A Total Maximum Daily Load Analysis for Recreational Uses of the Still River Regional Basin

FINAL – July 8, 2010

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

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INTRODUCTION

The Total Maximum Daily Load (TMDL) analysis is a management tool used to restore impaired waters by establishing the maximum amount of a pollutant that a waterbody can receive without adverse impacts to fish, wildlife, recreation, or other public uses. A TMDL takes into account pollutant loadings from point sources, nonpoint sources, background levels and incorporates a margin of safety. The completed analysis provides guidance for responsible parties to use as a framework for developing an implementation plan to reduce pollutants in impaired waters.

A Total Maximum Daily Load (TMDL) analysis was completed for indicator bacteria in the Still River Regional Basin. The specific waterbodies included in the TMDL analysis are the Still River, Miry Brook, Kohanza Brook, Padanaram Brook, Sympaug Brook, East Swamp Brook and Limekiln Brook (Figure 1 of Appendix A). These waterbodies are included on the *2008 List of Connecticut Waterbodies Not Meeting Water Quality Standards* (Chapter 3 of the *2008 State of Connecticut Integrated Water Quality Report*[1]) due to exceedences of the indicator bacteria criteria contained within the State *Water Quality Standards*[2] (WQS). Attainment of the target TMDLs presented herein is expected to result in achievement and maintenance of the bacteria criteria established in the WQS. (For more information regarding assessed and impaired waterbodies throughout the state, please refer to *2008 State of Connecticut Integrated Water Quality Report*[1].)

Under section 303(d) of the Federal Clean Water Act (CWA), States are required to develop TMDLs for waters impacted by pollutants that are included on their Impaired Waters Lists, and 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. Federal regulations specify that TMDL loadings may be expressed as a mass per time, toxicity, or other appropriate measure[3]. For the Still River Regional Basin TMDLs, loadings are expressed as the percent reductions necessary at specific locations in order to achieve the water quality standards and support recreational uses. The U.S. Environmental Protection Agency's (EPA) most recent guidance recommends that all TMDLs and associated load allocations and wasteload allocations be expressed in terms of daily time increments[4]. The percent reduction TMDLs for the Still River Regional Basin are applicable each and every day until recreational use goals are attained. 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 the TMDL 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 the TMDL analyses.

The Still River Regional Basin extends through the municipalities of Bethel, Brookfield, Danbury, Newtown, New Fairfield, New Milford, Redding, and Ridgefield. These 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 are identified in Appendix B of the MS4 permit, that contain

designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit requires municipalities to develop a program to reduce the discharge of pollutants, as well as to protect water quality. The Stormwater Management Plan (plan) must include the following six control measures: public education and outreach; public participation; illicit discharge detection and elimination; management of stormwater from construction sites (greater than 1 acre); post-construction stormwater management; and pollution prevention and good housekeeping. Each regulated municipality must identify, implement, and measure the effectiveness of measures utilized to comply with plan requirements. Additional information regarding the general permit can be obtained on the Connecticut Department of Environmental Protection (DEP) website at http://www.ct.gov/dep/cwp/view.asp?a=2721&q =325702& depNavGID=1654.

TMDLs that have been established by states are submitted to the EPA Regional Office 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 local stakeholders to develop and implement Watershed Based Management Plans (plans), which describe 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 where technically and economically feasible. 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 Still River Regional Basin 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 TMDL implementation as well as a water quality monitoring plan.

PRIORITY RANKING

See Table 1 for priority rankings of the subject waterbodies.

DESCRIPTION OF THE WATERBODY

See "Site Specific Information" in Appendix B.

POLLUTANT OF CONCERN AND POLLUTANT SOURCES

Potential sources of indicator bacteria include point and nonpoint sources, such as stormwater runoff, sanitary sewer overflows (collection system failures), and illicit discharges. Potential sources that have been tentatively identified based on land-use (Figure 3 of Appendix A) and site survey work for each of the waterbodies are presented in Table 2.

Table 1. The status of impairment for each of the subject waterbodies as well as the TMDL development priority based on the *2008 State of Connecticut Integrated Water Quality Report*[1].

Waterbody Name	Waterbody Segment	Waterbody Segment Description	303(d) Listed	Impairment Use / Cause	Priority
Still River (Brookfield/ Danbury/ New Milford)	CT6600-00_01 CT6600-00_02 CT6600-00_03 CT6600-00_05	From mouth at confluence with Housatonic River, New Milford, upstream to Lake Kenosia, Danbury	Yes	Recreation / Indicator bacteria	H
Still River (Danbury)	CT6600-00_04	From confluence with Sympaug upstream to confluence with Padanaram Brook, Danbury.	No	Unassessed	-
Miry Brook (Danbury)	CT6601-00_01	From confluence with Still River, Danbury, upstream to headwaters at North Ridgefield Pond outlet, Ridgefield.	Yes	Recreation / Indicator bacteria	H
Kohanza Brook (Danbury)	CT6602-00_01	From confluence with Padanaram Brook upstream to Ridgewood Country Club Pond outlet, Danbury.	Yes	Recreation / Indicator bacteria	H
Padanaram Brook (Danbury)	CT6603-00_01	From confluence with Still River upstream to headwaters at Padanaram Reservoir outlet, Danbury.	Yes	Recreation / Indicator bacteria	H
Sympaug Brook (Danbury)	CT6604-00_01	From confluence with Still River upstream to Greatpasture Rd crossing, Danbury.	Yes	Recreation / Indicator bacteria	H
East Swamp Brook (Bethel)	CT6605-00_01	From confluence with Limekiln Brook upstream to confluence with Wolf Pit Brook, Bethel.	Yes	Recreation / Indicator bacteria	H
Limekiln Brook (Danbury / Newtown)	CT6606-00_01 CT6606-00_03	From confluence with Still River upstream to confluence with Danbury WPCF outfall, Danbury.	Yes	Recreation / Indicator bacteria	H

An "H" indicates that the waterbody was included on the *List* as a high priority because assessment information suggested a TMDL may be needed to restore the water quality impairment and a TMDL was planned for development within 3-5 years.

Table 3 lists the municipal wastewater treatment plant that discharges to the Still River Regional Basin. Disinfection required under the National Pollutant Discharge Elimination System (NPDES) Permit is sufficient to reduce indicator bacteria densities to below levels of concern in the treatment plant effluent when in use and functioning properly (See the Numeric Water Quality Target section for further explanation).

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

Waterbody Name	Nonpoint Sources	Point Sources
Still River	Urban runoff, Source unknown	Source unknown
Miry Brook	Urban runoff, Source unknown	Source unknown
Kohanza Brook	Source unknown	Source unknown
Padanaram Brook	Source unknown	Source unknown
Sympaug Brook	Source unknown	Source unknown
East Swamp Brook	Source unknown	Source unknown
Limekiln Brook	Source unknown	Source unknown

Data reported by the WWTP in compliance with their NPDES Permit requirements was reviewed for the 2003, 2004, 2005, 2006, and 2007 disinfection seasons. The WWTP monitors and reports fecal coliform bacteria. *E. coli* bacteria are a component of fecal coliforms. The WWTP discharge permit limits fecal coliforms to less than 200 col/100ml based on a 30 day average and 400 col/100ml based on a 7 day geometric mean. The WWTP did not exceed their permit limits over the review period. Because *E. coli* is one of the bacteria types that comprise the fecal coliform group and the WWTP did not exceed their fecal coliform limit, it is assumed that the WWTP is not significant contributor to in-stream *E. coli* concentrations.

Table 3. Wastewater Treatment Facilities in the Still River Regional Basin.

Facility	NPDES ID	Discharges to
Danbury WPCF	CT0100145	Limekiln Brook

There are four industrial discharges in the Still River Basin which are listed in Table 4. Three of the facilities are fuel stations and one is a manufacturing facility. All of these discharges are related to remediation of contaminated groundwater and are not expected to contribute *E. coli* to the watershed. A limit for indicator bacteria was not included when the initial NPDES Permits

were issued. These discharges are not considered potential point sources of indicator bacteria to the Still River Basin.

Table 4. Industrial discharges in the Still River Regional Basin.

Facility	NPDES ID	Discharges to
Danbury Amoco	EA0100090	Still River
Getty – Brookfield	EA01000YY	Still River
Shell – Brookfield	GRS000009	Still River
Eaton Corporation	EA0100140	Unnamed tributary of Sympaug Brook

There are approximately 18 industrial and commercial stormwater dischargers operating under general permits in the Still River Basin. These facilities provided bacteria monitoring data for stormwater runoff ranging from 6 to >2,419 col/100mls during 2003, 2005, and 2006. The median concentration was 100 col/100mls. A review of 47 *E. coli* samples collected by seven towns in the basin at industrial and commercial sites as required under the MS4 permit indicated that bacteria levels ranged from 1 to 12,970 col/100mls during 2004, 2005, and 2006. The median concentration was 245 col/100mls.

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 (both designated and non-designated swimming areas), 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 conducted in areas with known human fecal material contamination[6]. 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 Still River Regional Basin are presented in Table 5. The general recreational criteria listed in the WQS for "all other recreational uses" are applicable throughout the watershed since there are no designated or non-designated swimming areas located in segments covered by the TMDL.

Table 5. Applicable indicator bacteria criteria for the subject waterbodies.

Waterbody Name	Waterbody Segment	Class	Bacterial Indicator	Criteria
Still River (New Milford/ Brookfield)-01	CT6600-00_01	B	Escherichia coli (*E. Coli*)	Geometric mean less than 126 col/100ml Single sample maximum 576 col/100ml
Still River (Brookfield/ Danbury)-02	CT6600-00_02	B		
Still River (Danbury)-03	CT6600-00_03	B		
Still River (Danbury)-04	CT6600-00_04	B		
Still River (Danbury)-05	CT6600-00_05	A		
Miry Brook (Danbury)-01	CT6601-00_01	A		
Kohanza Brook (Danbury)-01	CT6602-00_01	A		
Padanaram Brook-01	CT6603-00_01	A		
Sympaug Brook-01	CT6604-00_01	B		
East Swamp Brook (Bethel)-01	CT6605-00_01	B		
Limekiln Brook-01	CT6606-00_01	A		
Limekiln Brook-03	CT6606-00_03	A		

NUMERIC WATER QUALITY TARGET

TMDL calculations were performed consistent with the analytical procedures presented in the guidelines for *Development of TMDLs for Indicator Bacteria in Contact Recreation Areas Using the Cumulative Frequency Distribution Function Method*[7]. All data used in the analysis and the results of all calculations are presented in Appendix B. In addition, Appendix B contains a summary of the TMDL analyses for each waterbody. The results are summarized in Table 6.

MARGIN OF SAFETY

TMDL analyses are required to include a margin of safety (MOS) to account for uncertainties regarding the relationship between load and waste load allocations, and water quality. The MOS may be either explicit or implicit in the analysis.

The analytical approach used to calculate the TMDLs incorporates an implicit MOS. Sampling results that indicate quality better than necessary to achieve consistency with the criteria are assigned a percent reduction of "zero" instead of a negative percent reduction. This creates an excess capacity that is averaged as a zero value thereby contributing to the implicit MOS. In addition, the indicator bacteria criteria used in this TMDL analysis were developed exclusively from data derived from studies conducted by EPA at high use designated public bathing areas with known human fecal contamination[6]. Therefore, the criteria provide an additional level of protection when applied to waters not used as designated swimming areas or contaminated by human fecal material. As a result, achieving the criteria results in an "implicit MOS".

Table 6. Summary of TMDL analysis.

Waterbody Name	Waterbody Segment Description	Waterbody Segment	Monitoring Site	Average Percent Reduction to Meet Water Quality Standards			
				TMDL	WLA	LA	MOS
Still River (Brookfield / Danbury/ New Milford)	From mouth at confluence with Housatonic River, New Milford, upstream to Lake Kenosia, Danbury	CT6600-00_01	332	52	62	49	Implicit
			1622	76	80	75	Implicit
		CT6600-00_02	1609	87	89	86	Implicit
			1610	89	92	88	Implicit
		CT6600-00_03	1611	89	93	88	Implicit
		CT6600-00_04*	338	68	77	66	Implicit
		CT6600-00_05	338	68	77	66	Implicit
			1613	72	72	72	Implicit
			1612	3	0	3	Implicit
Miry Brook (Danbury)	From confluence with Still River, Danbury, upstream to headwaters at North Ridgefield Pond outlet, Ridgefield.	CT6601-00_01	1608	72	77	71	Implicit
Kohanza Brook (Danbury)	From confluence with Padanaram Brook upstream to Ridgewood Country Club Pond outlet, Danbury.	CT6602-00_01	1607	85	84	85	Implicit
Padanaram Brook (Danbury)	From confluence with Still River upstream to headwaters at Padanaram Reservoir outlet, Danbury.	CT6603-00_01	613	85	89	84	Implicit
Sympaug Brook (Danbury)	From confluence with Still River upstream to Greatpasture Rd crossing, Danbury.	CT6604-00_01	342	88	91	88	Implicit
East Swamp Brook (Bethel)	From confluence with Limekiln Brook upstream to confluence with Wolf Pit Brook, Bethel.	CT6605-00_01	680	66	79	61	Implicit
Limekiln Brook (Danbury / Newtown)	From confluence with Still River upstream to confluence with Danbury WPCF outfall, Danbury.	CT6606- 00_01	148	71	73	71	Implicit
		CT6606-00_03	673	48	60	43	Implicit

*Data was unavailable for segment CT6600-00_04. Site 338 was determined to be representative of segment CT6600-00_04 and used to provide a TMDL analysis.

SEASONAL ANALYSIS

Previous investigations by the DEP into seasonal trends of indicator bacteria densities in surface waters indicate that the summer months typically exhibit the highest densities of any season[8]. This phenomenon 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.

TMDL IMPLEMENTATION GUIDANCE

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

It is important to note that the TMDLs are effective for the entire watershed because they are a measurement of compounded impacts at a single point. As such, corrective actions must be undertaken at the source(s) whether it is a tributary or illicit discharge pipe, in order to achieve the required percent reductions. Also, the approach to TMDL implementation is anticipated to be on a watershed wide scale, which will require that all sources within the regional basin that are contributing to the in-stream impairment be addressed. One approach to TMDL implementation would be to develop a watershed based plan for the Still River Regional Basin. The plan should follow guidelines provided by the EPA and include participation for all watershed towns. The following guidance offers suggestions regarding BMP implementation, however the goal is to allow responsible parties flexibility in developing a TMDL implementation plan (watershed based plan). The DEP supports an adaptive and iterative management approach where reasonable controls are implemented and water quality is monitored in order to evaluate for achievement of the TMDL goals and modification of controls as necessary.

Point sources to Still River and its tributaries include regulated stormwater discharged by the watershed municipalities, as well as stormwater discharged by industrial and commercial facilities under the general permit. Control actions for regulated stormwater include the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 Permit). Under the MS4 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.ct.gov/dep/cwp/view.asp?a=2709&q=324154&depNavGID=1643#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.

