986. U.S. Environmental Protection Agency, Office of Water, January 1986. (EPA440/5-84-002).

6. Water Quality Database. Connecticut Department of Environmental Protection, Monitoring and Assessment Program.

APPENDIX II
Project Maps



NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. 2016 orthoimagery obtained from the United States Department of Agriculture's (USDA), National Agriculture Imagery Program (NAIP).

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

WATERSHED OVERVIEW MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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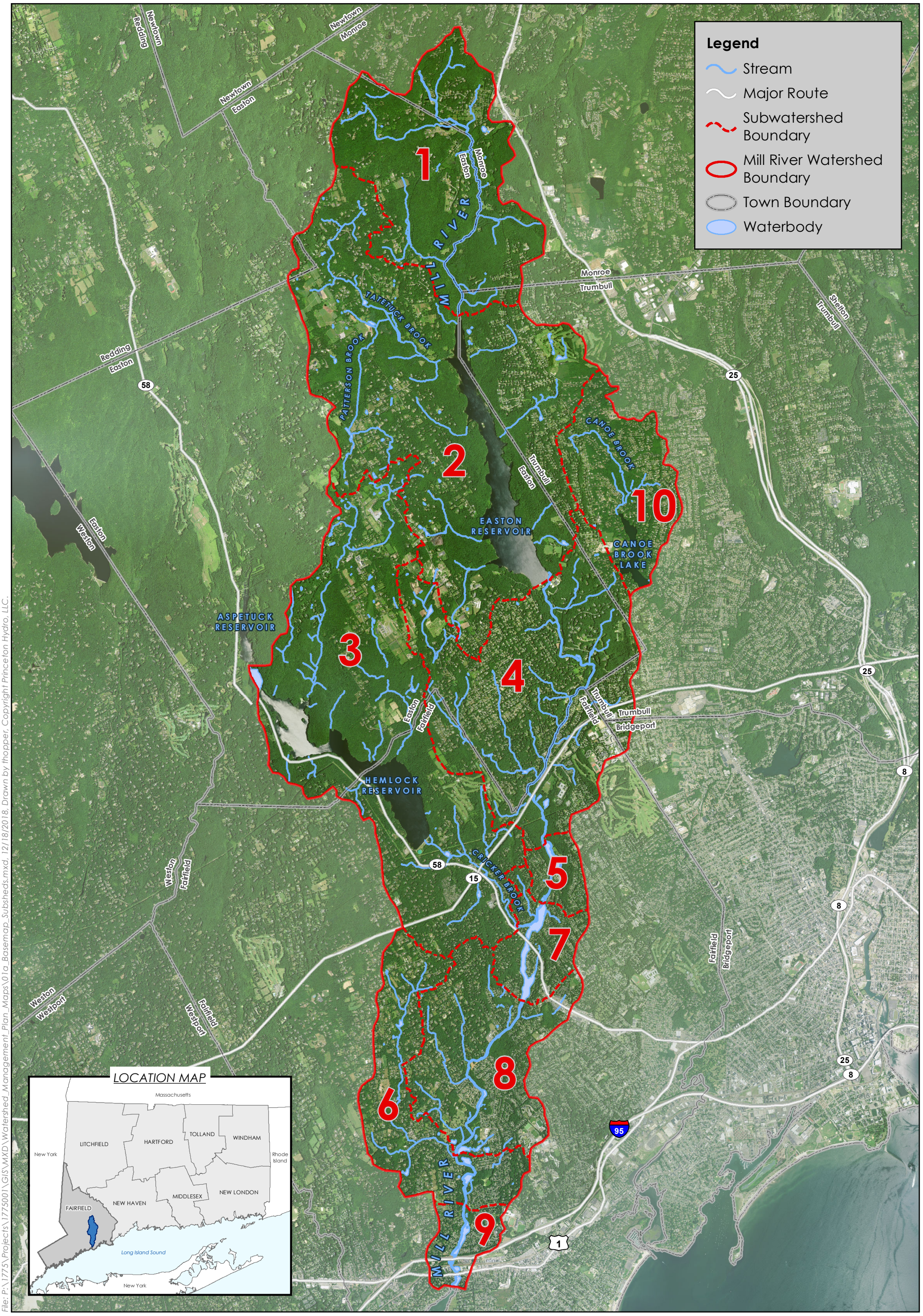

File: P:\1775\Projects\1775001\GIS\MXD\Watershed_Management_Plan_Maps\01a_Basemap_Subsheds.mxd, 12/18/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. 2016 orthoimagery obtained from the United States Department of Agriculture's (USDA), National Agriculture Imagery Program (NAIP).

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SUBWATERSHED MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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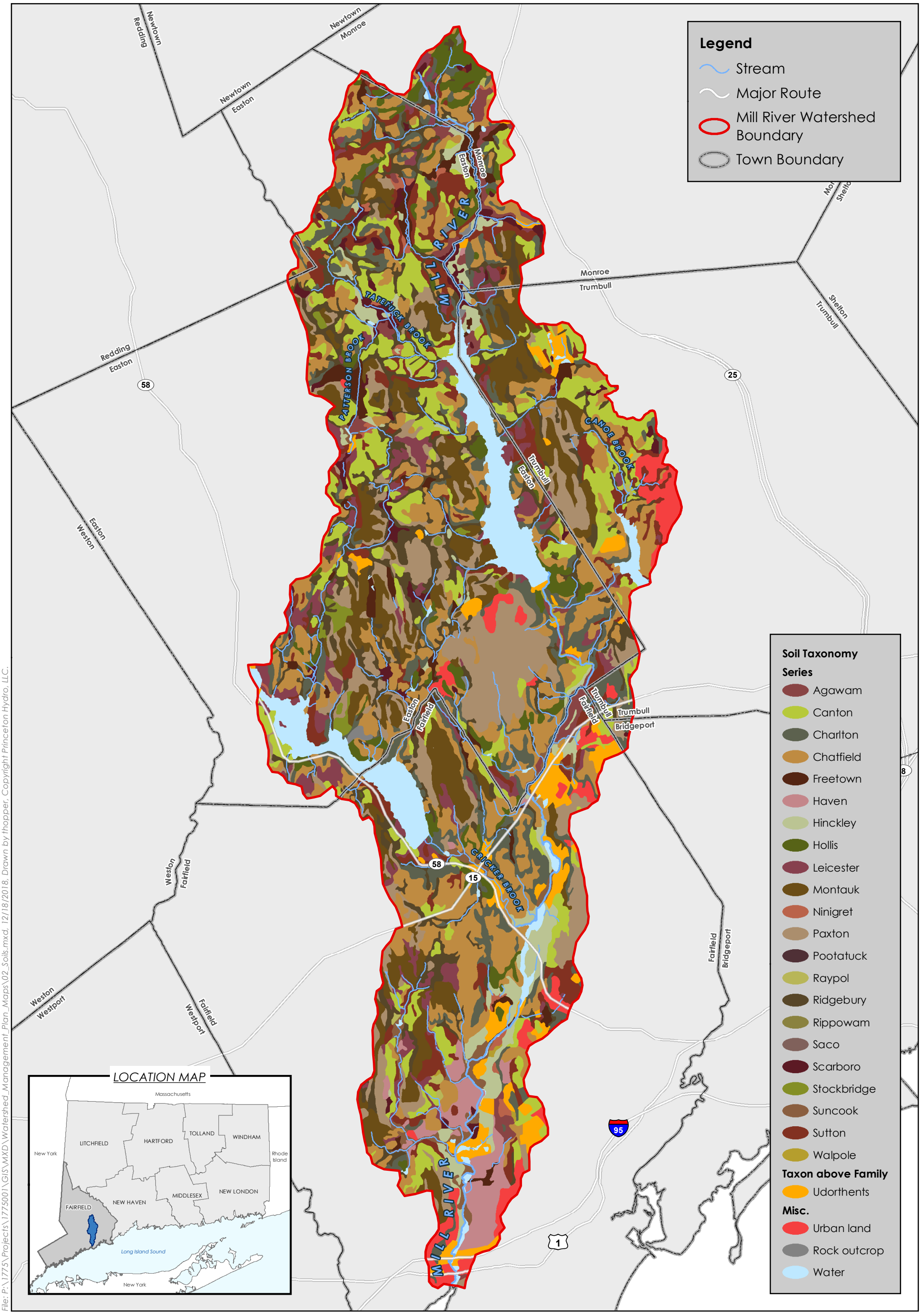