Upon approval of a TMDL by EPA, Section 6(k) of the MS4 Permit requires the municipality to review its plan to determine if its stormwater discharges contribute the pollutant(s) for which the TMDL had been designated. If the municipality contributes a pollutant(s) in excess of the designated TMDL allocation, the municipality must modify its plan to implement the TMDL within four months of TMDL approval by EPA. For the discharges to the TMDL waterbody(ies), the municipality must assess the six minimum measures of its plan and modify the plan to implement additional, necessary controls for each appropriate measure. Particular focus should be placed on the following plan components: public education program, illicit discharge detection and elimination, stormwater structures cleaning, priority for the repair, upgrade, or retrofit of storm sewer structures.

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. Nonpoint sources of bacteria can include wildlife and improper handling of pet waste. BMPs for the management of nonpoint sources nuisance wildlife control plans, and pet waste ordinances. Nuisance wildlife information can be found on the DEP's website at http://www.ct.gov/dep/cwp/view.asp?a=2723&q=325944&depNavGID=1655. It is expected that as progress is made implementing BMPs, *E. coli* bacteria levels will decrease and the water quality criteria for recreational use will be achieved and maintained.

The DEP encourages all local stakeholders to continue their efforts by working together to implement the TMDLs. One process is through the development of a watershed based plan. A watershed based plan for TMDL implementation formulated at the local level will most efficiently make use of local resources by assigning tasks to responsible parties and serving as an agreed roadmap to reducing bacteria loading to the Still River.

In addition, the members of the DEP's watershed management program will continue to provide technical and educational assistance to the local municipalities and other stakeholders, as well as identify potential funding sources, when available, for implementation of the TMDL and monitoring plan. Please use the following link for contact information for involved DEP staff: http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325624&depNav_GID=1654.

WATER QUALITY MONITORING PLAN

Section 6(h)(1)(a) of the MS4 Permit specifies 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, a comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts. Therefore, 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. In order to customize their monitoring plan to better identify TMDL pollutant sources and track the effectiveness of TMDL pollutant reduction measures, the municipality may request written approval from the DEP for an alternative monitoring program as allowed by Section 6(h)(1)(B) of the permit:

> *"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 advises municipalities with discharges that contribute pollutant(s) for which a TMDL(s) has been designated to request approval for an alternative monitoring program to address both source detection and progress quantification objectives. Source detection monitoring may include 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. Such monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. Further guidance for an alternative monitoring program is included in Appendix C.

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 the Code of Federal Regulations[9]. 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 provides reasonable assurance that the municipalities will take steps towards achieving the target TMDLs and reducing point sources of stormwater containing bacteria. If portions of a watershed are not subject to the Connecticut's MS4 Permit Program, the DEP has the authority to include those additional municipally-owned or municipally-operated Small MS4s located outside an Urbanized Area as may be designated by the Commissioner. This option could be pursued if future monitoring indicates non-attainment of recreational goals in the Still River Regional Basin.

The NPDES permits for all municipal wastewater treatment plants within the watershed provide an enforceable mechanism for regulating discharges of bacteria to surface waterbodies. Each permit contains limits for bacteria loading in the effluent discharging to the receiving waterbody. These limits and other components of the permit can be adjusted as needed if the wastewater discharge is shown to influence the water quality of the receiving waterbody.

In addition, the DEP continues to work with watershed stakeholders to draft Watershed Based Plans (WBPs) under the CWA 319 program. (http://www.ct.gov/dep/cwp/view.asp?a=2719&q=335504&depNav_GID=1654). As part of these WBPs, watershed stakeholders are required to investigate impairments and promote the implementation of nonpoint source pollution best management practices and stormwater management practices in the watershed. The DEP approves CWA 319 Watershed Based Plans, including those that address management measures to reduce bacteria and source mitigation in order to support the TMDLs. WBPs include watershed-wide and place-based recommendations aimed at reducing nonpoint sources of pollution, including bacteria. These recommended WBP projects may be eligible for CWA 319 funding, as long as such projects are not used for permit compliance.

PROVISIONS FOR REVISING THE TMDL

The DEP reserves the authority to modify the TMDLs as needed to account for new information made available during the implementation of the TMDLs. Modification of the TMDLs will only be made following an opportunity for public participation and be subject to the review and approval of the EPA. New information, which may 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 analyses 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 Waterbodies Not Meeting Water Quality Standards* until monitoring data confirms that recreation use is fully supported.

PUBLIC PARTICIPATION

The Still River Regional Basin TMDL document was noticed for public review and comment. A Notice of Intent to adopt the TMDL was published on the CT DEP website from 7/29/09-9/10/09. The Notice was also printed in the Hartford Courant on 7/30/09. Local municipalities and Non-Governmental Organizations were individually notified by mail of the comment period. The DEP received several comment letters and the final TMDL document was modified to reflect any reasonable requests submitted in the comment letters. It is expected that open forums will continue as implementation of the TMDL occurs.

REFERENCES

1 - Connecticut Department of Environmental Protection, 2008. *2008 State of Connecticut Integrated Water Quality Report*. Bureau of Water Protection and Land Reuse, 79 Elm Street, Hartford, CT.

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

3 - Code of Federal Regulations, Title 40, CFR, section 130.2(i).

4 – United States Environmental Protection Agency. November 15, 2006 memorandum. *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits*.

5 - U.S. Census Bureau, March 2002. www.census.gov/geo/www/ua/ua_2k.html.

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

7 - Connecticut Department of Environmental Protection, 2005. *Development of Total Maximum Daily Loads (TMDLs) for Indicator Bacteria in Contact Recreation Areas Using the Cumulative Distribution Function Method.* Bureau of Water Management, 79 Elm Street, Hartford, CT.

8 - Connecticut Department of Environmental Protection, 2002. *Water Quality Summary Report for Sasco Brook, Mill River, Rooster River, Fairfield County Connecticut*. November 2002. Bureau of Water Management, 79 Elm Street, Hartford, CT.

9 - Code of Federal Regulations, Title 40, CFR, Part 136.