File: P:\1775\Projects\1775001\GIS\MXD\Watershed_Management_Plan_Maps\02_Soils.mxd, 12/18/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. SSURGO Soils obtained from NRCS, USDA, Soil Survey Geographic (SSURGO) Database for the State of Connecticut.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SOIL MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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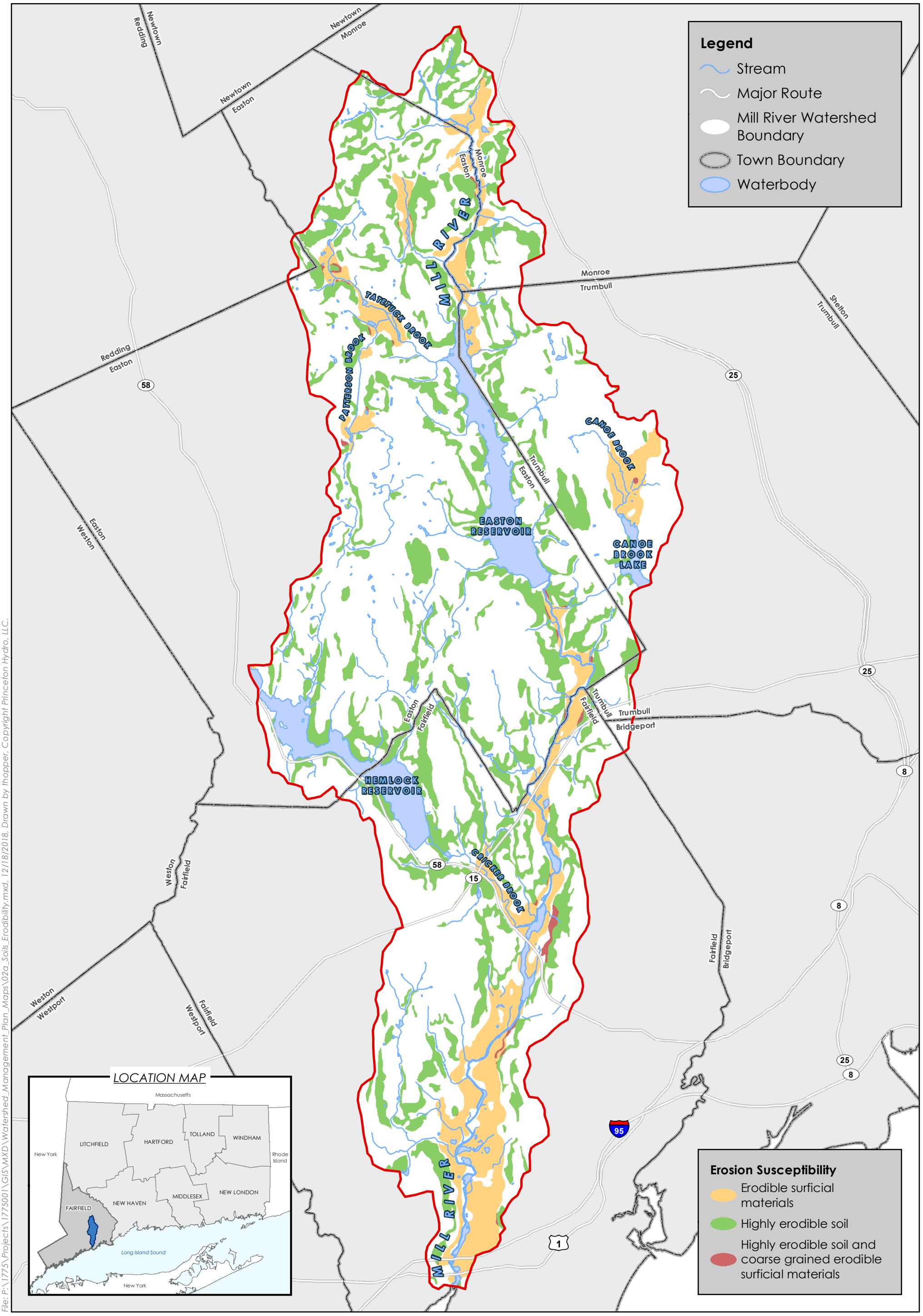

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Erosion susceptibility, streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SOIL ERODIBILITY MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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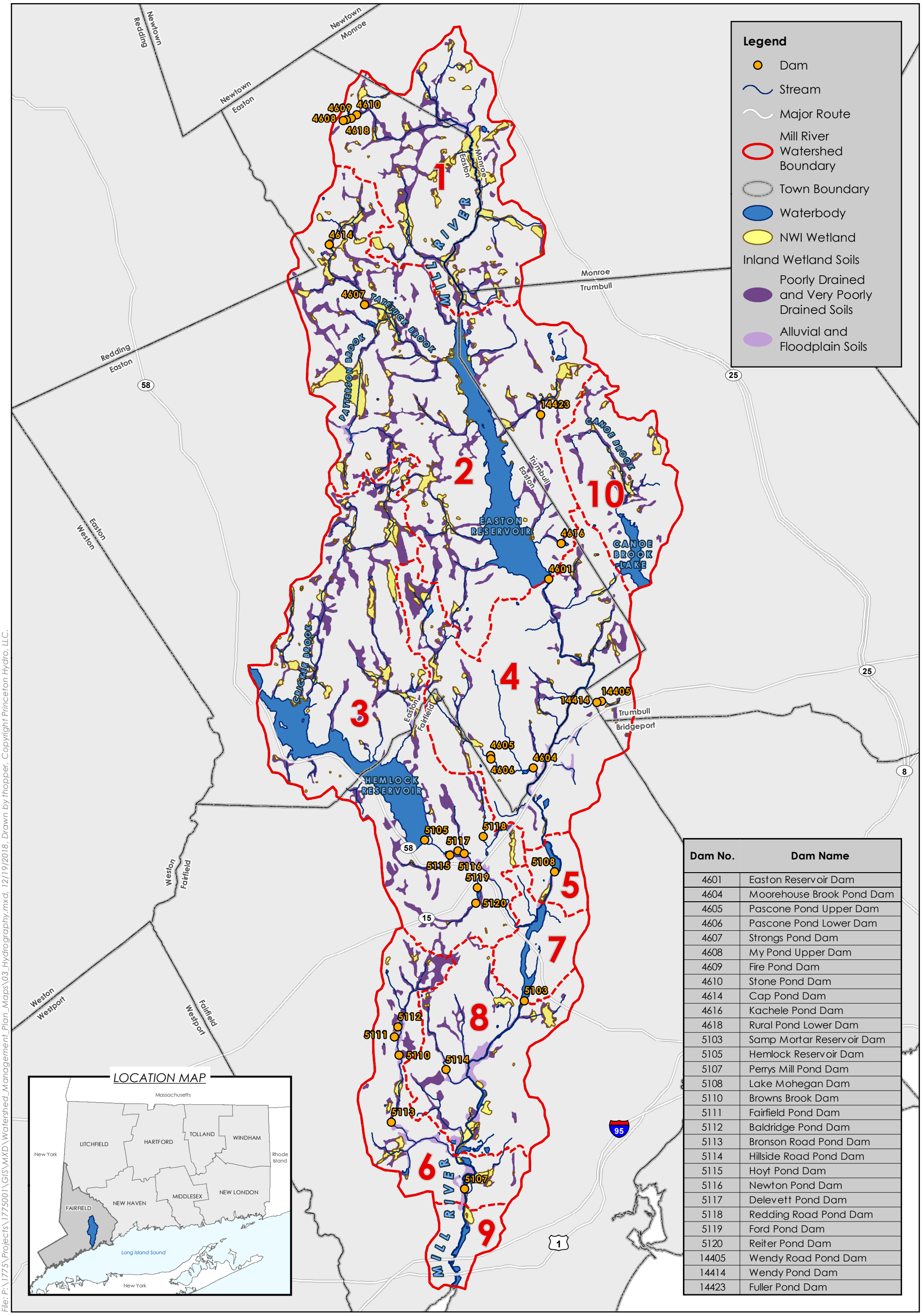

Dam No.	Dam Name
4601	Easton Reservoir Dam
4604	Moorehouse Brook Pond Dam
4605	Pascone Pond Upper Dam
4606	Pascone Pond Lower Dam
4607	Strongs Pond Dam
4608	My Pond Upper Dam
4609	Fire Pond Dam
4610	Stone Pond Dam
4614	Cap Pond Dam
4616	Kachele Pond Dam
4618	Rural Pond Lower Dam
5103	Samp Mortar Reservoir Dam
5105	Hemlock Reservoir Dam
5107	Perrys Mill Pond Dam
5108	Lake Mohegan Dam
5110	Browns Brook Dam
5111	Fairfield Pond Dam
5112	Baldridge Pond Dam
5113	Bronson Road Pond Dam
5114	Hillside Road Pond Dam
5115	Hoyt Pond Dam
5116	Newton Pond Dam
5117	Delevett Pond Dam
5118	Redding Road Pond Dam
5119	Ford Pond Dam
5120	Reiter Pond Dam
14405	Wendy Road Pond Dam
14414	Wendy Pond Dam
14423	Fuller Pond Dam

NOTES:
1. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Inland wetland soils obtained from CT DEEP and based off NRCS, USDA, Soil Survey Geographic (SSURGO) Database for the State of Connecticut.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

HYDROGRAPHY AND WETLANDS MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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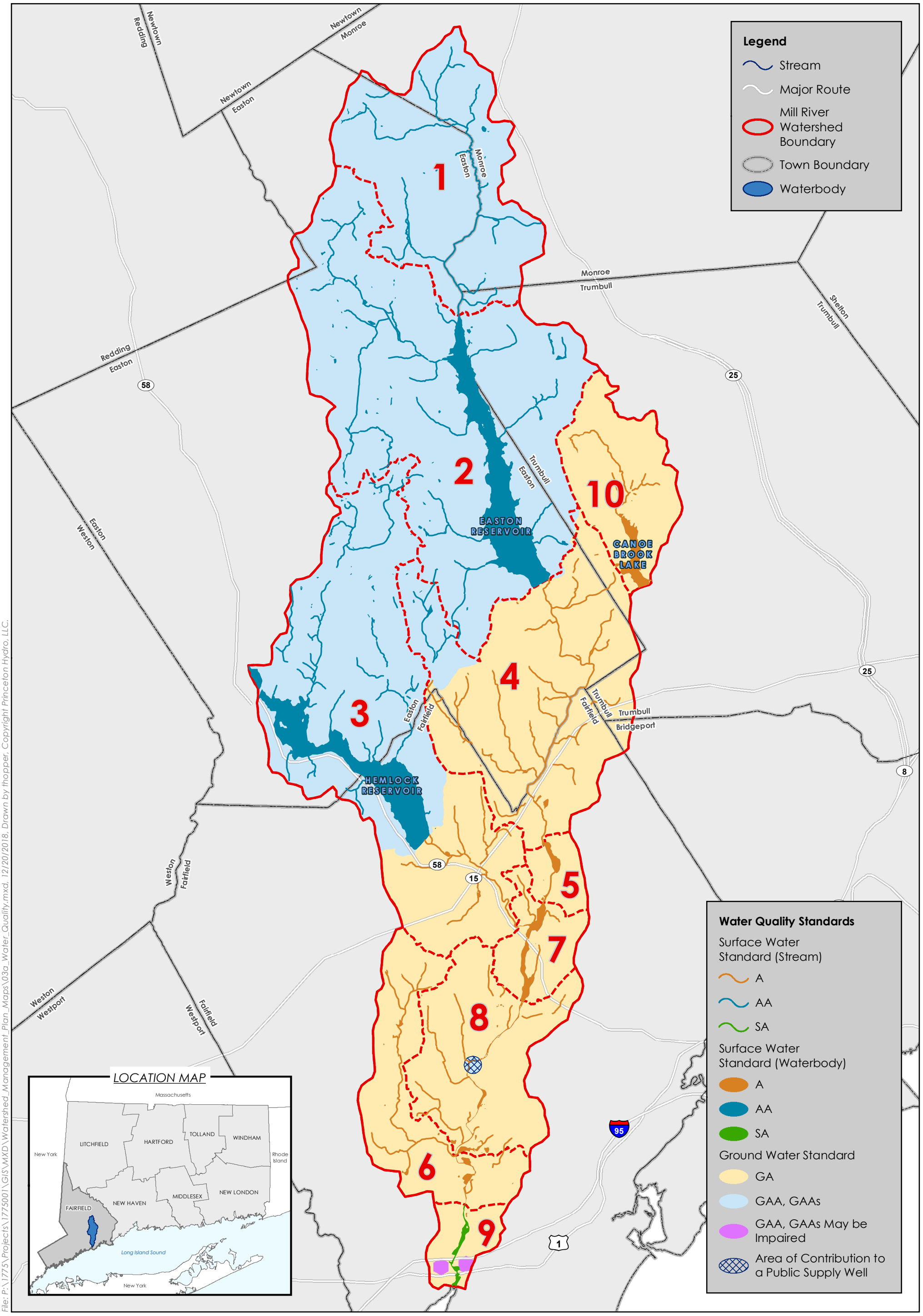