Appendix A. Regional Basin Maps

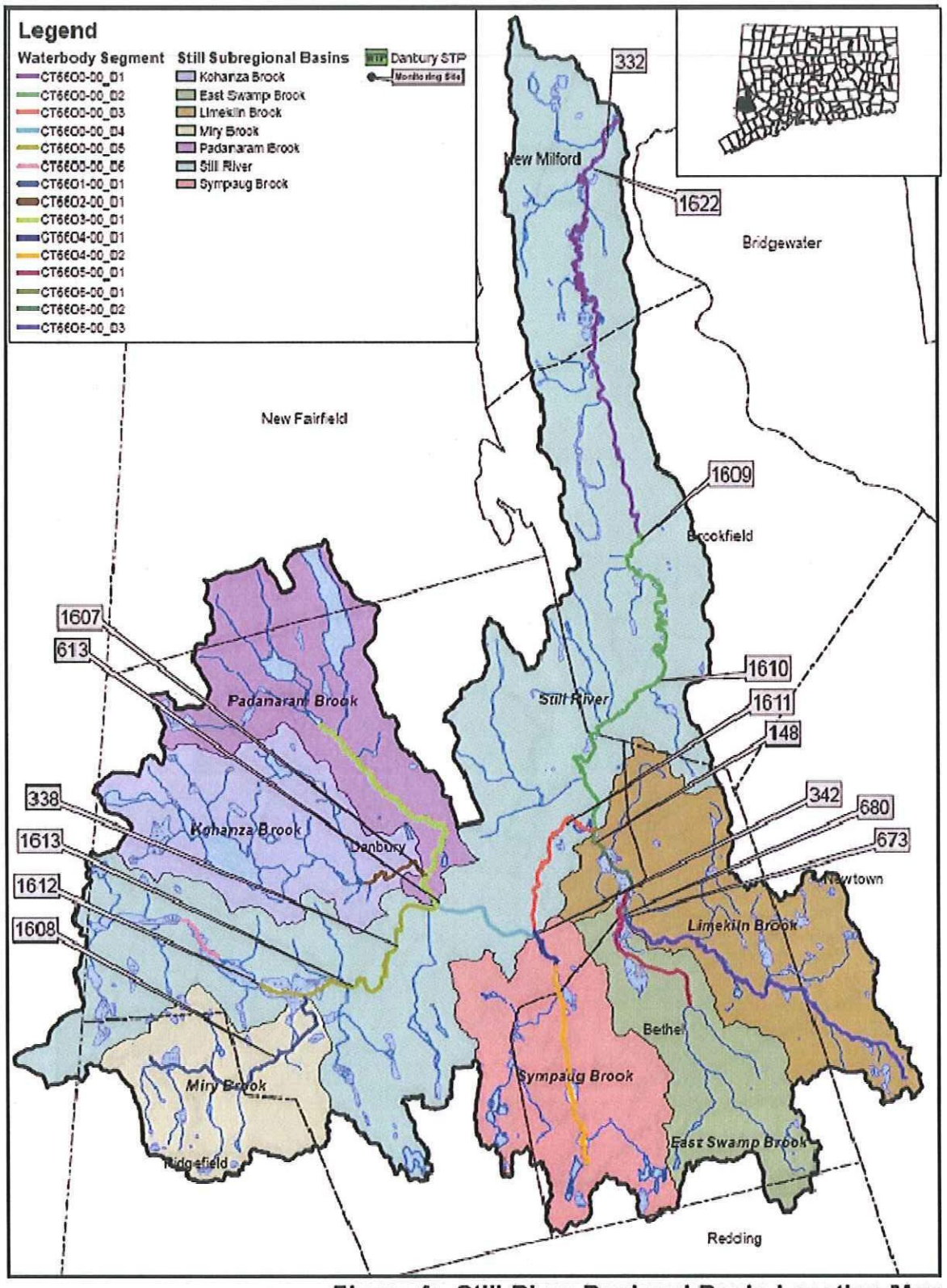


Figure 1: Still River Regional Basin Location Map

Map Data: CTDEP
Map Created: July 2008

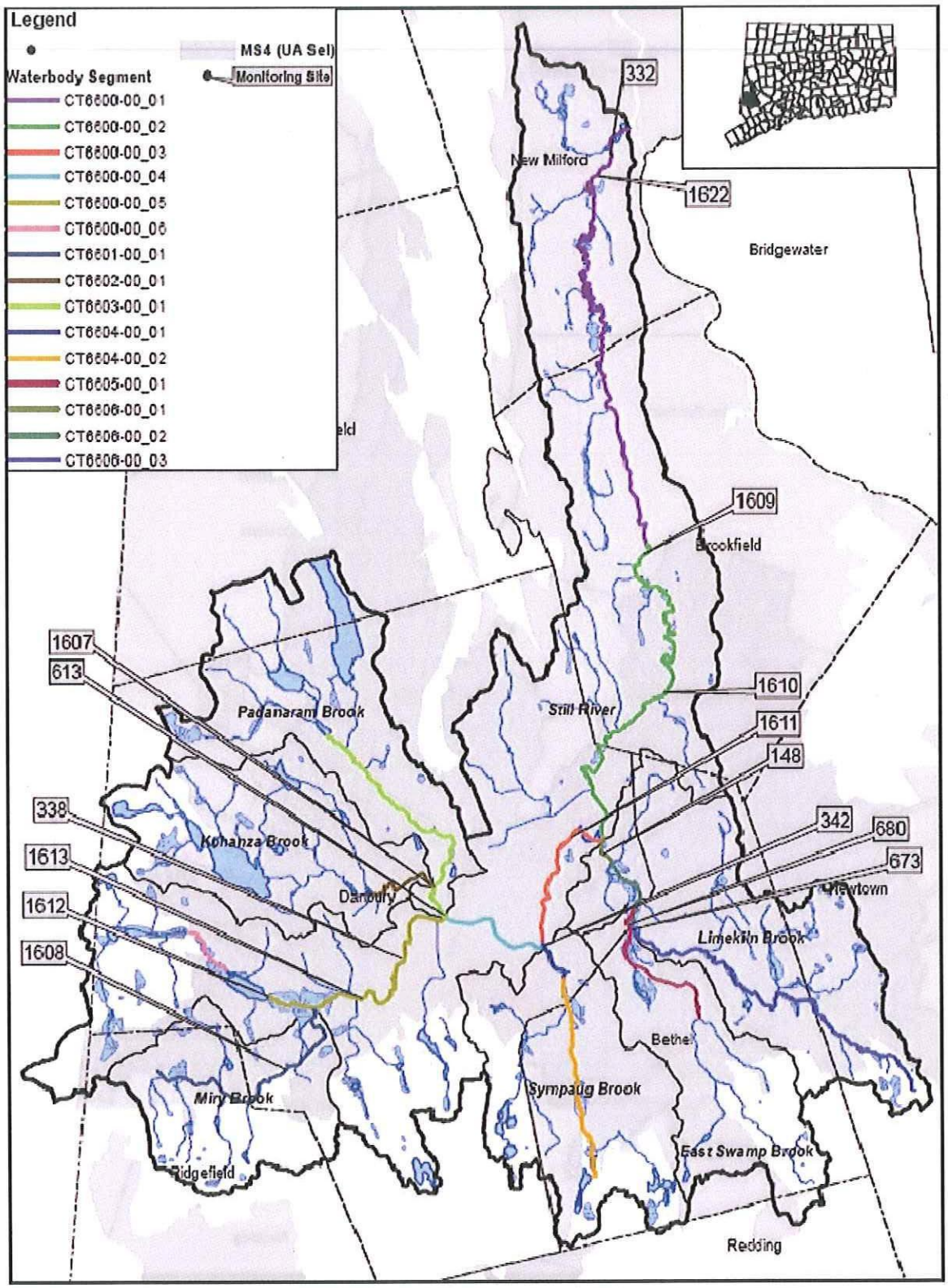


Figure 2: Still River Regional Basin Designated MS4 Area Map

Map Data: CTDEP
Map Created: July 2008

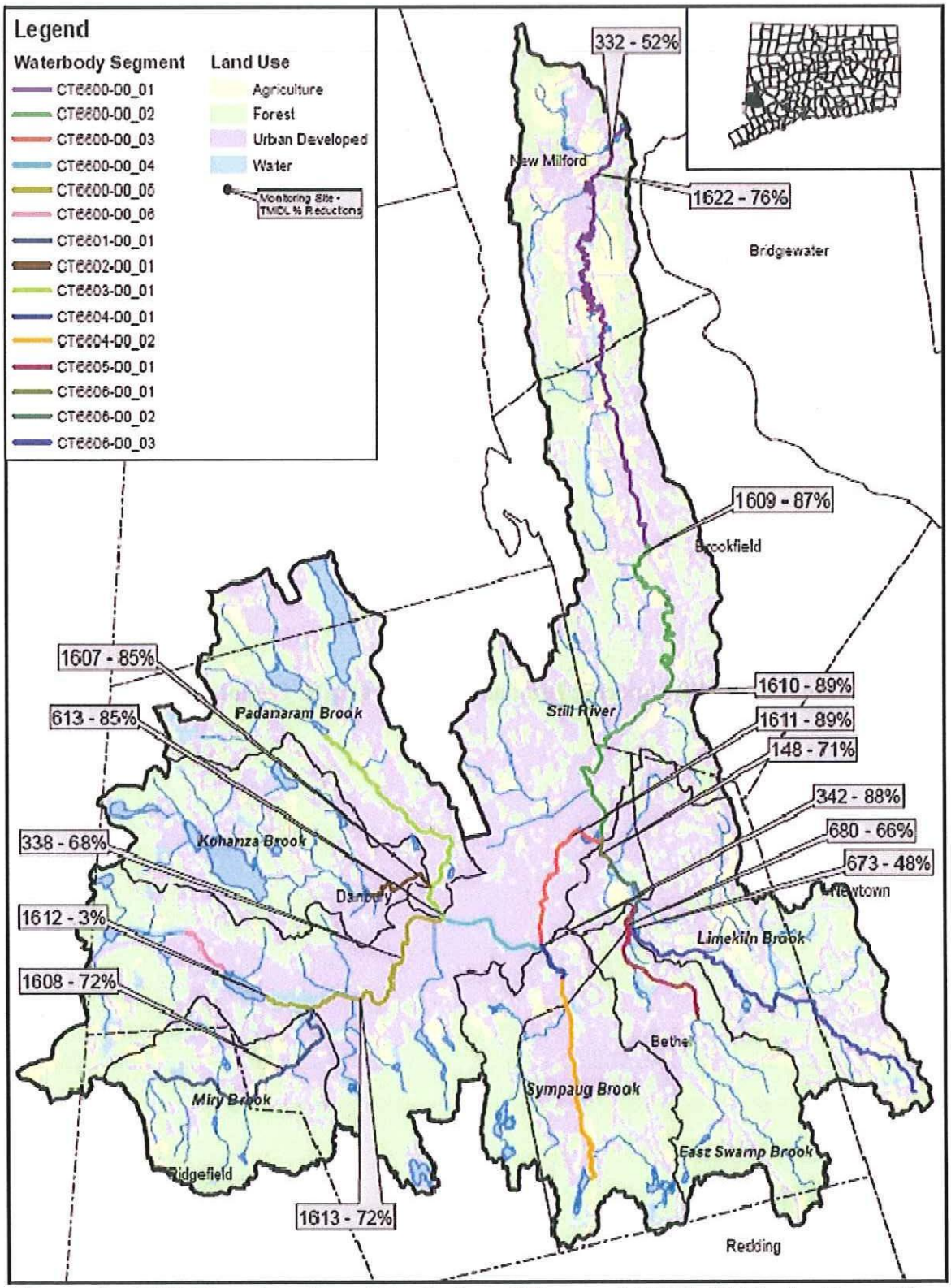


Figure 3: Still River Regional Basin Land Use and TMDL % Reductions Map

Appendix B. Site Specific Information and TMDL Calculations

Appendix B-1
Still River
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Still River
Waterbody Segment IDs: CT6600-00_01, CT6600-00_02, CT6600-00_03, CT6600-00_04, CT6600-00_05
Waterbody Description: From the confluence with Housatonic River (New Milford) to Lake Kenosia outlet (Danbury)
Waterbody Segment Size: 36.04 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class A and Class B

Watershed Description:
Total Drainage Basin Area: 20,071 acres
Subregional Basin Name & Code: Still River, 6600
Regional Basin: Still
Major Basin: Housatonic River Basin
Watershed Towns: Brookfield, Danbury, New Milford, Ridgefield, Bethel,
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	8.2
Forest	39.9
Urban	47.5
Water	4.4

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

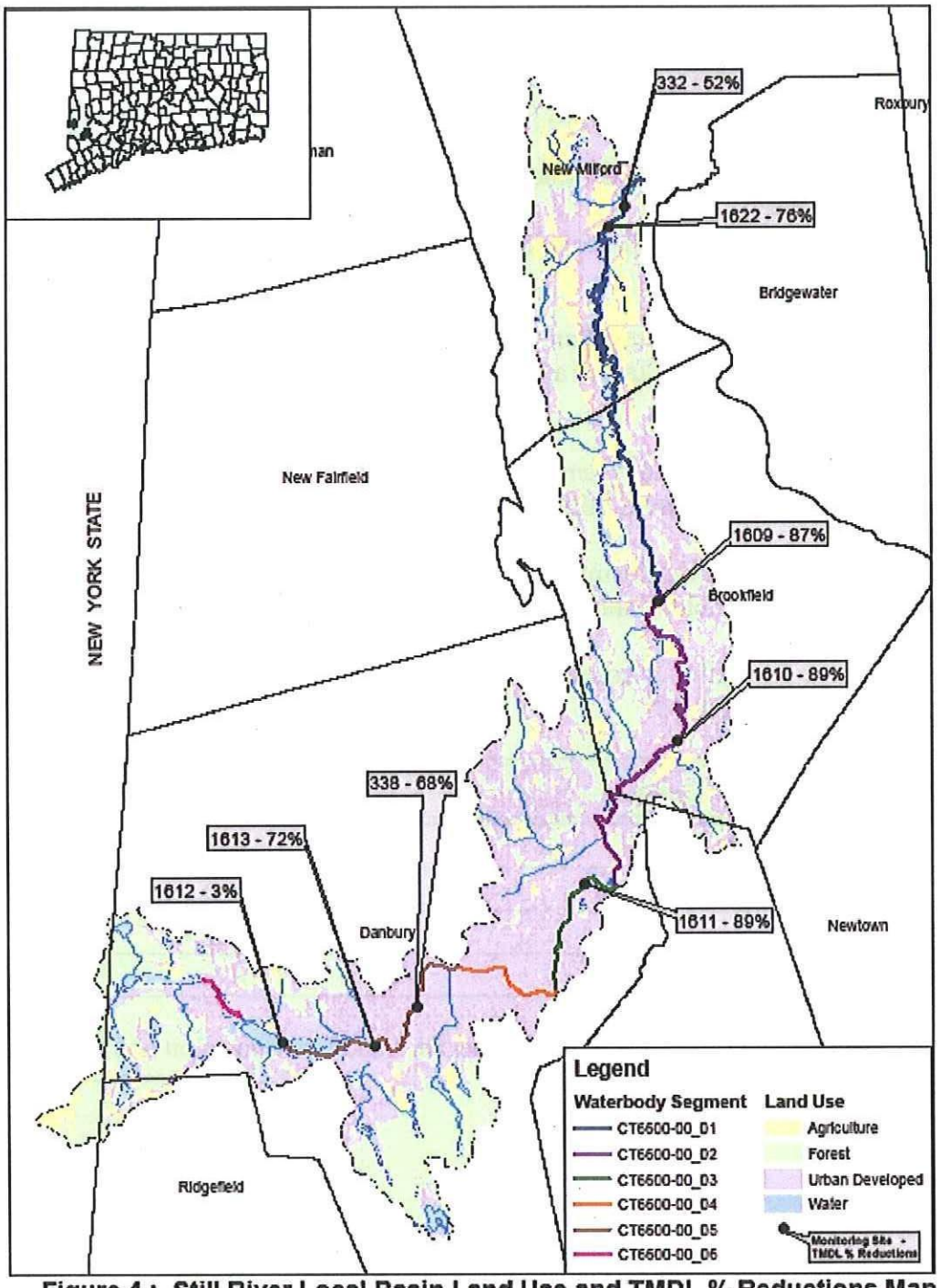


Figure 4 : Still River Local Basin Land Use and TMDL % Reductions Map

Still River
CT5600-00_01

Data Used in the Analysis

Monitoring Site: 332, Still River - upstream side of Lanesville Road Crossing (Dead end)

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	240	11.0	0.5238	133	45
6/20/05	0.00	0.00	0.24	DRY	400	15.0	0.7143	212	47
7/6/05	0.31	0.31	0.32	WET	840	17.0	0.8095	262	69
7/20/05	0.00	2.95	2.97	WET	1100	18.0	0.8571	337	69
8/3/05	0.00	0.00	0.01	DRY	160	7.0	0.3333	85	47
8/17/05	0.00	0.00	1.36	DRY	74	3.5	0.1667	52	30
8/31/05	0.00	0.00	0.00	DRY	390	13.5	0.6429	177	55
9/14/05	0.00	0.00	0.01	DRY	97	5.0	0.2381	65	33
9/27/05	0.24	0.24	0.25	WET	460	16.0	0.7619	243	46
5/3/06	0.08	0.09	0.09	DRY	74	3.5	0.1667	52	30
6/20/06	0.08	0.08	0.09	DRY	230	9.0	0.4286	107	54
7/27/06	0.00	0.00	0.01	DRY	390	13.5	0.6429	177	55
8/28/06	0.00	0.00	0.77	DRY	3900	20.0	0.9524	576	85
5/17/07	0.00	0.01	0.01	DRY	17000	21.0	1.0000	576	97
6/19/07	0.00	0.00	0.00	DRY	240	11.0	0.5238	133	45
6/26/07	0.00	0.00	0.00	DRY	41	1.0	0.0476	27	34
7/17/07	0.00	0.03	0.11	DRY	110	6.0	0.2857	75	32
8/22/07	0.77	0.92	0.93	WET	2800	19.0	0.9048	421	84
9/11/07	0.00	0.00	0.00	DRY	200	8.0	0.3810	95	52
9/13/07	0.00	0.00	0.00	DRY	240	11.0	0.5238	133	45
9/26/07	0.00	0.00	0.00	DRY	63	2.0	0.0952	38	40

Statistics

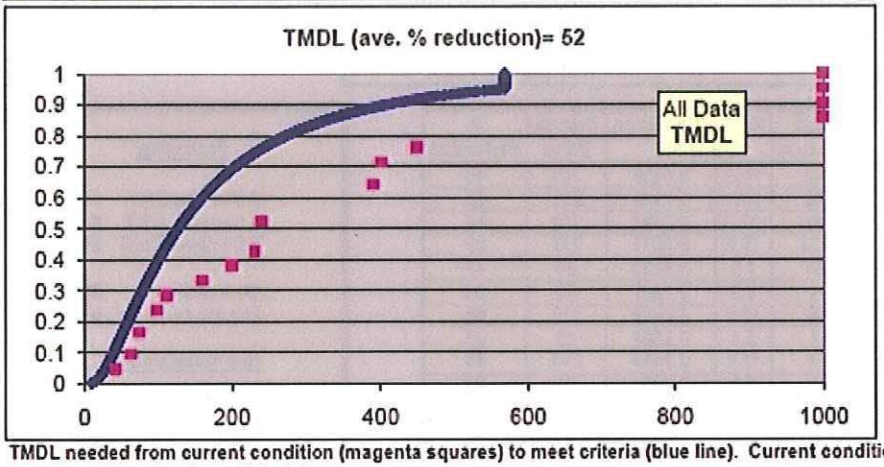
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	328
Log std deviation	0.6433

Avg % Reduction

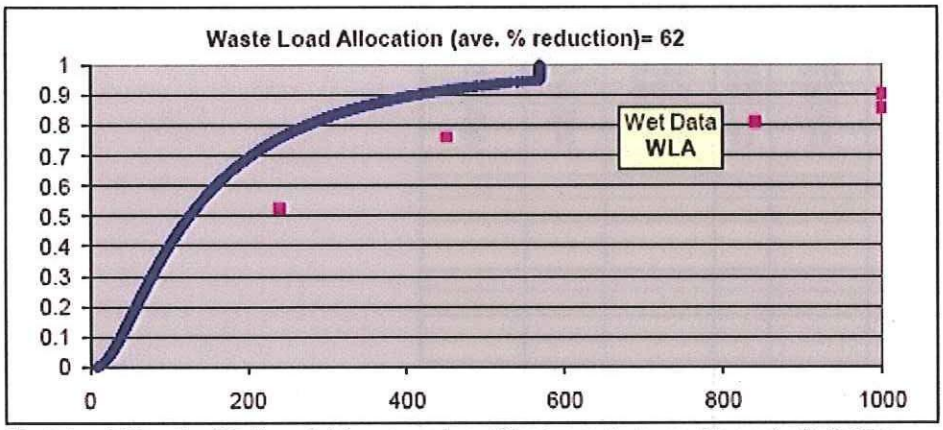
Wet (WLA)	62
Dry (LA)	49
Total (TMDL)	52

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

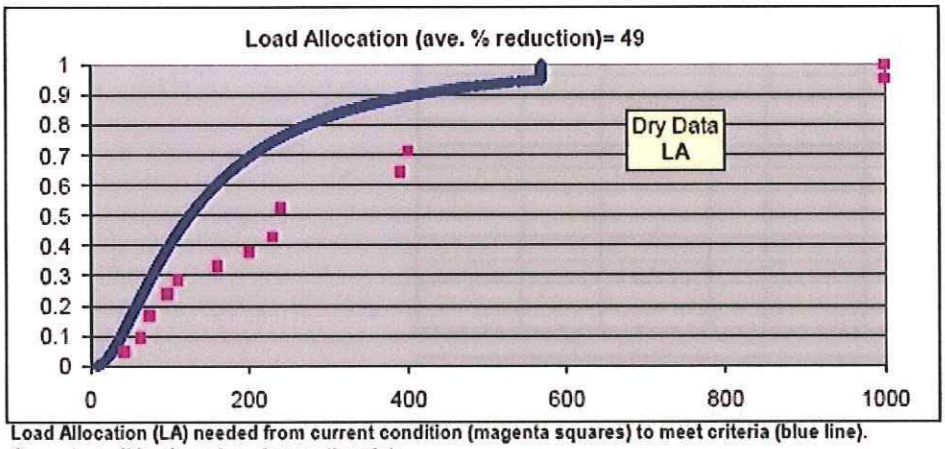
Still River Criteria Curve for Monitoring Site 332
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_01