File: P:\1775\Projects\1775001\GIS\MXD\Watershed_Management_Plan_Maps\03a_Water_Quality.mxd, 12/20/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Water quality standards, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

WATER QUALITY CLASSIFICATION MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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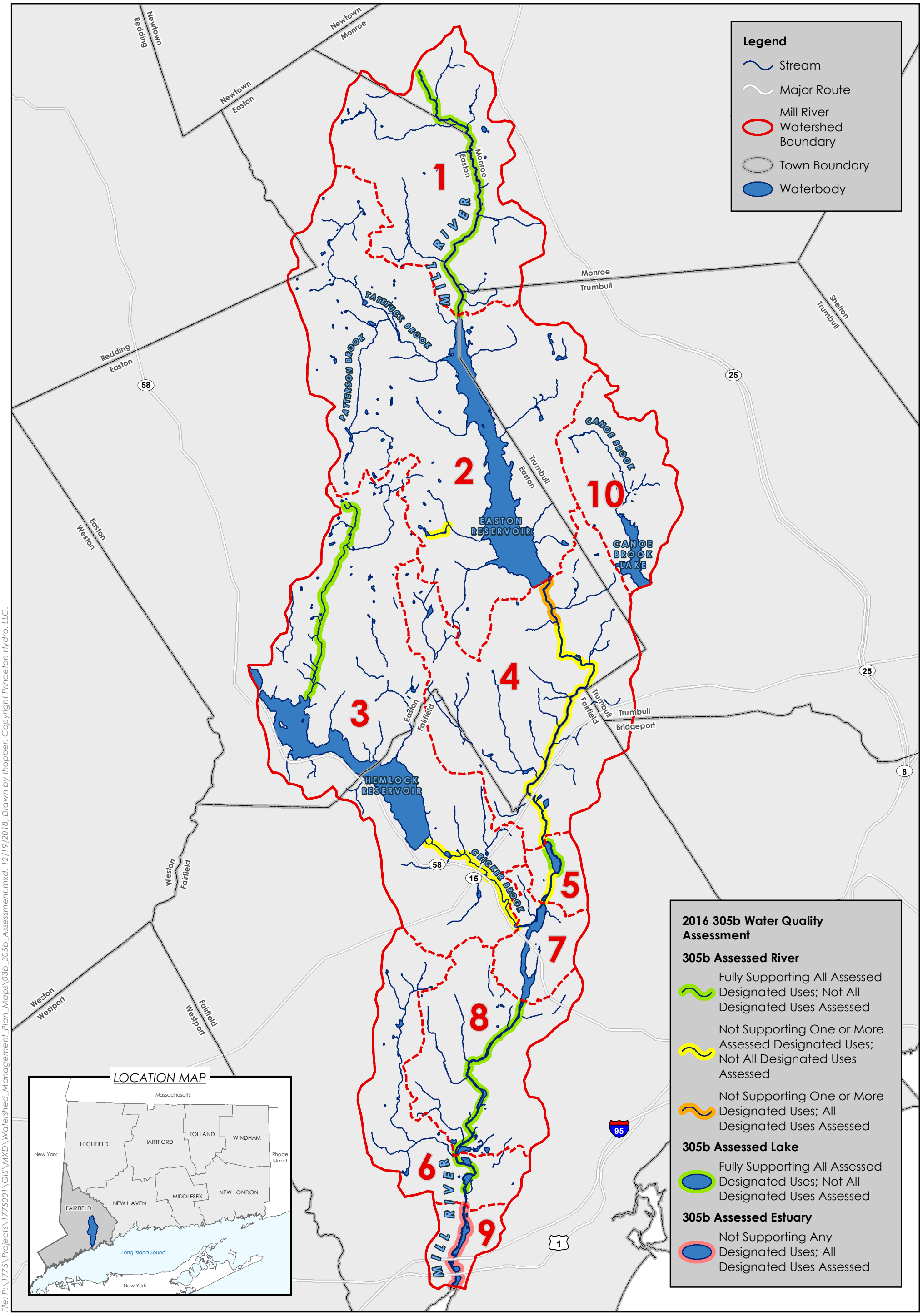

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NOTES:
1. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. 305b water quality assessments, streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

305B WATER QUALITY ASSESSMENT MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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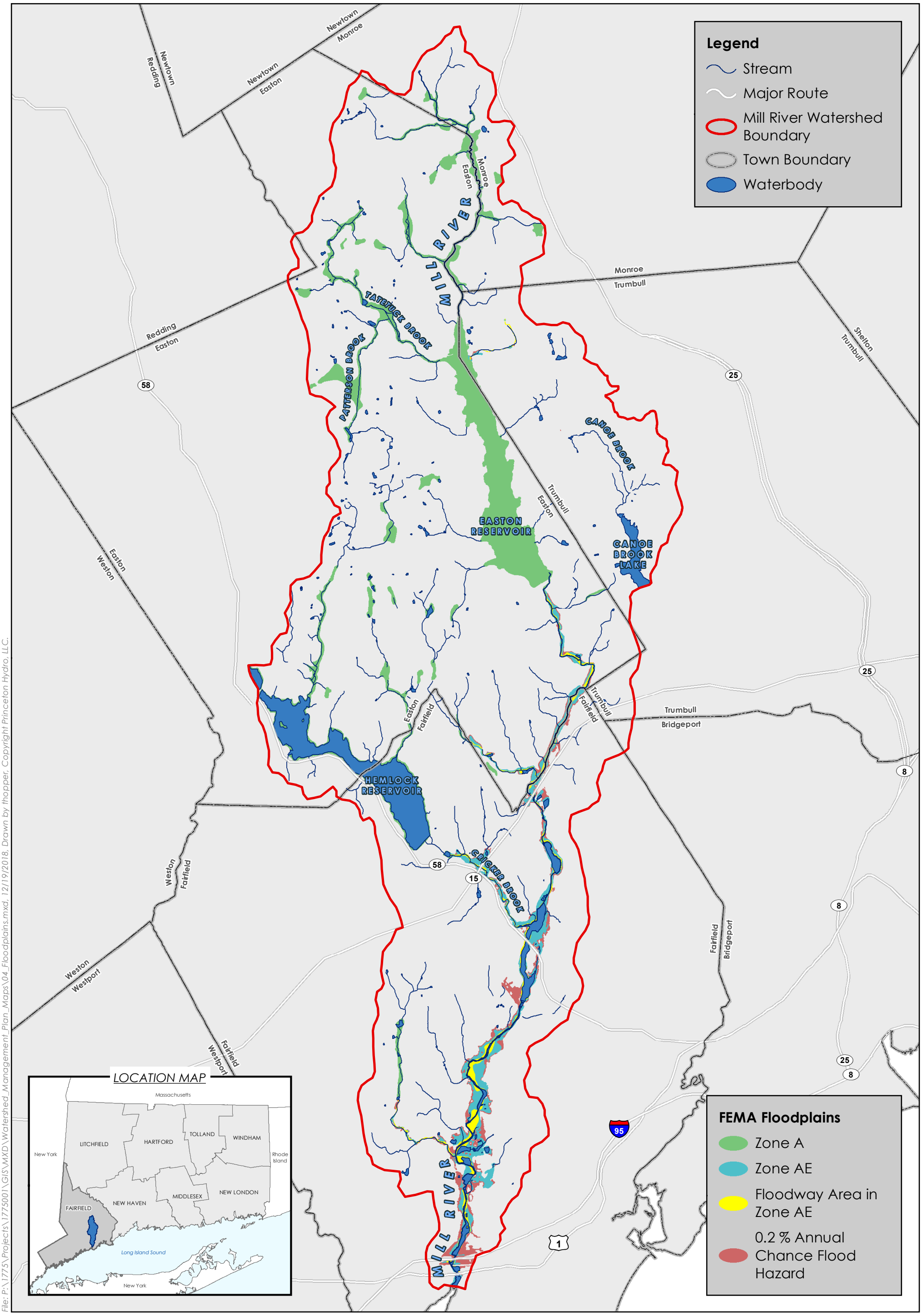

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Flood insurance rate map, effective 11/06/2017, obtained from FEMA Flood Map Service Center: https://msc.fema.gov/portal/

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

FEMA FLOODPLAIN MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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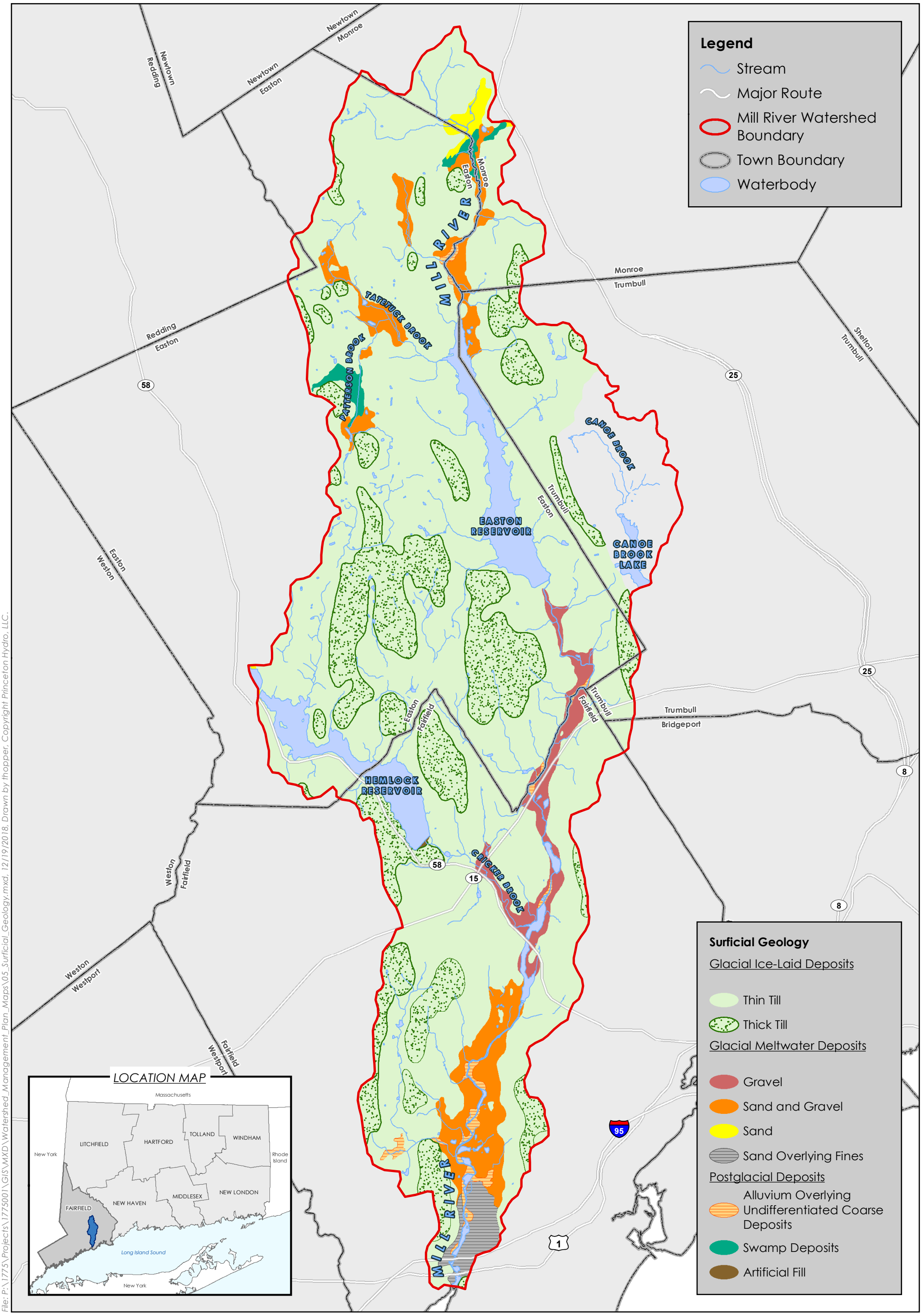

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, town boundaries, and surficial geology obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SURFICIAL GEOLOGY MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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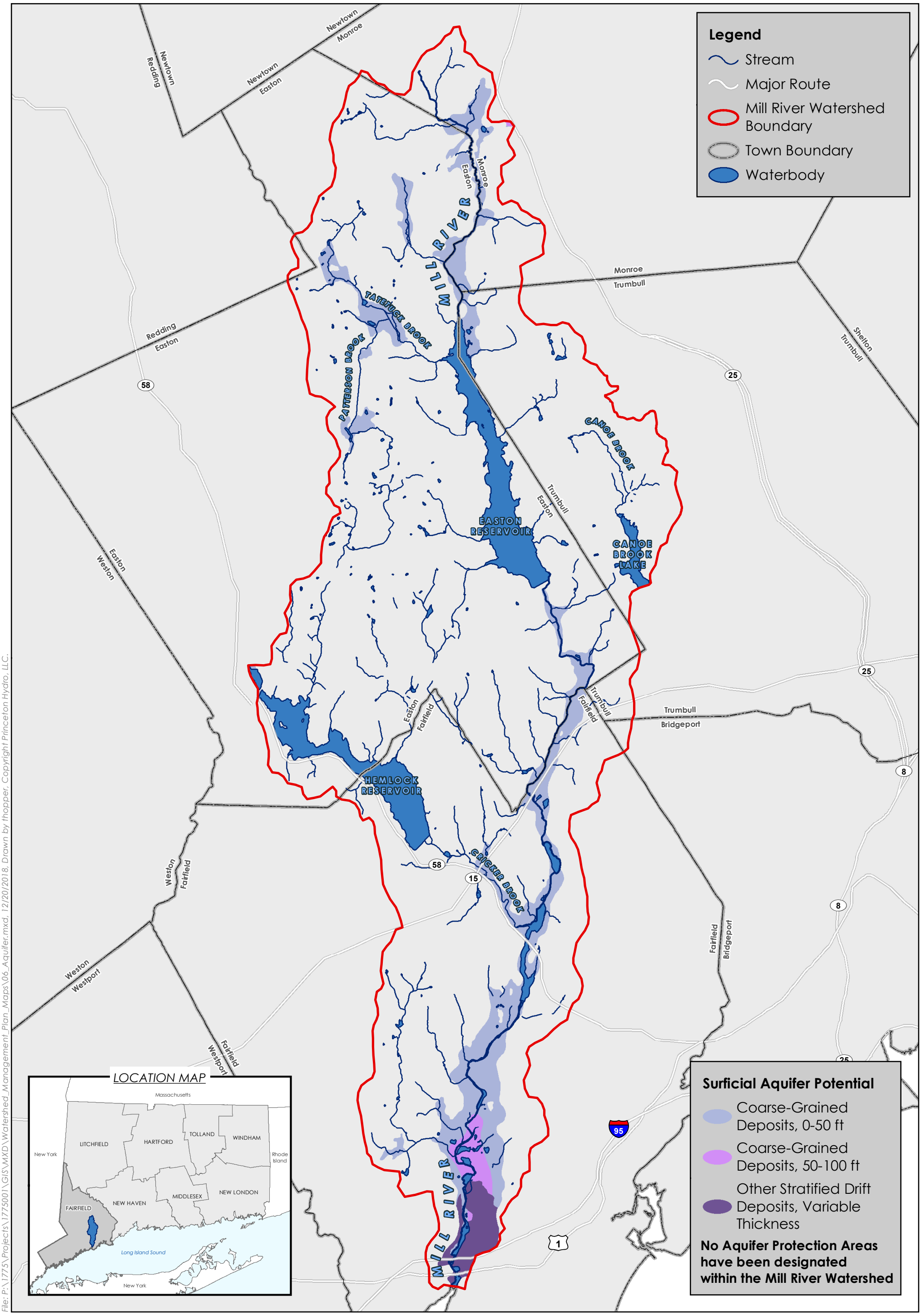

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, town boundaries, and surficial aquifer potential obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

AQUIFER MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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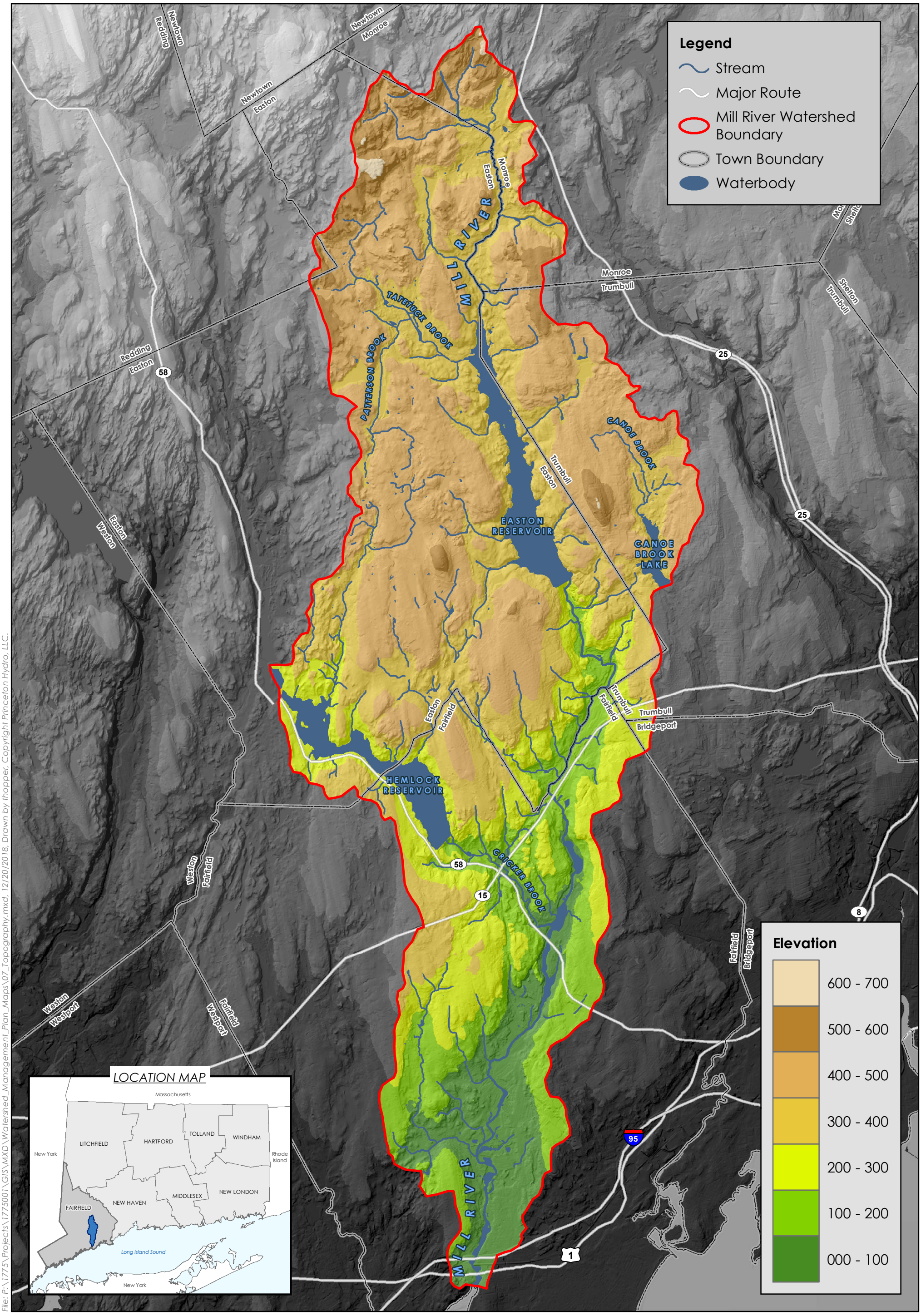