Data Used in the Analysis

Monitoring Site: 1622, Still River - upstream cascade in Harrybrooke Park

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col/100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/6/05	0.00	0.45	0.46	WET	160	2.0	0.0465	27	83
6/20/05	0.00	0.00	0.24	DRY	810	31.0	0.7209	216	73
7/6/05	0.31	0.31	0.32	WET	590	28.0	0.6512	180	69
7/20/05	0.00	2.95	2.97	WET	1100	34.5	0.8023	276	75
8/3/05	0.00	0.00	0.01	DRY	190	4.5	0.1047	40	79
8/17/05	0.00	0.00	1.36	DRY	290	12.0	0.2791	73	75
8/31/05	0.00	0.00	0.00	DRY	550	26.0	0.6047	161	71
9/14/05	0.00	0.00	0.01	DRY	290	12.0	0.2791	73	75
9/27/05	0.24	0.24	0.25	WET	540	25.0	0.5814	152	72
5/3/06	0.08	0.09	0.09	DRY	120	1.0	0.0233	20	83
6/1/06	0.27	0.27	0.27	WET	290	12.0	0.2791	73	75
6/14/06	0.00	0.00	0.01	DRY	330	18.0	0.4186	104	68
6/20/06	0.08	0.09	0.09	DRY	680	30.0	0.6977	203	70
6/29/06	0.25	1.76	2.36	WET	3900	38.5	0.8953	400	90
7/12/06	0.03	0.03	0.04	DRY	1550	36.0	0.8372	312	80
7/19/06	0.14	0.14	0.15	WET	300	14.0	0.3256	83	72
7/26/06	0.00	0.00	0.01	DRY	450	22.0	0.5116	129	71
7/27/06	0.00	0.00	0.01	DRY	500	24.0	0.5581	144	71
8/2/06	0.00	0.00	0.00	DRY	220	7.0	0.1628	51	77
8/9/06	0.00	1.42	4.26	WET	460	23.0	0.5349	137	70
8/14/06	0.00	0.01	0.01	DRY	580	27.0	0.6279	170	70
8/23/06	0.01	0.01	0.52	DRY	370	21.0	0.4884	123	67
8/28/06	0.00	0.00	0.77	DRY	3900	38.5	0.8953	400	90
5/17/07	0.00	0.01	0.01	DRY	24000	43.0	1.0000	576	98
6/6/07	0.00	0.00	1.35	DRY	1100	34.5	0.8023	276	75
6/12/07	0.06	0.18	0.23	DRY	1600	37.0	0.8605	341	79
6/19/07	0.00	0.00	0.00	DRY	310	15.5	0.3605	91	71
6/26/07	0.00	0.00	0.00	DRY	320	17.0	0.3953	99	69
6/27/07	0.00	0.00	0.00	DRY	260	10.0	0.2326	64	75
7/5/07	0.96	1.32	1.32	WET	5500	40.0	0.9302	491	91
7/10/07	0.00	0.00	0.24	DRY	970	33.0	0.7674	247	75
7/17/07	0.00	0.03	0.11	DRY	310	15.5	0.3605	91	71
7/17/07	0.00	0.03	0.11	DRY	230	8.0	0.1860	55	76
7/25/07	0.00	0.00	1.20	DRY	350	20.0	0.4651	116	67
8/2/07	0.00	0.00	0.02	DRY	340	19.0	0.4419	110	68
8/9/07	0.01	0.73	0.73	WET	11000	42.0	0.9767	576	95
8/22/07	0.77	0.92	0.93	WET	6500	41.0	0.9535	576	91
8/30/07	0.00	0.00	0.00	DRY	170	3.0	0.0698	32	81
9/6/07	0.00	0.00	0.00	DRY	250	9.0	0.2093	60	76
9/11/07	0.00	0.00	0.00	DRY	210	6.0	0.1395	46	78
9/13/07	0.00	0.00	0.00	DRY	610	29.0	0.6744	191	69
9/13/07	0.00	0.00	0.00	DRY	860	32.0	0.7442	231	73
9/26/07	0.00	0.00	0.00	DRY	190	4.5	0.1047	40	79

Statistics

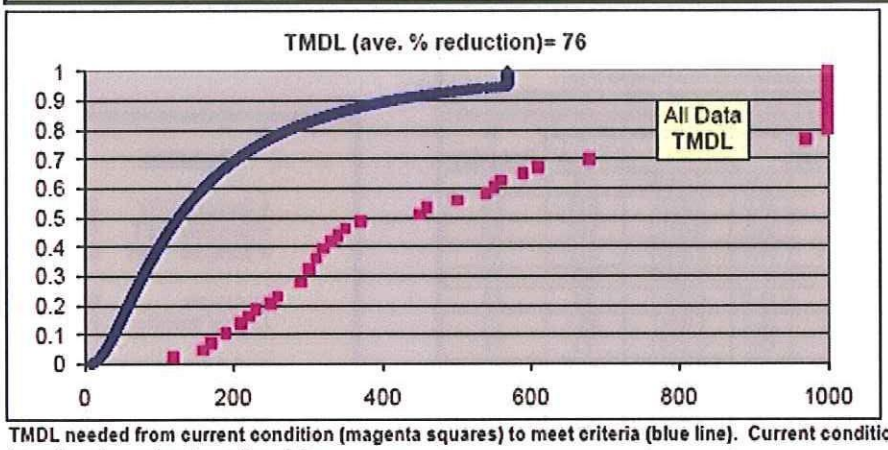
# Samples DRY	32
# Samples WET	11
# Samples Total	43
Geomean	602
Log std deviation	0.5214

Avg % Reduction

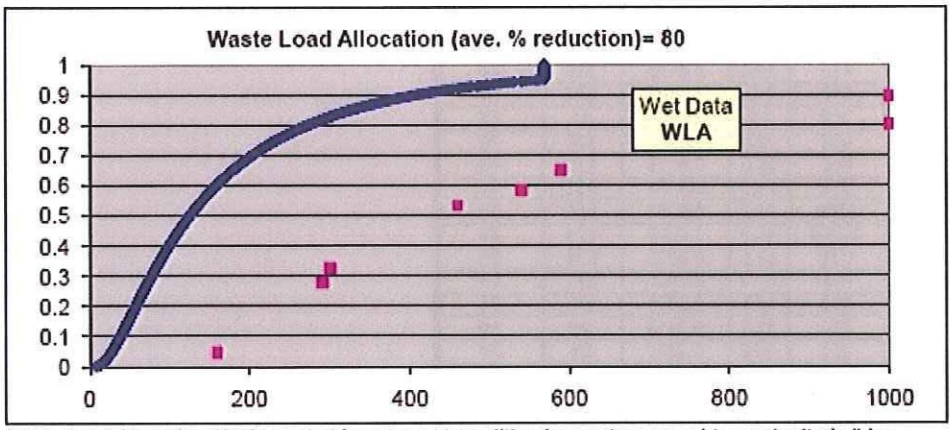
Wet (WLA)	80
Dry (LA)	75
Total (TMDL)	76

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

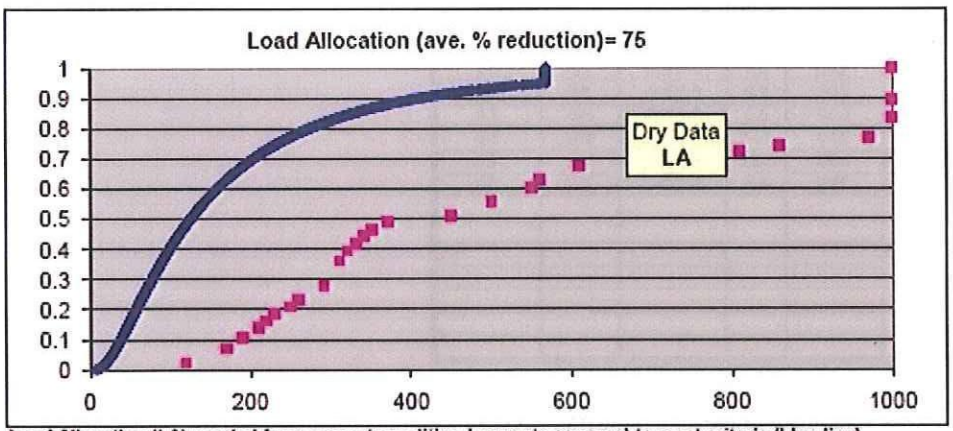
Still River Criteria Curve for Monitoring Site 1622
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_02

Data Used in the Analysis

Monitoring Site: 1600, Still River - at USGS station upstream of Route 7

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.43	0.46	WET	220	2.0	0.1000	39	82
6/20/05	0.00	0.00	0.24	DRY	610	9.0	0.4500	112	82
7/6/05	0.31	0.31	0.32	WET	11000	20.0	1.0000	576	95
7/20/05	0.00	2.66	2.97	WET	1400	13.0	0.6500	180	87
8/3/05	0.00	0.00	0.01	DRY	570	7.0	0.3500	88	84
8/17/05	0.00	0.00	1.36	DRY	480	5.0	0.2500	68	86
8/31/05	0.00	0.00	0.00	DRY	1600	14.0	0.7000	204	87
9/14/05	0.00	0.00	0.01	DRY	520	6.0	0.3000	78	85
9/27/05	0.24	0.24	0.25	WET	2900	17.0	0.8500	327	89
6/20/06	0.09	0.09	0.09	DRY	1300	12.0	0.6000	159	88
7/27/06	0.00	0.00	0.01	DRY	580	8.0	0.4000	100	83
8/26/06	0.00	0.00	0.77	DRY	2000	16.0	0.8000	274	86
5/17/07	0.00	0.01	0.01	DRY	6500	19.0	0.9500	573	91
6/19/07	0.00	0.00	0.00	DRY	1100	11.0	0.5500	141	87
6/26/07	0.00	0.00	0.00	DRY	1900	15.0	0.7500	235	88
7/17/07	0.00	0.03	0.11	DRY	420	3.0	0.1500	49	88
8/22/07	0.77	0.92	0.93	WET	4600	18.0	0.9000	410	91
9/11/07	0.00	0.00	0.00	DRY	720	10.0	0.5000	126	83
9/13/07	0.00	0.00	0.00	DRY	430	4.0	0.2000	58	87
9/26/07	0.00	0.00	0.00	DRY	190	1.0	0.0500	28	85

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

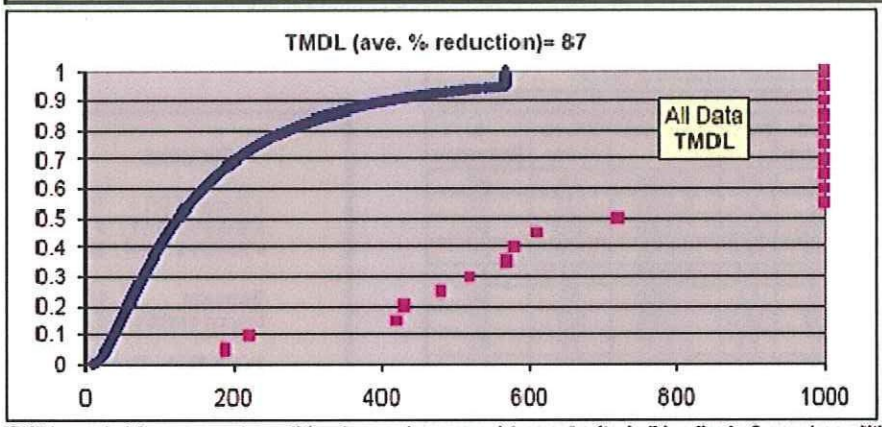
Statistics

# Samples DRY	15
# Samples WET	5
# Samples Total	20
Geomean	1059
Log std deviation	0.4716

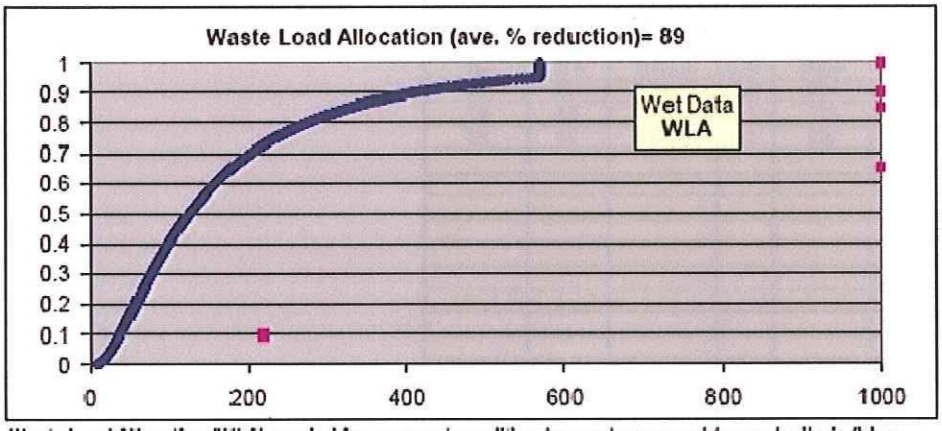
Avg % Reduction

Wet (WLA)	89
Dry (LA)	86
Total (TMDL)	87

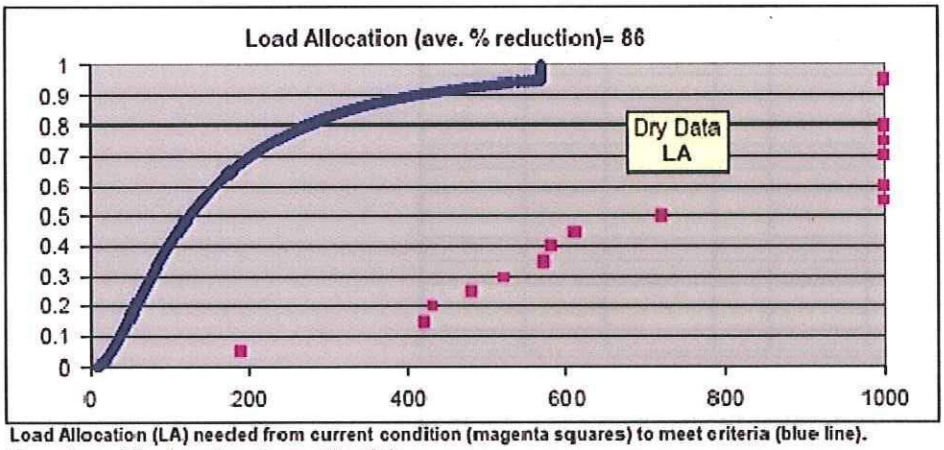
Still River Criteria Curve for Monitoring Site 1609
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_02

Data Used in the Analysis

Monitoring Site: 1610, Still River - at Grays Bridge Road crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	540	6.0	0.2857	75	86
6/20/05	0.00	0.00	0.24	DRY	1040	11.0	0.5238	133	87
7/6/05	0.31	0.31	0.32	WET	32000	21.0	1.0000	576	98
7/20/05	0.00	2.96	2.97	WET	1600	13.0	0.6190	167	90
8/3/05	0.00	0.00	0.01	DRY	610	8.0	0.3810	95	84
8/17/05	0.00	0.00	1.38	DRY	440	4.0	0.1905	66	87
8/31/05	0.00	0.00	0.00	DRY	1500	12.0	0.5714	149	90
9/14/05	0.00	0.00	0.01	DRY	580	7.0	0.3333	85	85
9/27/05	0.24	0.24	0.25	WET	11000	20.0	0.9524	576	95
5/3/06	0.08	0.09	0.09	DRY	230	1.5	0.0714	33	86
6/20/06	0.08	0.08	0.09	DRY	1900	14.0	0.6667	167	90
7/27/06	0.00	0.00	0.01	DRY	470	5.0	0.2381	65	86
8/28/06	0.00	0.00	0.77	DRY	2500	15.0	0.7143	212	92
5/17/07	0.00	0.01	0.01	DRY	3900	18.0	0.8571	337	91
6/19/07	0.00	0.00	0.00	DRY	3700	17.0	0.8095	262	92
6/26/07	0.00	0.00	0.00	DRY	4600	19.0	0.9048	421	91
7/17/07	0.00	0.03	0.11	DRY	320	3.0	0.1429	47	85
8/22/07	0.77	0.92	0.93	WET	2800	16.0	0.7619	243	91
9/11/07	0.00	0.00	0.00	DRY	720	10.0	0.4762	119	83
9/13/07	0.00	0.00	0.00	DRY	650	9.0	0.4286	107	84
9/26/07	0.00	0.00	0.00	DRY	230	1.5	0.0714	33	86

Statistics

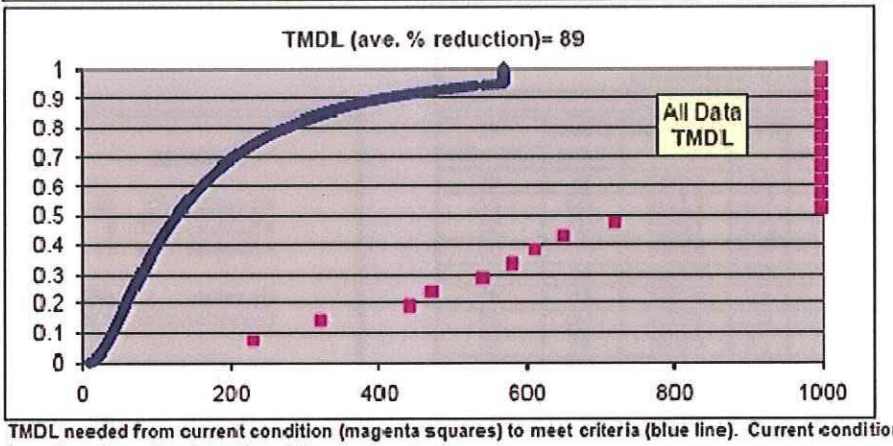
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	1299
Log std deviation	0.5578

Avg % Reduction

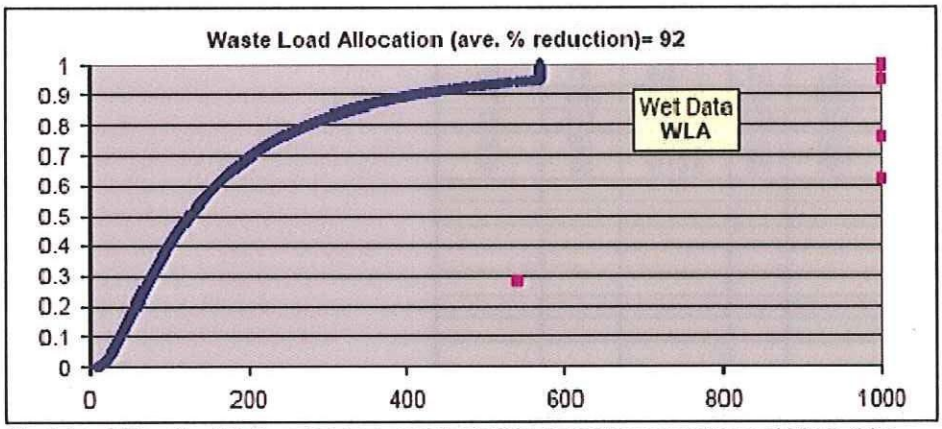
Wet (WLA)	92
Dry (LA)	88
Total (TMDL)	89

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

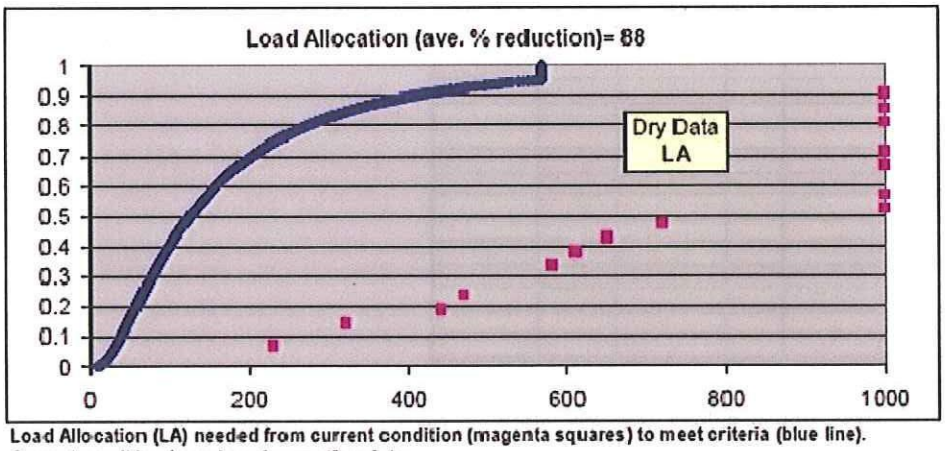
Still River Criteria Curve for Monitoring Site 1610
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_03

Data Used in the Analysis

Monitoring Site: 1611, Still River - downstream side of Eagle Road crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/5/05	0.00	0.45	0.46	WET	340	2.0	0.0952	38	89
6/20/05	0.00	0.00	0.24	DRY	600	8.5	0.4048	101	83
7/6/05	0.31	0.31	0.32	WET	17000	20.5	0.9762	576	97
7/20/05	0.00	2.95	2.97	WET	2100	14.0	0.6667	187	91
8/3/05	0.00	0.00	0.01	DRY	450	4.0	0.1905	56	88
8/17/05	0.00	0.00	1.38	DRY	550	7.0	0.3333	85	85
8/31/05	0.00	0.00	0.00	DRY	5500	18.0	0.8571	337	94
9/14/05	0.00	0.00	0.01	DRY	460	5.0	0.2381	65	86
9/27/05	0.24	0.24	0.25	WET	8100	19.0	0.9048	421	93
5/3/06	0.06	0.09	0.09	DRY	270	1.0	0.0476	27	90
6/20/06	0.06	0.06	0.09	DRY	1500	13.0	0.6190	167	89
7/27/06	0.00	0.00	0.01	DRY	910	12.0	0.5714	149	84
8/28/06	0.00	0.00	0.77	DRY	2400	15.0	0.7143	212	91
5/17/07	0.00	0.01	0.01	DRY	3700	17.0	0.8095	282	92
6/19/07	0.00	0.00	0.00	DRY	790	11.0	0.5238	133	83
6/26/07	0.00	0.00	0.00	DRY	600	8.5	0.4048	101	83
7/17/07	0.00	0.03	0.11	DRY	700	10.0	0.4762	119	83
8/22/07	0.77	0.92	0.93	WET	3600	16.0	0.7619	243	93
9/11/07	0.00	0.00	0.00	DRY	17000	20.5	0.9762	576	97
9/13/07	0.00	0.00	0.00	DRY	540	6.0	0.2857	75	86
9/26/07	0.00	0.00	0.00	DRY	380	3.0	0.1429	47	88

Statistics

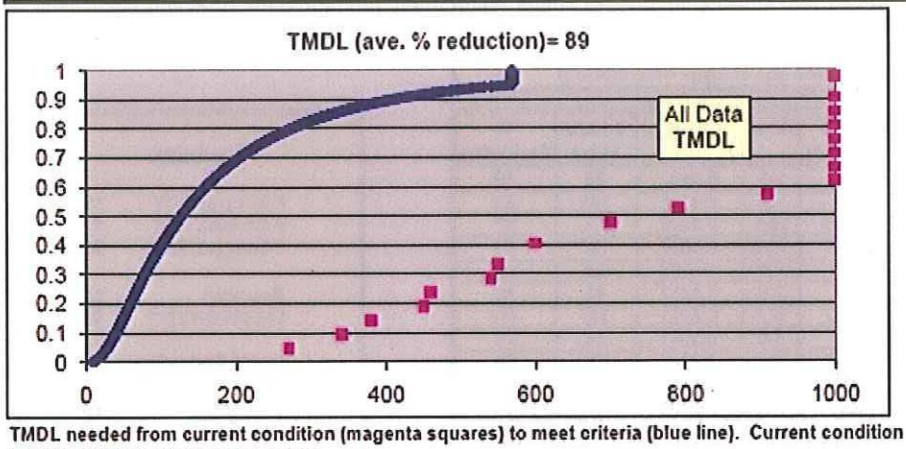
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	1330
Log std deviation	0.5497

Avg % Reduction

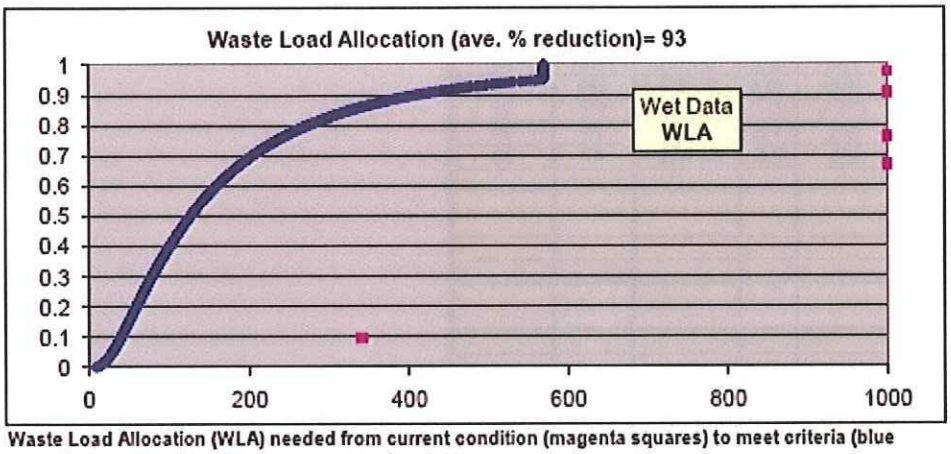
Wet (WLA)	93
Dry (LA)	88
Total (TMDL)	89

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided CTDEP. 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.

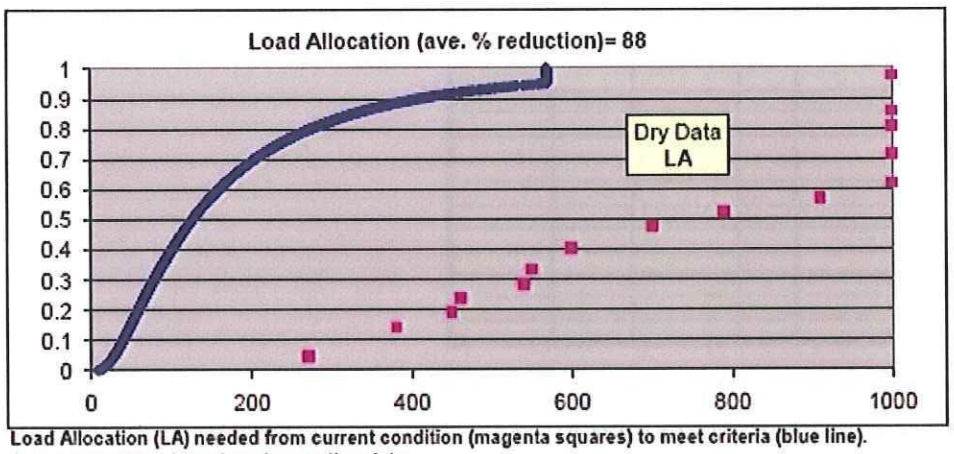
Still River Criteria Curve for Monitoring Site 1611
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_05

Data Used in the Analysis

Monitoring Site: 338, Still River - end of Oil Mill Road

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.43	0.46	WET	160	3.5	0.1667	52	68
6/20/05	0.00	0.00	0.24	DRY	270	8.0	0.3810	95	65
7/6/05	0.31	0.31	0.32	WET	2600	18.0	0.8571	337	87
7/20/05	0.00	2.95	2.97	WET	980	16.0	0.7619	243	75
8/3/05	0.00	0.00	0.01	DRY	310	9.0	0.4286	107	66
8/17/05	0.00	0.00	1.38	DRY	660	14.0	0.6667	167	72
8/31/05	0.00	0.00	0.00	DRY	8200	21.0	1.0000	576	93
9/14/05	0.00	0.00	0.01	DRY	206	6.0	0.2857	75	64
9/27/05	0.24	0.24	0.26	WET	1900	17.0	0.8095	282	85
5/3/06	0.08	0.09	0.09	DRY	10	1.0	0.0476	27	0
6/20/06	0.08	0.08	0.09	DRY	370	10.0	0.4762	119	68
7/27/06	0.00	0.00	0.01	DRY	160	3.5	0.1667	52	68
8/28/06	0.00	0.00	0.77	DRY	680	15.0	0.7143	212	76
5/17/07	0.00	0.01	0.01	DRY	2800	19.0	0.9048	421	85
6/19/07	0.00	0.00	0.00	DRY	220	7.0	0.3333	85	61
6/26/07	0.00	0.00	0.00	DRY	170	5.0	0.2381	65	62
7/17/07	0.00	0.03	0.11	DRY	400	11.0	0.5238	133	67
8/22/07	0.77	0.92	0.93	WET	580	13.0	0.6190	167	71
9/11/07	0.00	0.00	0.00	DRY	7000	20.0	0.9524	576	92
9/13/07	0.00	0.00	0.00	DRY	570	12.0	0.5714	149	74
9/26/07	0.00	0.00	0.00	DRY	63	2.0	0.0952	38	40

Statistics

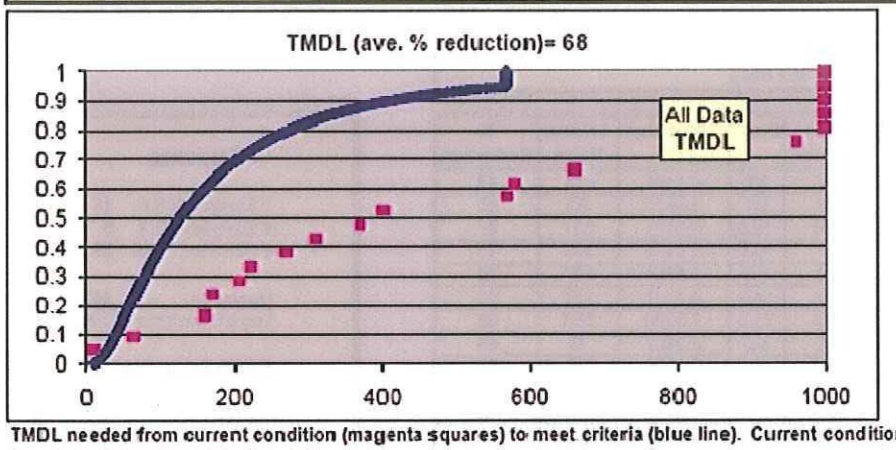
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	482
Log std deviation	0.6774

Avg % Reduction

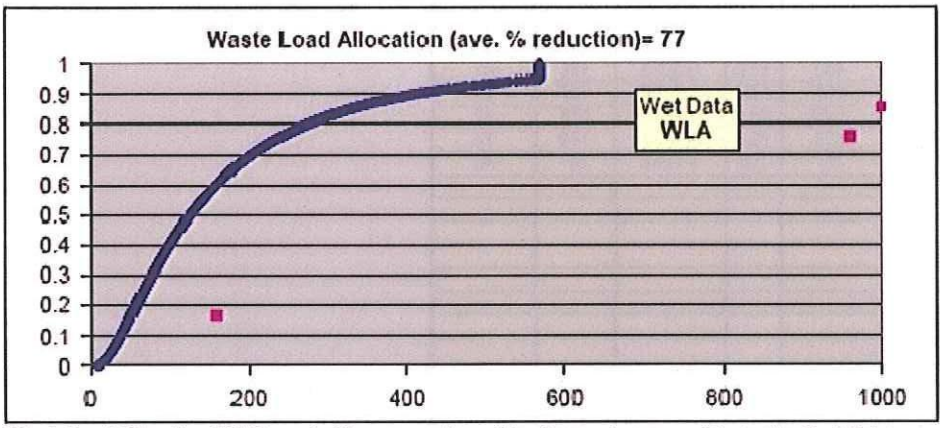
Wet (WLA)	77
Dry (LA)	66
Total (TMDL)	68