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Elevation (2016 LiDAR) data obtained from the CT ECO website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

TOPOGRAPHY MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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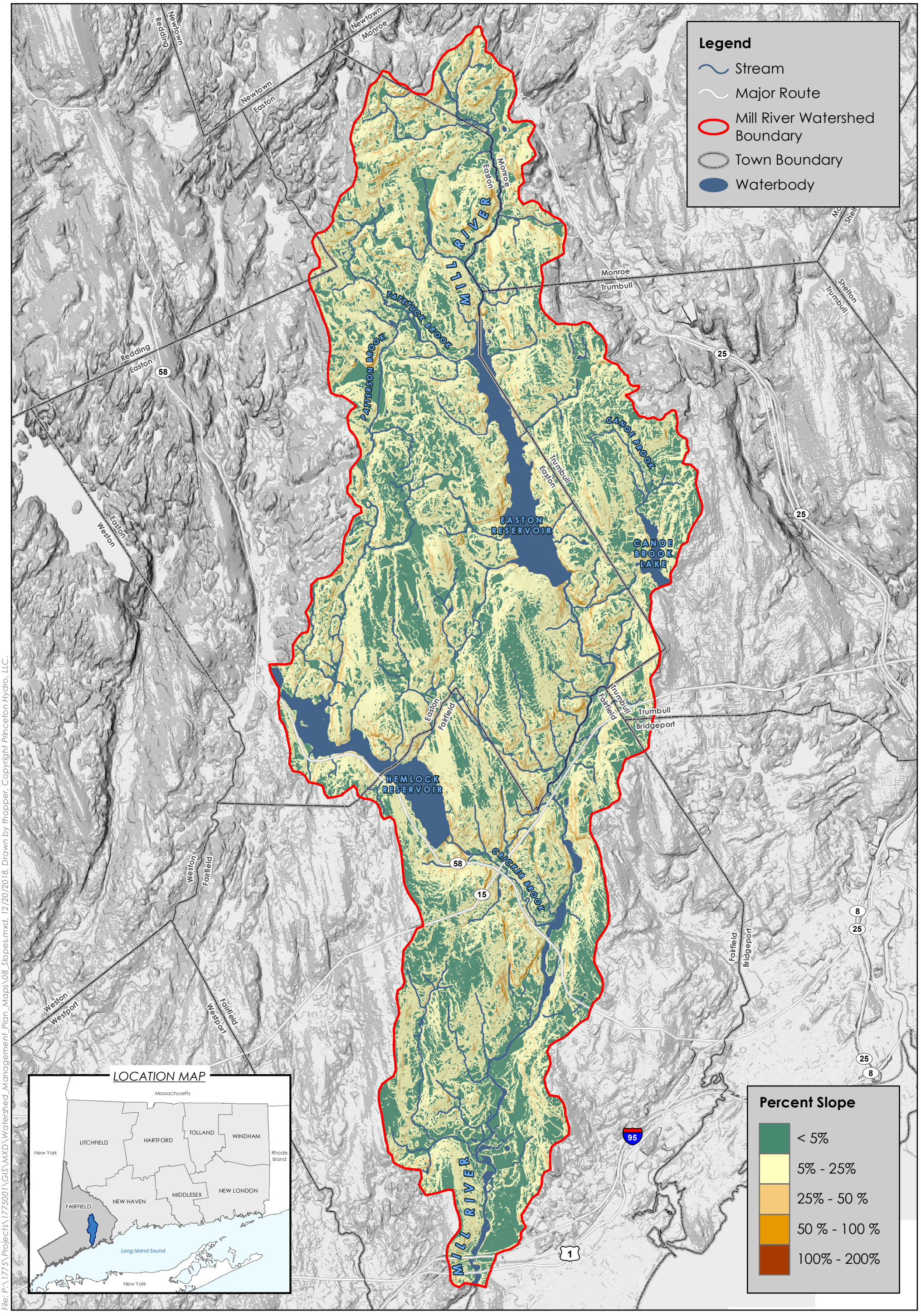

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Slopes (2016 LiDAR data) obtained from the CT ECO website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SLOPE MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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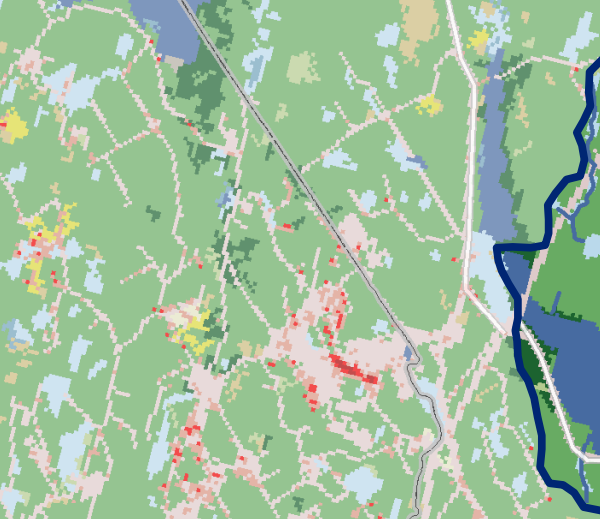
2011 Land Cover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed High Intensity
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

Legend

- Stream
- Major Route
- Mill River Watershed Boundary
- Town Boundary



NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. 2011 land cover obtained from the Multi-Resolution Land Characteristics (MRLC) consortium's, National Land Cover Database (NLCD).

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

2011 LAND COVER MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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2011 Land Cover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed High Intensity
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

Legend

- Stream
- Major Route
- Subwatershed Boundary
- Mill River Watershed Boundary
- Town Boundary

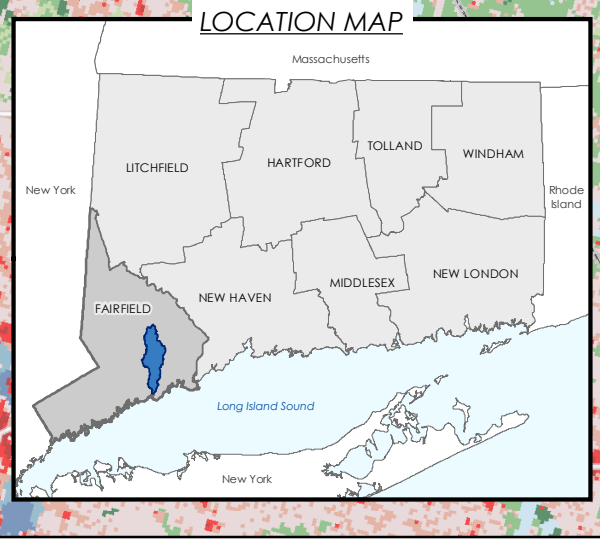
1 2 3 4 5 6 7 8 9 10

MILL RIVER

Newtown, Monroe, Easton, Weston, Trumbull, Shelton, Fairfield, Bridgeport, Westport

25 8 58 15 95 1

LOCATION MAP



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NOTES:
1. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. 2011 land cover obtained from the Multi-Resolution Land Characteristics (MRLC) consortium's, National Land Cover Database (NLCD).

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

2011 LAND COVER MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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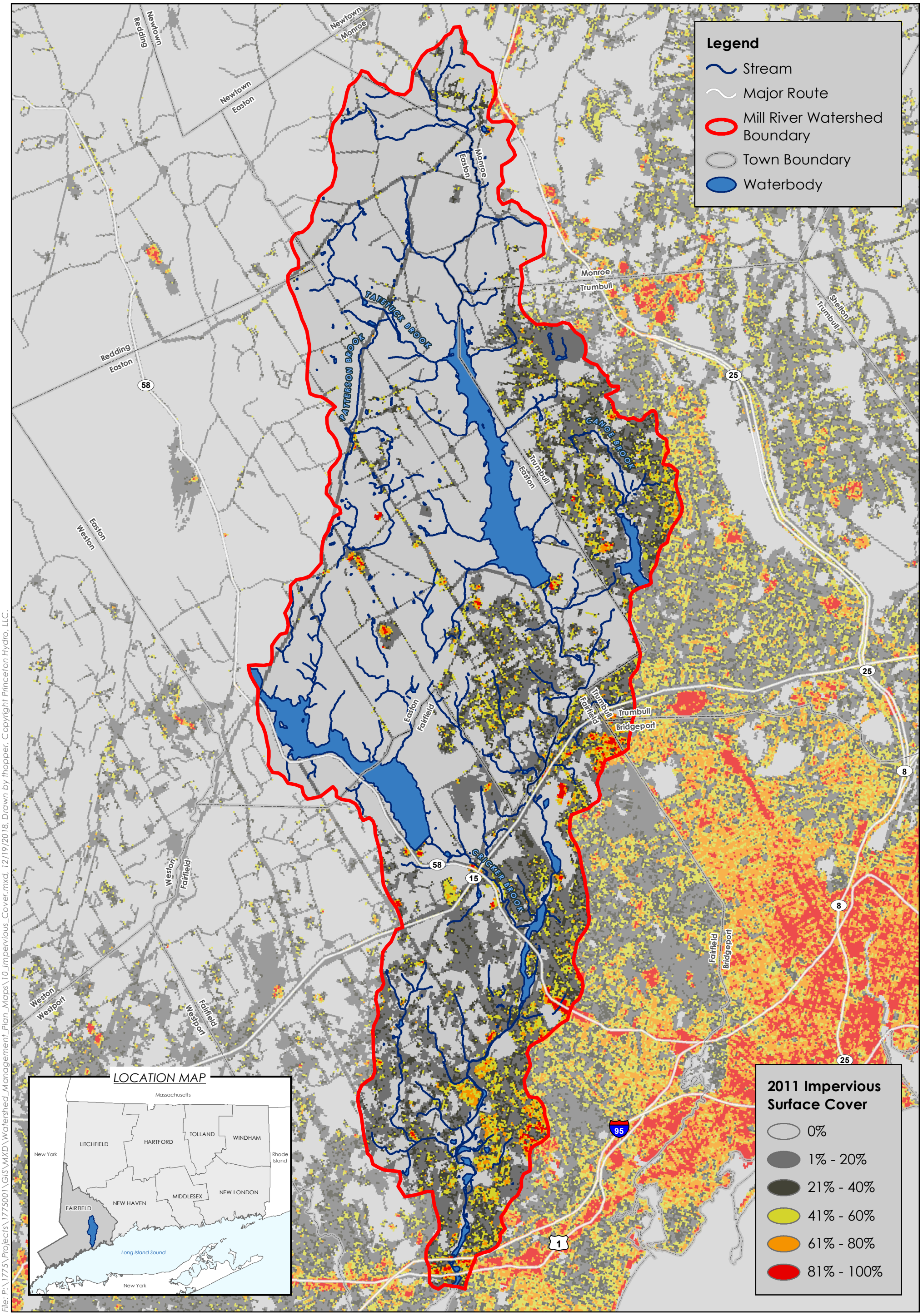

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. 2011 impervious surface cover obtained from the Multi-Resolution Land Characteristics (MRLC) consortium's, National Land Cover Database (NLCD).

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

2011 IMPERVIOUS SURFACE COVER MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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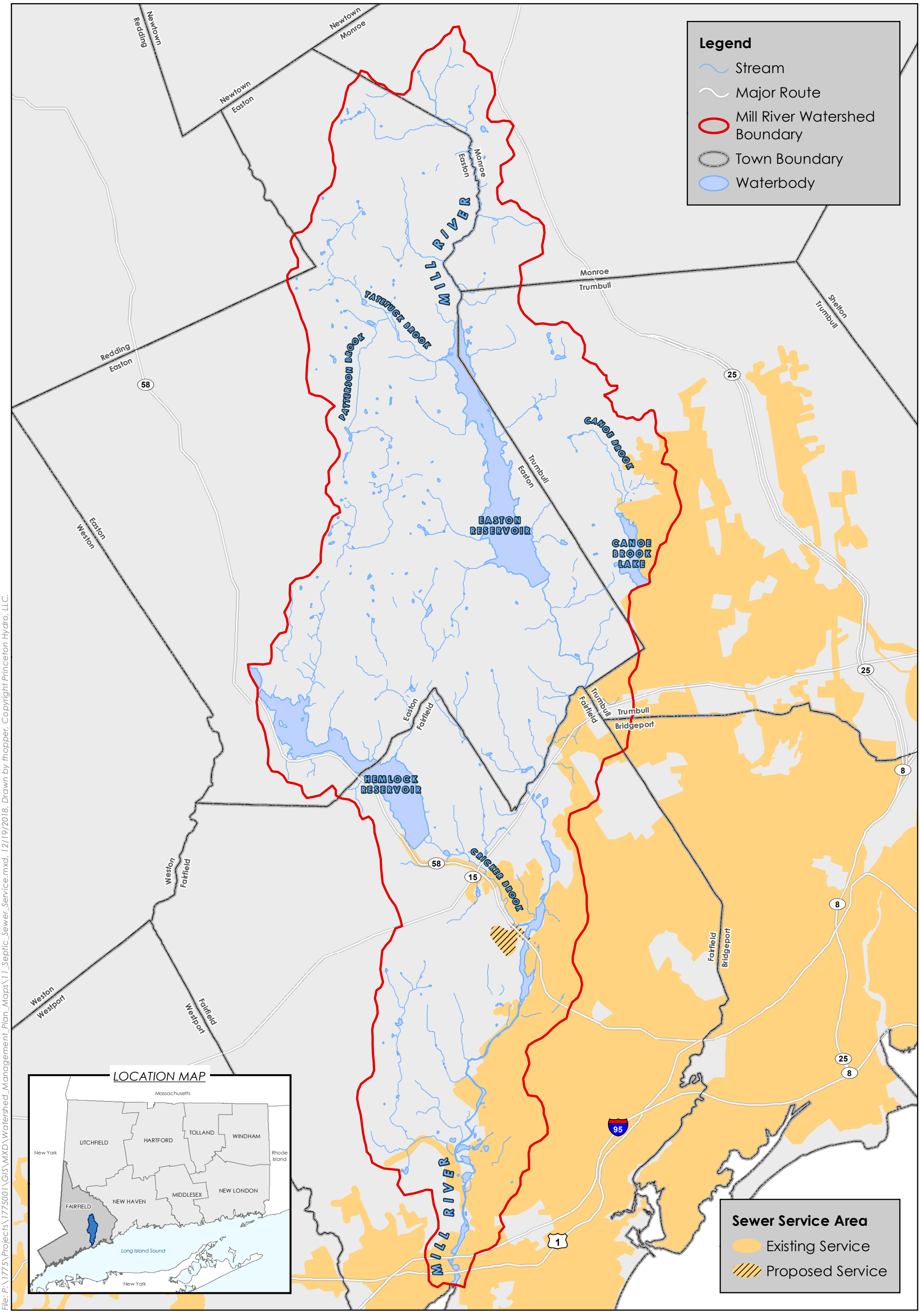

File: P:\1775\Projects\1775001\GIS\MXD\Watershed_Management_Plan_Maps\11_Septic_Sewer_Service.mxd, 12/19/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, town boundaries, and sewer service areas obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

SEWER SERVICE MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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Resource No.	Resource Name	Resource Type
1	David Mallett Jr. House	Building
2	Christ Episcopal Church and Tashua Burial Ground	Building
3	Merritt Parkway	District
4	Greenfield Hill Historic District	District
5	Bronson Windmill	Structure
6	David Ogden House	Building
7	Restmore	Building
8	Jonathan Sturges House	Building
9	Southport Historic District	District

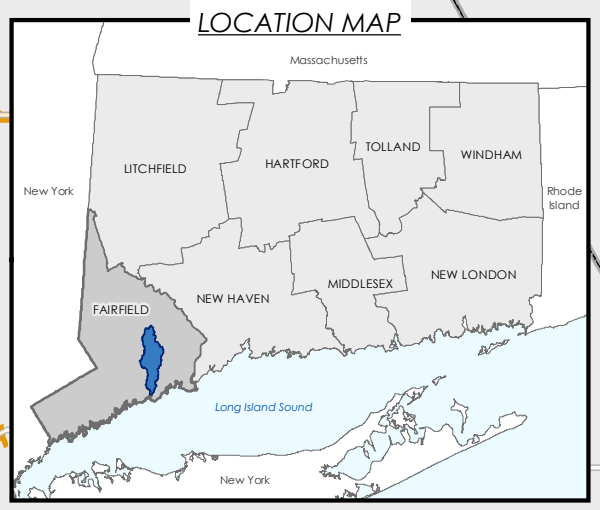
Legend

- Stream
- Major Route
- Mill River Watershed Boundary
- Town Boundary
- Waterbody

Historic & Cultural Resources

- Cultural Resource Building
- Cultural Resource Object
- Cultural Resource Structure
- Cultural Resource District

LOCATION MAP



NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Cultural resources obtained from the National Register of Historic Places Geospatial Dataset.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

HISTORIC & CULTURAL RESOURCES MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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Natural Diversity and Critical Habitats

Natural Diversity Area

Critical Habitat

Estuarine, Beachshore

Estuarine, Intertidal Marsh

Legend

Stream

Major Route

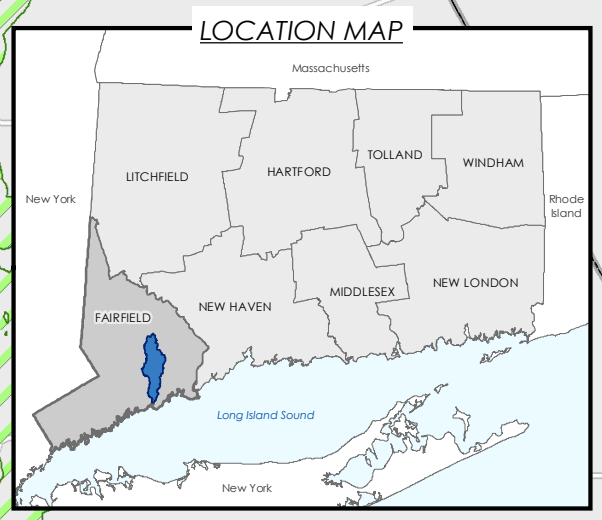
Mill River Watershed Boundary

Town Boundary

Waterbody

Newtown
Monroe
Monroe
Easton
MILL RIVER
Monroe
Trumbull
Shelton
Trumbull
TATETUCK BROOK
PATTERSON BROOK
Redding
Easton
58
25
CANOE BROOK
Trumbull
Easton
EASTON RESERVOIR
CANOE BROOK LAKE
Easton
Weston
Easton
Fairfield
Trumbull
Fairfield
Trumbull
Bridgeport
25
8
HEMLOCK RESERVOIR
Weston
Fairfield
58
15
CRICKER BROOK
8
Fairfield
Bridgeport
Weston
Westport
Fairfield
Westport
25
8
95
MILL RIVER
1