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

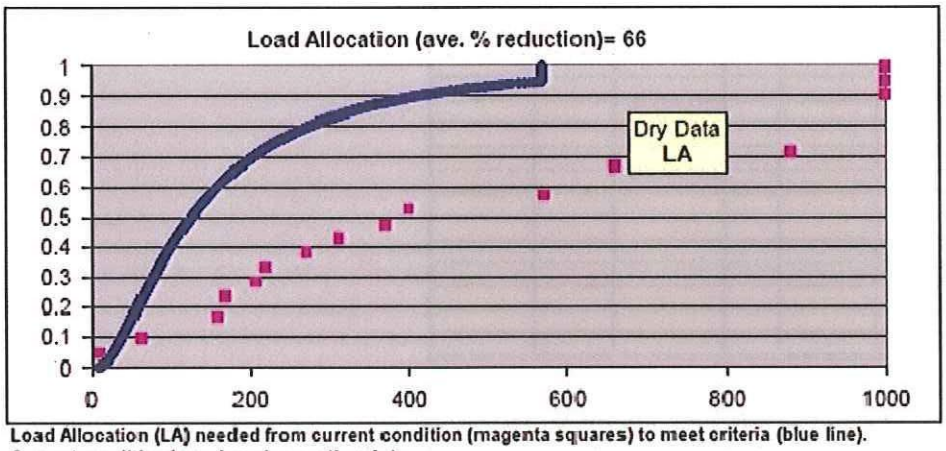
Still River Criteria Curve for Monitoring Site 338
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_05

Data Used in the Analysis

Monitoring Site: 1613, Still River - at downstream side of Segar Street crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	210	4.5	0.2143	61	71
6/20/05	0.00	0.00	0.24	DRY	180	3.0	0.1429	47	74
7/6/05	0.31	0.31	0.32	WET	1100	18.0	0.8571	337	69
7/20/05	0.00	2.93	2.97	WET	550	12.0	0.5714	149	73
8/3/05	0.00	0.00	0.01	DRY	580	13.5	0.6429	177	70
8/17/05	0.00	0.00	1.38	DRY	960	15.0	0.7143	212	78
8/31/05	0.00	0.00	0.00	DRY	7700	20.0	0.9524	576	93
9/14/05	0.00	0.00	0.01	DRY	420	9.0	0.4286	107	75
9/27/05	0.24	0.24	0.25	WET	1000	17.0	0.8095	282	72
5/3/06	0.08	0.09	0.09	DRY	31	1.0	0.0476	27	13
6/20/06	0.08	0.08	0.09	DRY	580	13.5	0.6429	177	70
7/27/06	0.00	0.00	0.01	DRY	130	2.0	0.0952	38	71
8/28/06	0.00	0.00	0.77	DRY	990	16.0	0.7619	243	75
5/17/07	0.00	0.01	0.01	DRY	1700	19.0	0.9048	421	75
6/19/07	0.00	0.00	0.00	DRY	260	6.0	0.2857	75	70
6/26/07	0.00	0.00	0.00	DRY	410	8.0	0.3810	95	77
7/17/07	0.00	0.03	0.11	DRY	440	10.0	0.4762	119	73
8/22/07	0.77	0.92	0.93	WET	490	11.0	0.5238	133	73
9/11/07	0.00	0.00	0.00	DRY	17000	21.0	1.0000	576	97
9/13/07	0.00	0.00	0.00	DRY	330	7.0	0.3333	85	74
9/26/07	0.00	0.00	0.00	DRY	210	4.5	0.2143	61	71

Statistics

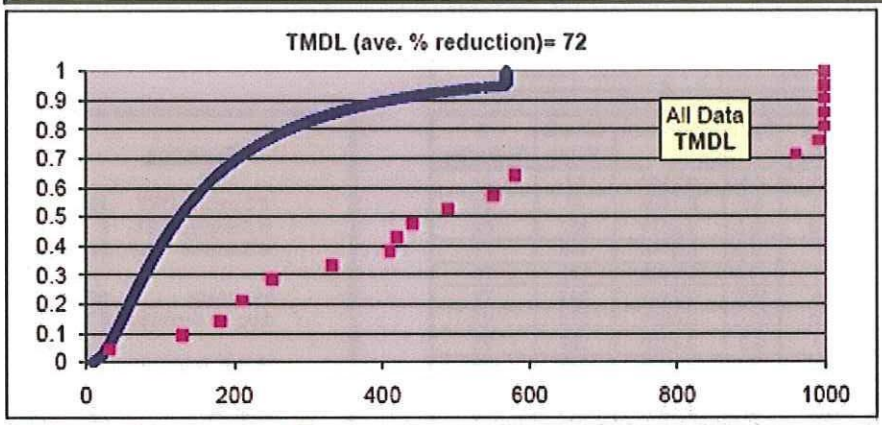
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	555
Log std deviation	0.5832

Avg % Reduction

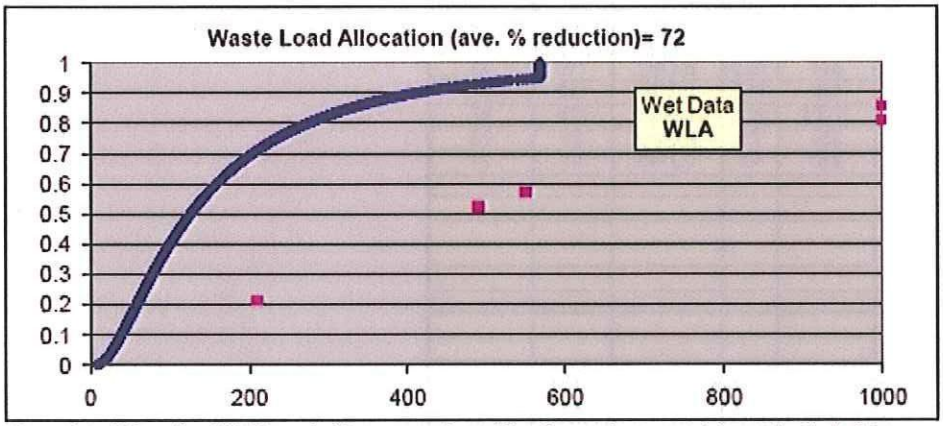
Wet (WLA)	72
Dry (LA)	72
Total (TMDL)	72

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

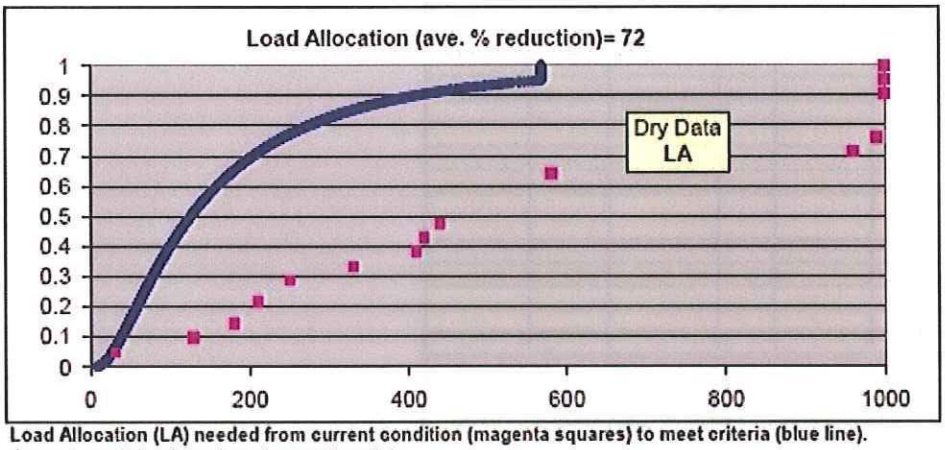
Still River Criteria Curve for Monitoring Site 1613
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Still River
CT6600-00_05

Data Used in the Analysis

Monitoring Site: 1612, Still River - at Kenosia Road Crossing at outlet for Kenosia Lake

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col/100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	10	1.0	0.0476	27	0
6/20/05	0.00	0.00	0.24	DRY	98	19.0	0.9048	421	0
7/6/05	0.31	0.31	0.32	WET	10	1.0	0.0476	27	0
7/20/05	0.00	2.66	2.97	WET	30	14.0	0.6667	187	0
8/3/05	0.00	0.00	0.01	DRY	10	1.0	0.0476	27	0
8/17/05	0.00	0.00	1.38	DRY	20	9.2	0.4381	109	0
8/31/05	0.00	0.00	0.00	DRY	1300	21.0	1.0000	576	56
9/14/05	0.00	0.00	0.01	DRY	110	20.0	0.9524	576	0
9/27/05	0.24	0.24	0.25	WET	10	1.0	0.0476	27	0
5/3/06	0.09	0.09	0.09	DRY	20	9.2	0.4381	109	0
5/20/06	0.06	0.06	0.09	DRY	20	9.2	0.4381	109	0
7/27/06	0.00	0.00	0.01	DRY	10	1.0	0.0476	27	0
8/28/06	0.00	0.00	0.77	DRY	31	15.0	0.7143	212	0
5/17/07	0.00	0.01	0.01	DRY	52	18.0	0.8571	337	0
6/19/07	0.00	0.00	0.00	DRY	10	1.0	0.0476	27	0
6/26/07	0.00	0.00	0.00	DRY	41	16.5	0.7857	261	0
7/17/07	0.00	0.03	0.11	DRY	20	9.2	0.4381	109	0
8/22/07	0.77	0.92	0.93	WET	20	9.2	0.4381	109	0
9/11/07	0.00	0.00	0.00	DRY	41	16.5	0.7857	261	0
9/13/07	0.00	0.00	0.00	DRY	20	9.2	0.4381	109	0
9/26/07	0.00	0.00	0.00	DRY	10	1.0	0.0476	27	0

Statistics

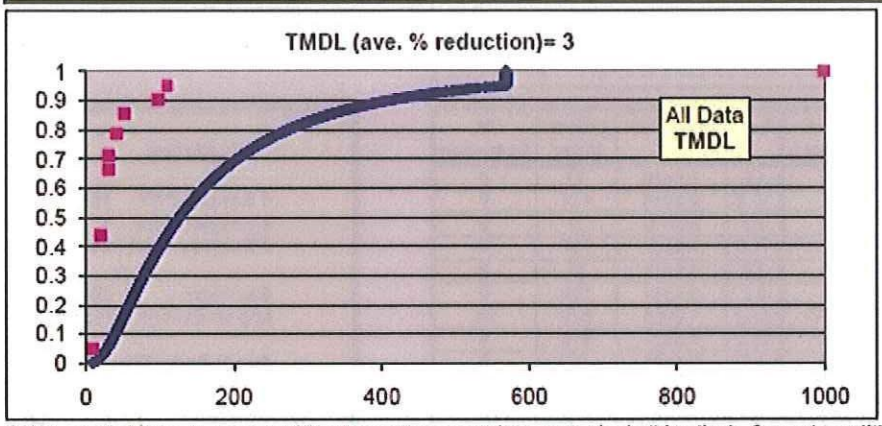
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	26
Log std deviation	0.5036

Avg % Reduction

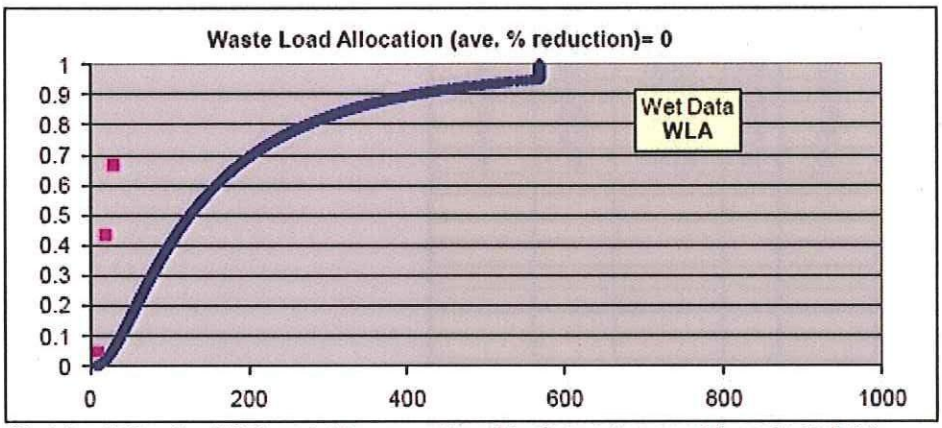
Wet (WLA)	0
Dry (LA)	3
Total (TMDL)	3

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

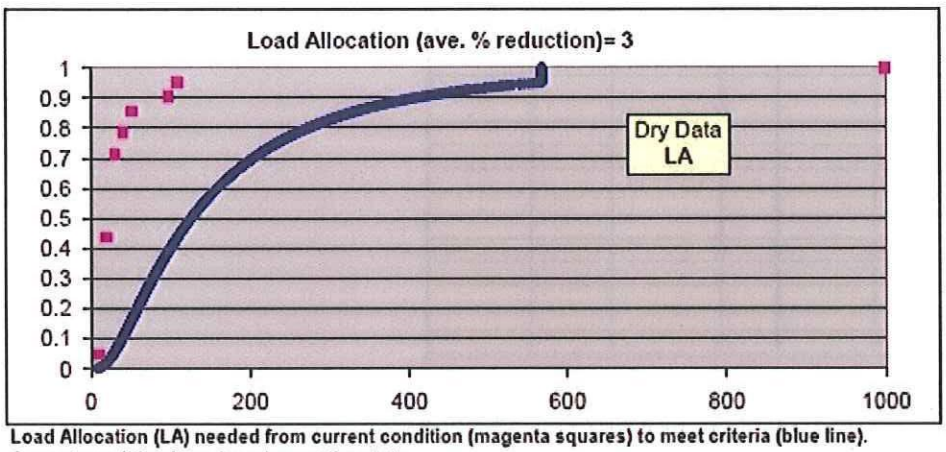
Still River Criteria Curve for Monitoring Site 1612
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-1
Still River
TMDL Summary

The TMDL analysis for the Still River was conducted at eight sites, which are representative of five river segments. Data was unavailable for segment CT6600-00_04, however, Site 338 was determined to be representative of segment CT6600-00_04. Site 338 was considered to provide a conservative reduction percentage for segment CT6600-00_04 (68% reduction). With the exception of Site 1612, the analysis indicates that the sites are influenced by sources of bacteria active under both wet weather and dry weather conditions. Site 1612 indicated a 0% wet weather reduction of indicator bacteria and only a 3% reduction for dry weather. Generally, percent reductions for wet weather conditions were found to be slightly higher than dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced by the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality will also reduce inputs of bacteria to the river. Since illicit discharges and failed sanitary collection systems may also be active at some sites during dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include as domestic animal waste, wildlife, and stormwater input as sheet flow.

Downstream view at Site 332 on Still River.

Downstream view at Site 1622 on Still River.

Downstream view at Site 1609 on Still River.

Downstream view at Site 1610 on Still River.

Downstream view at Site 1611 on Still River.

Downstream view at Site 338 on Still River.

Downstream view at Site 1613 on Still River.

Downstream view at Site 1612 on Still River.