LOCATION MAP



NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, town boundaries, critical habitats, and natural diversity areas obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

NATURAL DIVERSITY AND CRITICAL HABITAT MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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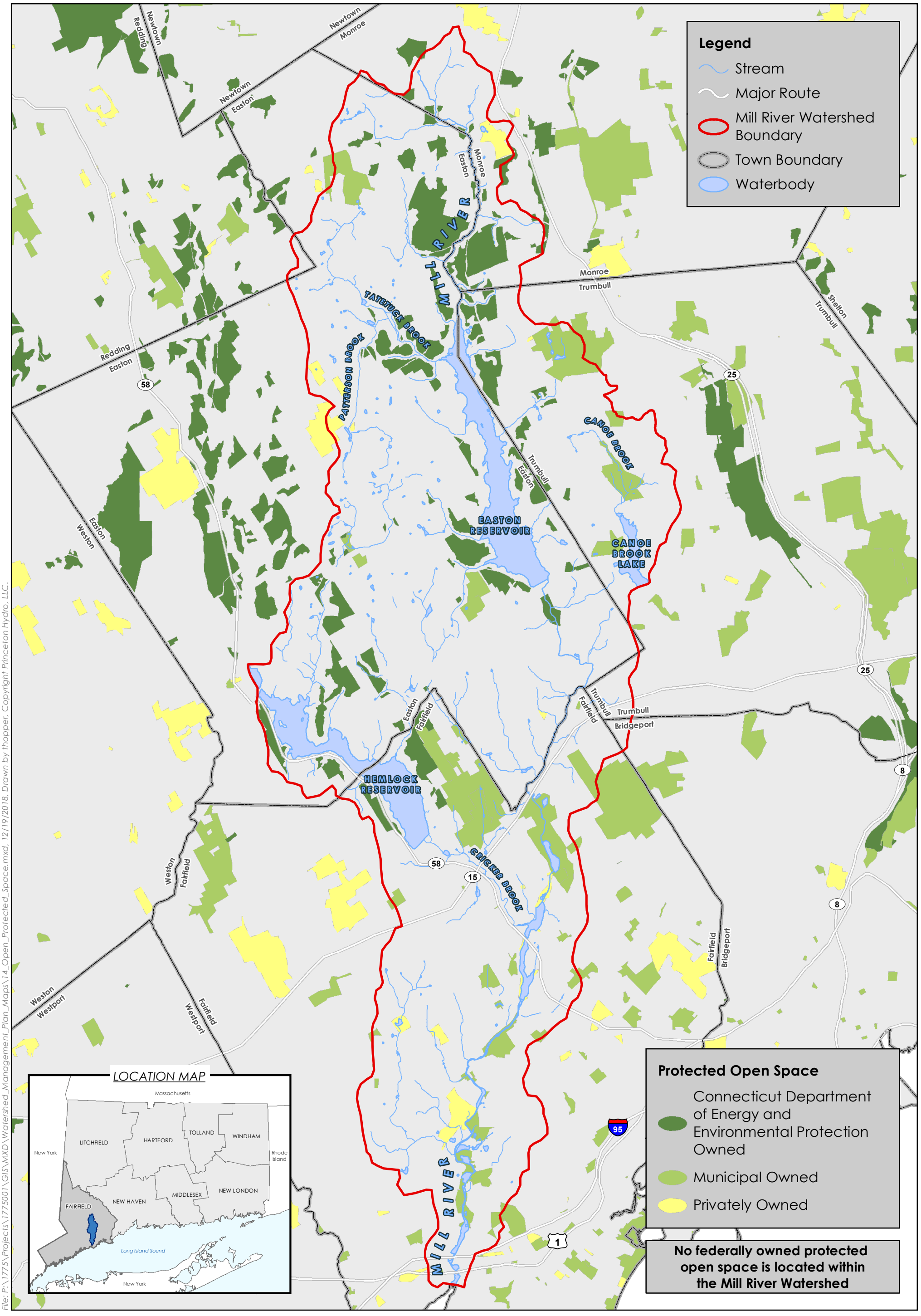

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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, town boundaries, and protected open space obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

PROTECTED OPEN SPACE MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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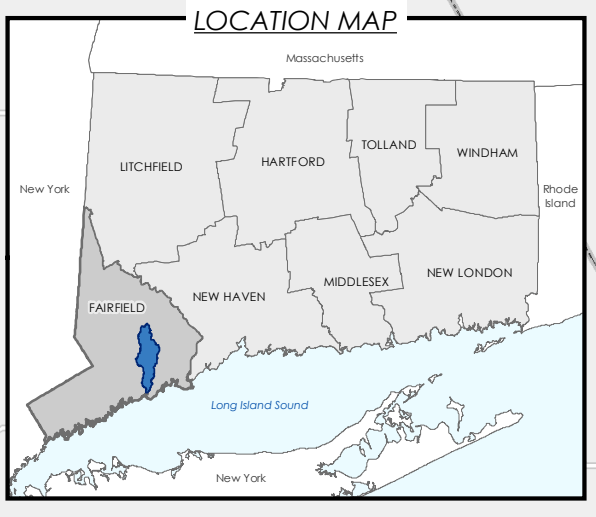
Legend

- Stream
- Major Route
- Subwatershed Boundary
- Mill River Watershed Boundary
- Town Boundary
- Waterbody

E. coli (cfu/100 ml)

- 371.3
- 297.9
- 195.7
- 189.3
- 170.7
- 166.7
- 94
- 84.6
- 71
- No Data

LOCATION MAP



NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. *E. coli* loading modeling performed by Princeton Hydro using the 'Model My Watershed' application developed by the Stroud Water Research Center.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

E. COLI CONCENTRATION MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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Legend
Stream
Major Route
Subwatershed Boundary
Mill River Watershed Boundary
Town Boundary
Waterbody
Sediment (tons/acre)
0.1664
0.1503
0.1214
0.1181
0.0782
0.0505
0.0148
0.0134
0.0056
No Data
LOCATION MAP
Massachusetts
New York
Rhode Island
Long Island Sound
LITCHFIELD
HARTFORD
TOLLAND
WINDHAM
FAIRFIELD
NEW HAVEN
MIDDLESEX
NEW LONDON
NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Sediment loading modeling performed by Princeton Hydro using the 'Model My Watershed' application developed by the Stroud Water Research Center.
0 5,000 10,000 Feet
Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet
SEDIMENT LOADING MAP
MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT
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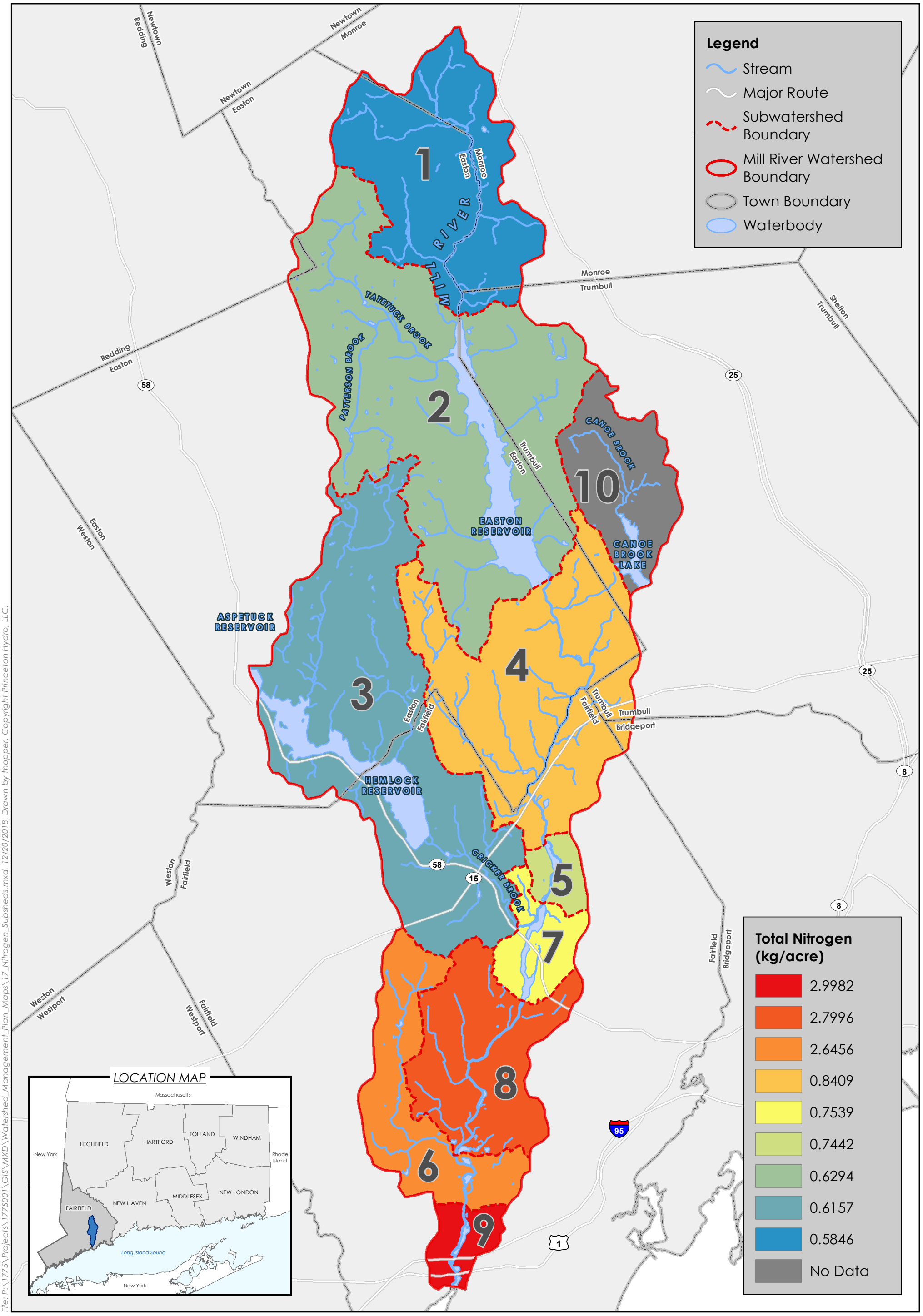
File: P:\1775\Projects\177500\GIS\MXD\Watershed_Management_Plan_Maps\16_Sediment_Subsheds.mxd, 12/19/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.



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NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Nitrogen loading modeling performed by Princeton Hydro using the 'Model My Watershed' application developed by the Stroud Water Research Center.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

NITROGEN LOADING MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
FAIRFIELD COUNTY, CONNECTICUT

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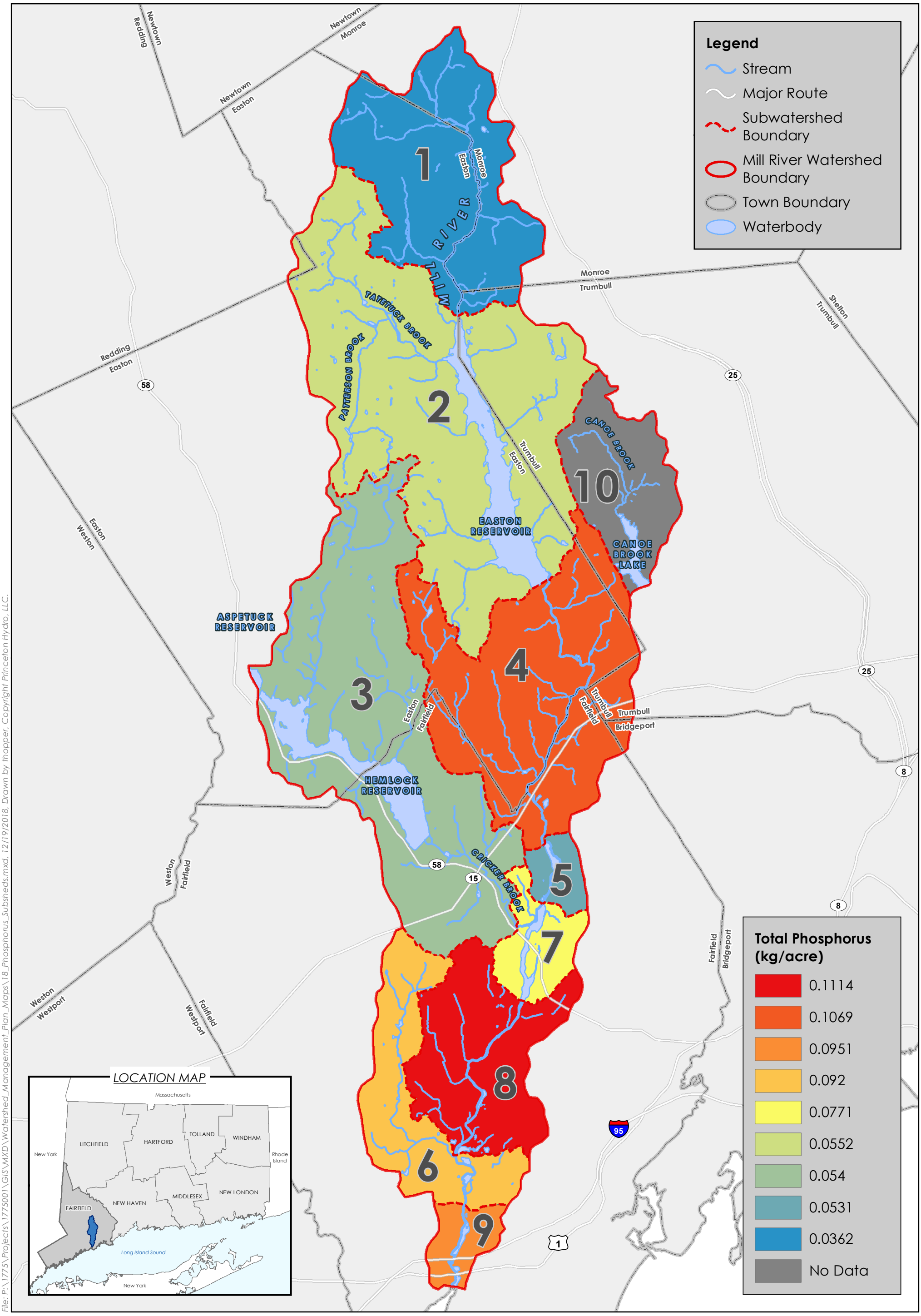

File: P:\1775\Projects\177500\GIS\MXD\Watershed_Management_Plan_Maps\18_Phosphorus_Subsheds.mxd, 12/19/2018, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. Watershed boundary created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
2. Streams, waterbodies, major routes, and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
3. Phosphorus loading modeling performed by Princeton Hydro using the 'Model My Watershed' application developed by the Stroud Water Research Center.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

PHOSPHORUS LOADING MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
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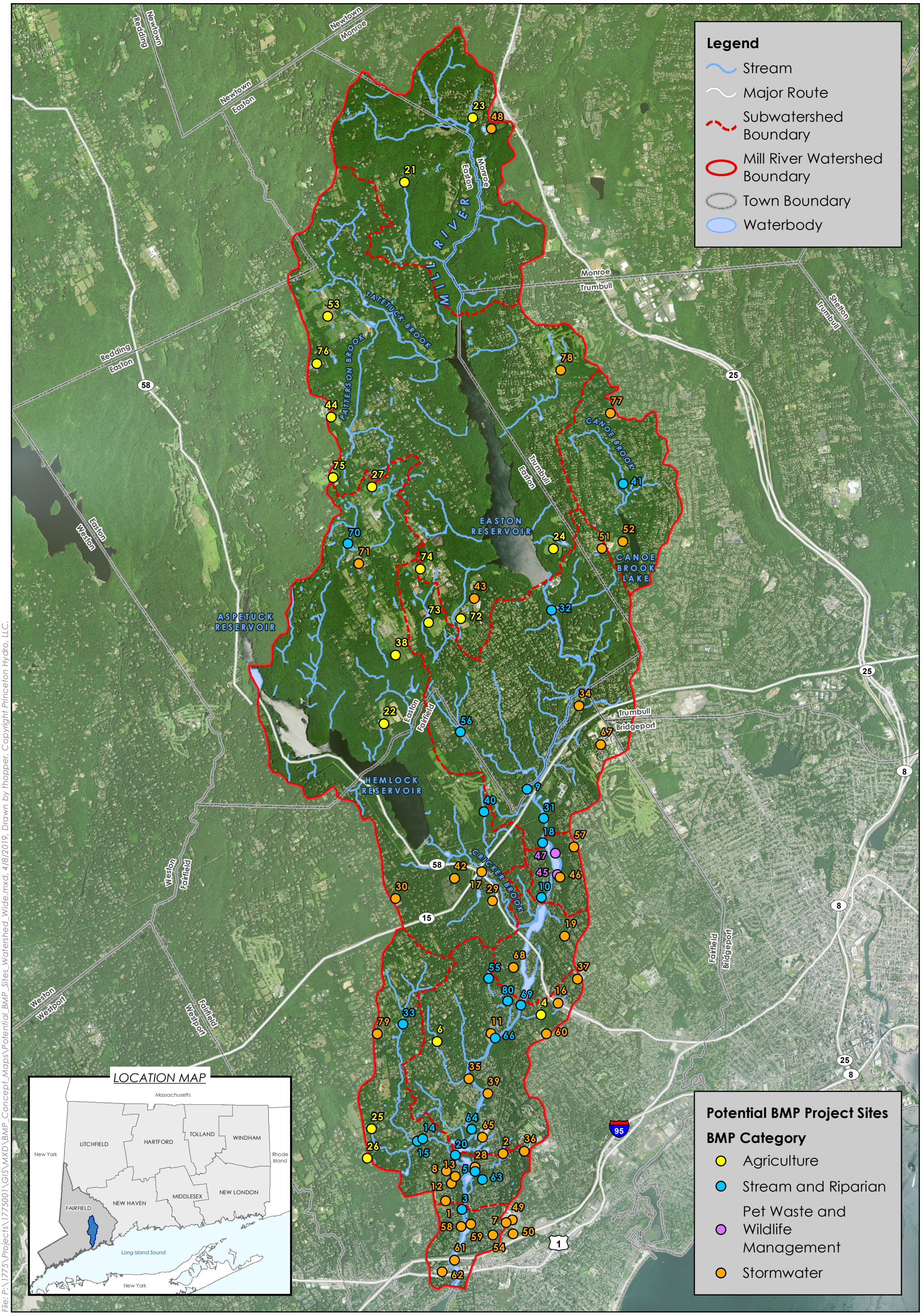

File: P:\1775\Projects\1775001\GIS\MXD\BMP_Concept_Maps\Potential_BMP_Sites_Watershed_Wide.mxd, 4/8/2019, Drawn by thopper, Copyright Princeton Hydro, LLC.

NOTES:
1. BMP project site locations are approximate.
2. Watershed boundaries created by Princeton Hydro based on drainage basins obtained from the CT DEEP GIS data website and refined using 2016 LiDAR data obtained from the CT ECO website.
3. Streams and town boundaries obtained from the CT Department of Energy and Environmental Protection (CT DEEP) GIS Data website.
4. 2016 imagery obtained from CT Environmental Conditions Online: http://www.cteco.uconn.edu.

0 5,000 10,000 Feet

Map Projection: NAD 1983 StatePlane Connecticut FIPS 0600 Feet

POTENTIAL BMP PROJECT SITE LOCATION MAP

MILL RIVER WATERSHED
WATERSHED MANAGEMENT PLAN
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