Appendix B-2
Miry Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Miry Brook
Waterbody Segment IDs: CT6601-00_01
Waterbody Description: From the confluence with the Still River, Danbury, upstream to headwaters at North Ridgefield Pond outlet, Ridgefield

Waterbody Segment Size: 3.42 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class A

Watershed Description:
Total Drainage Basin Area: 3,220 Acres
Subregional Basin Name & Code: Miry Brook, 6601
Regional Basin: Still
Major Basin: Housatonic River Basin
Watershed Towns: Danbury, Ridgefield
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	8.4
Forest	58.5
Urban	29.5
Water	3.5

* Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

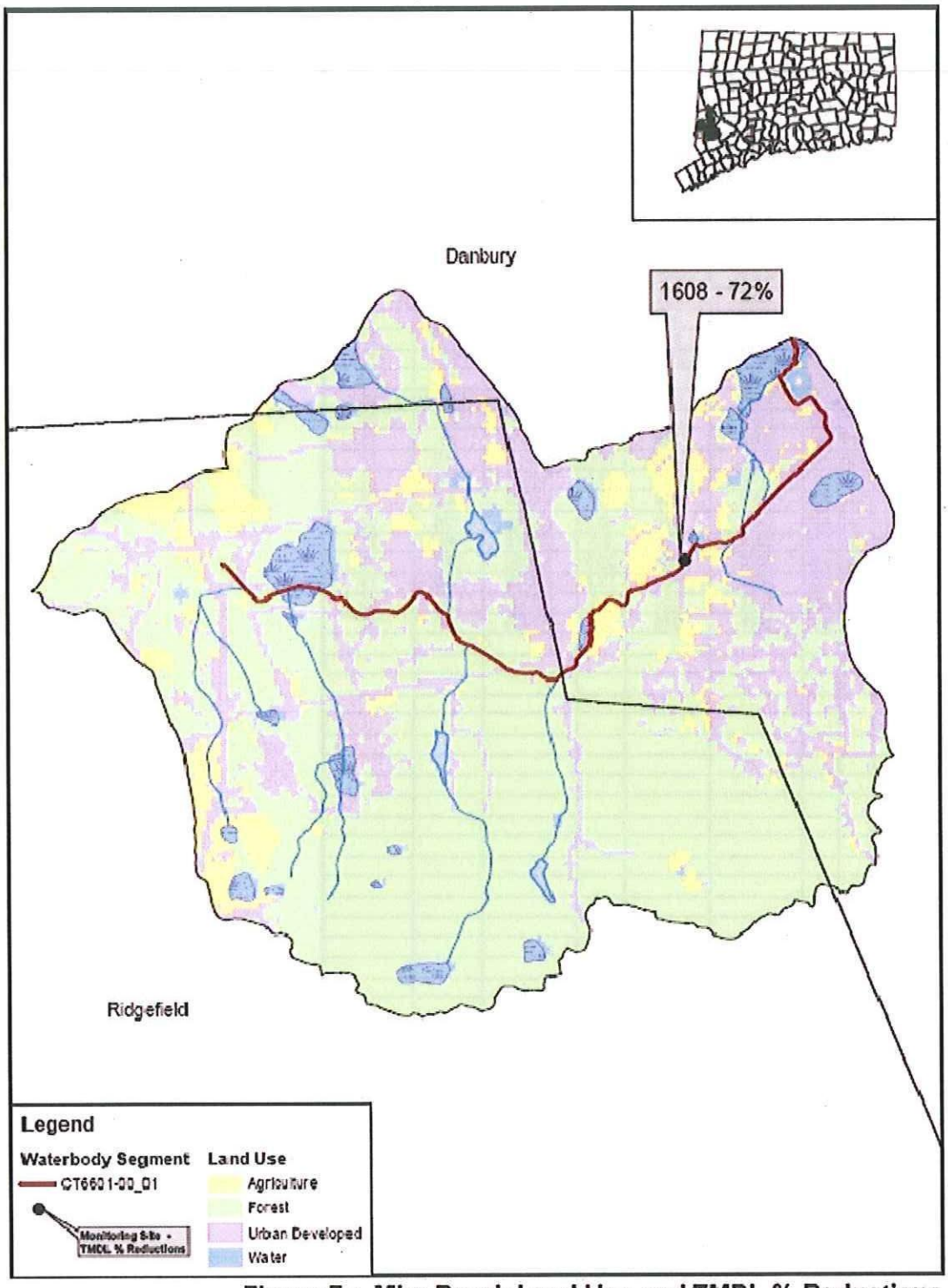


Figure 7 : Miry Brook Land Use and TMDL % Reductions

Map Data: CTDEP
Map Created: July 2008

Miry Brook
CT6601-00_01

Data Used in the Analysis

Monitoring Site: 1608, Miry Brook - at Ye Olde Road (Wooster School Driveway)

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	530	11.0	0.5500	141	73
6/20/05	0.00	0.00	0.24	DRY	460	9.0	0.4500	112	76
7/6/05	0.31	0.31	0.32	WET	1600	17.0	0.8500	327	80
7/20/05	0.00	2.95	2.97	WET	820	14.0	0.7000	204	75
8/3/05	0.00	0.00	0.01	DRY	310	6.0	0.3000	78	75
8/17/05	0.00	0.00	1.38	DRY	640	15.0	0.7500	235	72
8/31/05	0.00	0.00	0.00	DRY	2500	19.0	0.9500	573	77
9/14/05	0.00	0.00	0.01	DRY	86	2.0	0.1000	39	55
9/27/05	0.24	0.24	0.25	WET	660	12.0	0.6000	159	76
5/3/06	0.08	0.09	0.09	DRY	41	1.0	0.0500	28	32
7/27/06	0.00	0.00	0.01	DRY	360	7.0	0.3500	88	75
8/28/06	0.00	0.00	0.77	DRY	2000	18.0	0.9000	410	79
5/17/07	0.00	0.01	0.01	DRY	1500	16.0	0.8000	274	82
6/19/07	0.00	0.00	0.00	DRY	460	8.0	0.4000	100	78
6/26/07	0.00	0.00	0.00	DRY	470	10.0	0.5000	126	73
7/17/07	0.00	0.03	0.11	DRY	170	3.0	0.1500	49	71
8/22/07	0.77	0.92	0.93	WET	2700	20.0	1.0000	576	79
9/11/07	0.00	0.00	0.00	DRY	730	13.0	0.6500	180	75
9/13/07	0.00	0.00	0.00	DRY	190	4.0	0.2000	58	69
9/26/07	0.00	0.00	0.00	DRY	210	5.0	0.2500	68	68

Statistics

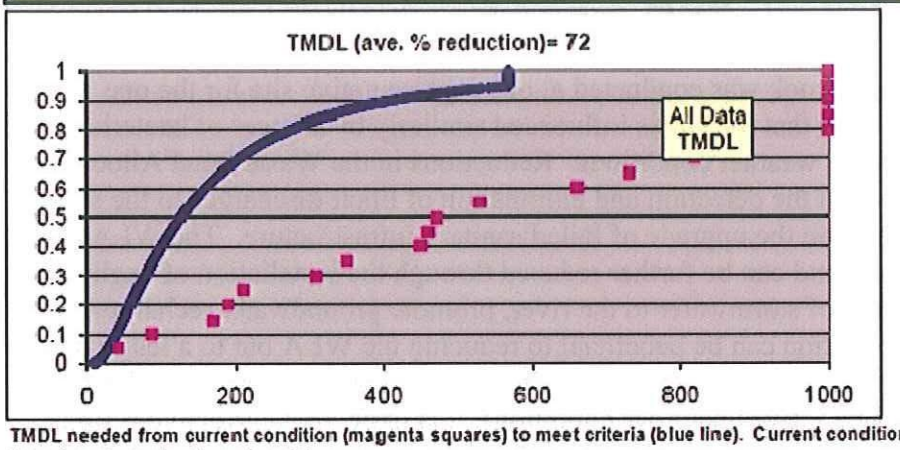
# Samples DRY	15
# Samples WET	5
# Samples Total	20
Geomean	510
Log std deviation	0.4802

Avg % Reduction

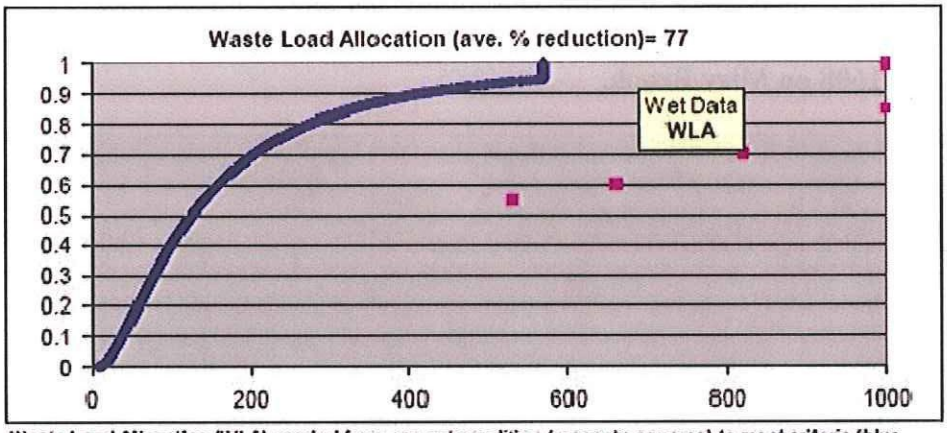
Wet (WLA)	77
Dry (LA)	71
Total (TMDL)	72

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. **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.

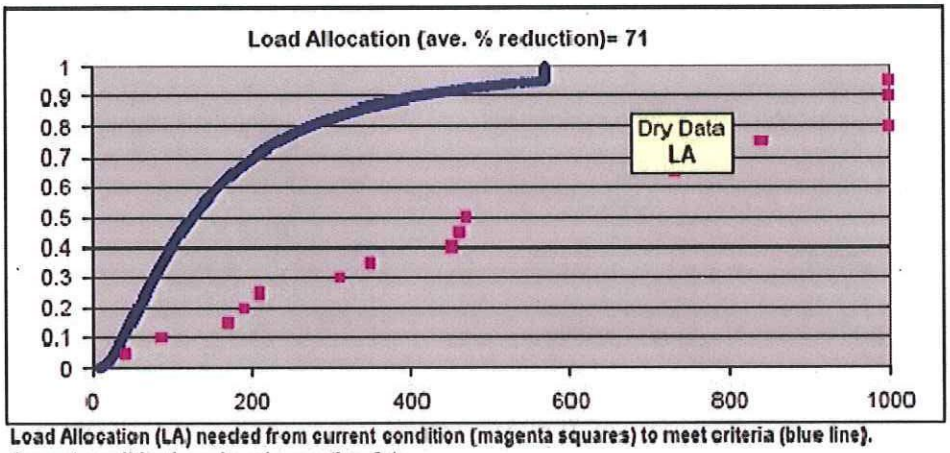
Miry Brook Criteria Curve for Monitoring Site 1608
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-2
Miry Brook
TMDL Summary

The TMDL analysis for Miry Brook was conducted at one representative site for the one segment. The analysis indicates that the site is influenced similarly by sources of bacteria active under both wet weather and dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. This action can be beneficial to reducing the WLA but to a lesser degree than those formerly mentioned given the conditions. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include as domestic animal waste, wildlife, and stormwater input as sheet flow.

Downstream view at Site 1608 on Miry Brook.

Appendix B-3
Kohanza Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Kohanza Brook
Waterbody Segment IDs: CT6602-00_01
Waterbody Description: From the confluence with Padanaram Brook, upstream to Ridgewood Country Club Pond outlet, Danbury.
Waterbody Segment Size: 1.14 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class A

Watershed Description:
Total Drainage Basin Area: 4,185 Acres
Subregional Basin Name & Code: Kohanza Brook, 6602
Regional Basin: Still
Major Basin: Housatonic River Basin
Watershed Towns: Danbury
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	4.2
Forest	43.4
Urban	42.2
Water	10.2

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

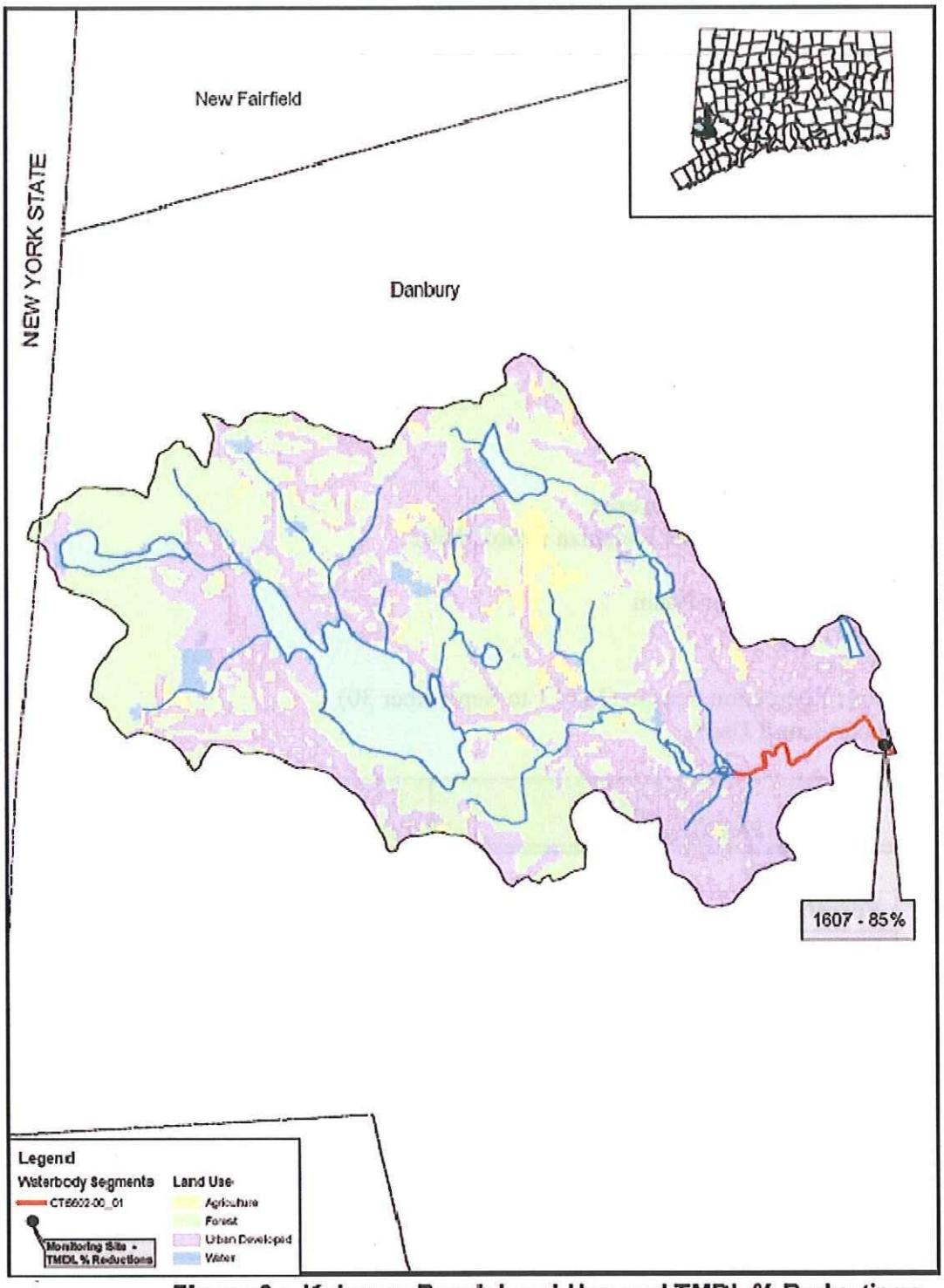


Figure 6 : Kohanza Brook Land Use and TMDL % Reductions

Map Data: CTDEP
Map Created: July 2008

Kohanza Brook
CT6602-00_01

Data Used in the Analysis

Monitoring Site: 1607, Kohanza Brook - at downstream side of Route 37 (North Street) crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.43	0.46	WET	310	4.0	0.1905	56	82
6/20/05	0.00	0.00	0.24	DRY	320	5.0	0.2381	65	80
7/6/05	0.31	0.31	0.32	WET	1200	14.0	0.6667	167	84
7/20/05	0.00	2.93	2.97	WET	760	11.0	0.5238	133	82
8/3/05	0.00	0.00	0.01	DRY	2900	16.5	0.7857	261	91
8/17/05	0.00	0.00	1.38	DRY	2900	16.5	0.7857	261	91
8/31/05	0.00	0.00	0.00	DRY	11000	21.0	1.0000	576	95
9/14/05	0.00	0.00	0.01	DRY	760	9.5	0.4524	113	85
9/27/05	0.24	0.24	0.26	WET	1800	15.0	0.7143	212	88
5/3/06	0.08	0.09	0.09	DRY	260	3.0	0.1429	47	82
5/20/06	0.08	0.08	0.09	DRY	4000	18.0	0.8571	337	92
7/27/06	0.00	0.00	0.01	DRY	710	8.0	0.3810	95	87
9/28/06	0.00	0.00	0.77	DRY	680	7.0	0.3333	85	88
5/17/07	0.00	0.01	0.01	DRY	380	6.0	0.2857	75	80
6/19/07	0.00	0.00	0.00	DRY	5100	19.0	0.9048	421	92
6/26/07	0.00	0.00	0.00	DRY	990	13.0	0.6190	167	83
7/17/07	0.00	0.03	0.11	DRY	760	9.5	0.4524	113	85
8/22/07	0.77	0.92	0.93	WET	980	12.0	0.5714	149	83
9/11/07	0.00	0.00	0.00	DRY	7700	20.0	0.9524	576	93
9/13/07	0.00	0.00	0.00	DRY	170	2.0	0.0952	38	78
9/26/07	0.00	0.00	0.00	DRY	85	1.0	0.0476	27	68

Statistics

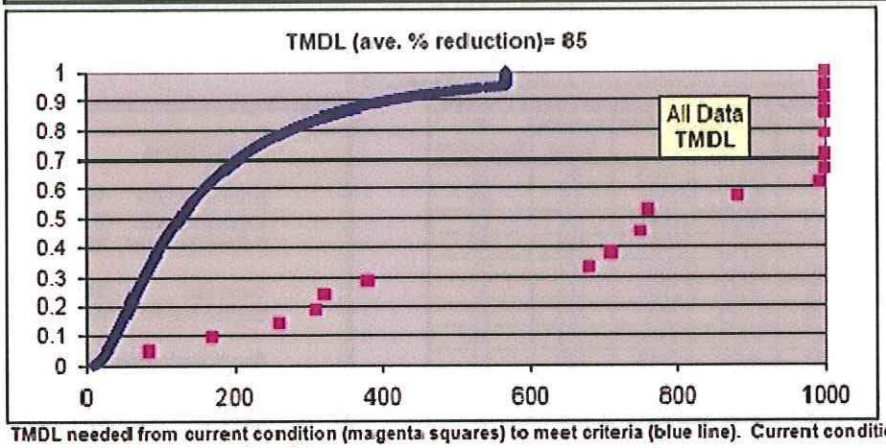
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	989
Log std deviation	0.5519

Avg % Reduction

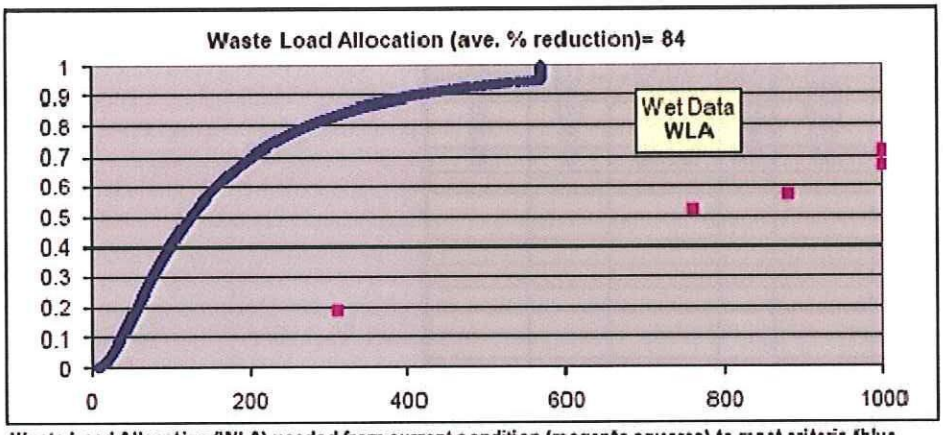
Wet (WLA)	84
Dry (LA)	85
Total (TMDL)	85

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

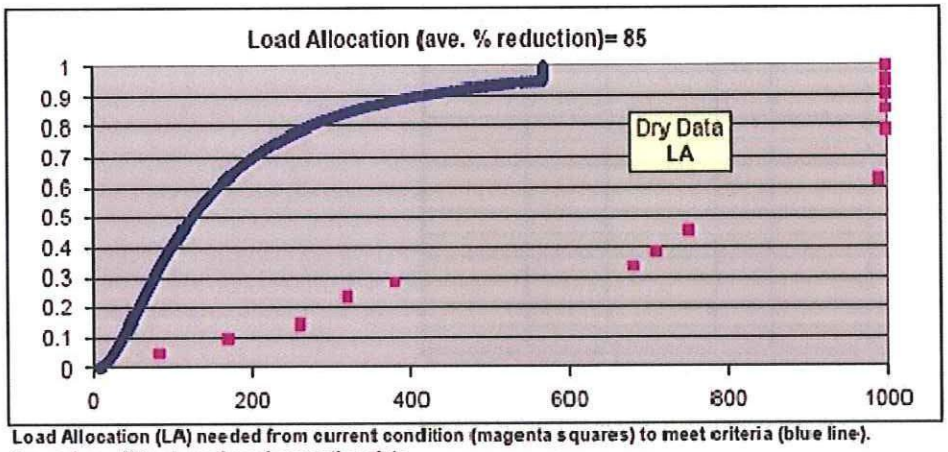
Kohanza Brook Criteria Curve for Monitoring Site 1607
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-3
Kohanza Brook
TMDL Summary

The TMDL analysis for Kohanza Brook was conducted at one representative site for segment CT6602-00_01. The analysis indicates that the site is influenced equally by sources of bacteria active under both wet weather and dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. This action can be beneficial to reducing the WLA but to a lesser degree than those formerly mentioned given the conditions. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include as domestic animal waste, wildlife, and stormwater input as sheet flow.

Downstream view at Site 1607 on Kohanza Brook.

Appendix B-4
Padanaram Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Padanaram Brook
Waterbody Segment IDs: CT6603-00_01
Waterbody Description: From the confluence with the Still River, upstream to headwaters at Padanaram Reservoir outlet, Danbury.
Waterbody Segment Size: 3.71 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class A

Watershed Description:
Total Drainage Basin Area: 4,651 Acres
Subregional Basin Name & Code: Padanaram Brook, 6603
Regional Basin: Still
Major Basin: Housatonic River Basin
Watershed Towns: Danbury, New Fairfield
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use:

Land Cover Category	Percent Composition
Agriculture	5.2
Forest	38.8
Urban	46.8
Water	9.2

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

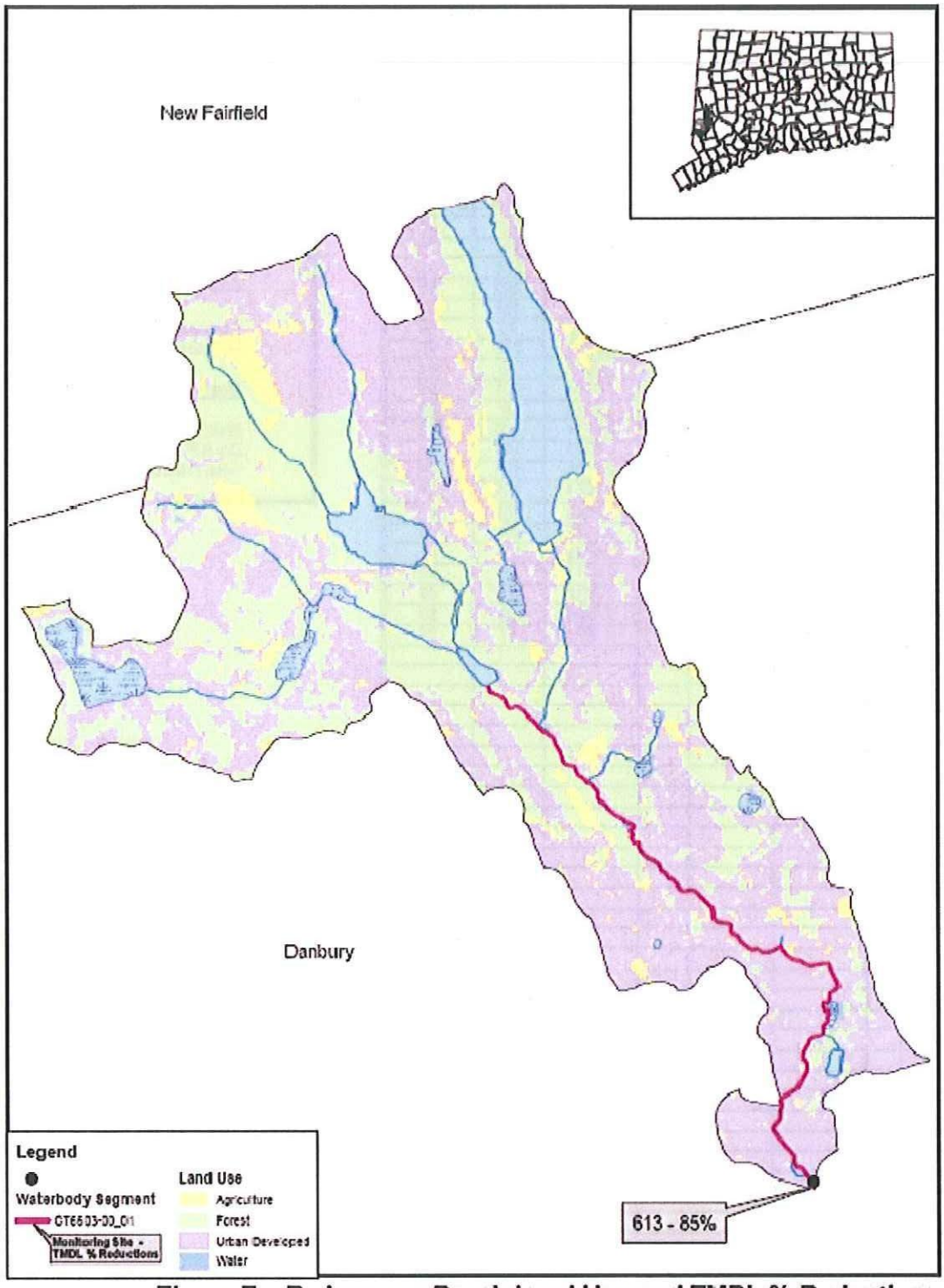


Figure 7 : Padanaram Brook Land Use and TMDL % Reductions

Padanaram Brook
CT6603-00_01

Data Used in the Analysis

Monitoring Site: 613, Padanaram Brook - upstream Crosby Road crossing across from Lee Hartel Drive

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col/100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	500	5.0	0.2381	65	87
6/20/05	0.00	0.00	0.24	DRY	960	14.5	0.6905	199	79
7/6/05	0.31	0.31	0.32	WET	6900	20.0	0.9524	576	92
7/20/05	0.00	2.95	2.97	WET	1900	17.0	0.8095	282	85
8/3/05	0.00	0.00	0.01	DRY	930	13.0	0.6190	167	82
8/17/05	0.00	0.00	1.36	DRY	600	6.0	0.2857	75	88
8/31/05	0.00	0.00	0.00	DRY	8200	21.0	1.0000	576	93
9/14/05	0.00	0.00	0.01	DRY	230	2.0	0.0952	38	84
9/27/05	0.24	0.24	0.26	WET	6500	19.0	0.9048	421	94
5/3/06	0.08	0.09	0.09	DRY	85	1.0	0.0476	27	68
6/20/06	0.08	0.08	0.09	DRY	810	12.0	0.5714	149	82
7/27/06	0.00	0.00	0.01	DRY	960	14.5	0.6905	199	79
8/28/06	0.00	0.00	0.77	DRY	770	10.5	0.5000	126	84
5/17/07	0.00	0.01	0.01	DRY	770	10.5	0.5000	126	84
6/19/07	0.00	0.00	0.00	DRY	750	8.5	0.4048	101	87
6/26/07	0.00	0.00	0.00	DRY	680	7.0	0.3333	85	88
7/17/07	0.00	0.03	0.11	DRY	750	8.5	0.4048	101	87
8/22/07	0.77	0.92	0.93	WET	2700	18.0	0.8571	337	88
9/11/07	0.00	0.00	0.00	DRY	1400	16.0	0.7619	243	83
9/13/07	0.00	0.00	0.00	DRY	410	4.0	0.1905	56	86
9/26/07	0.00	0.00	0.00	DRY	400	3.0	0.1429	47	88

Statistics

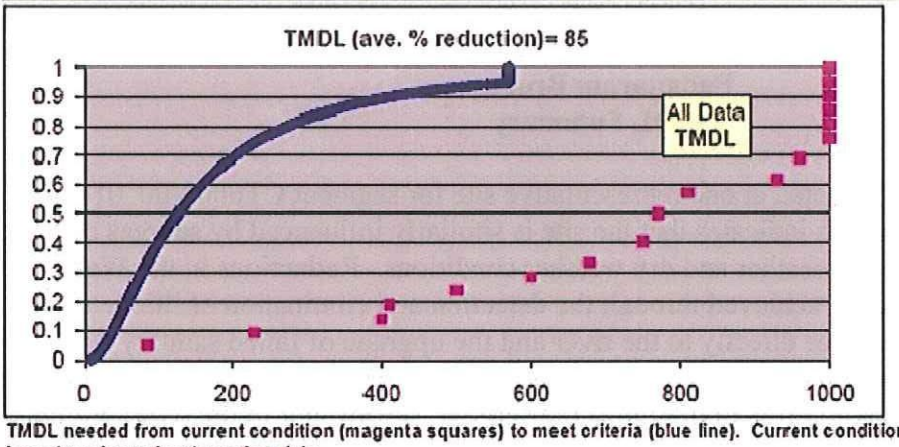
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	957
Log std deviation	0.4782

Avg % Reduction

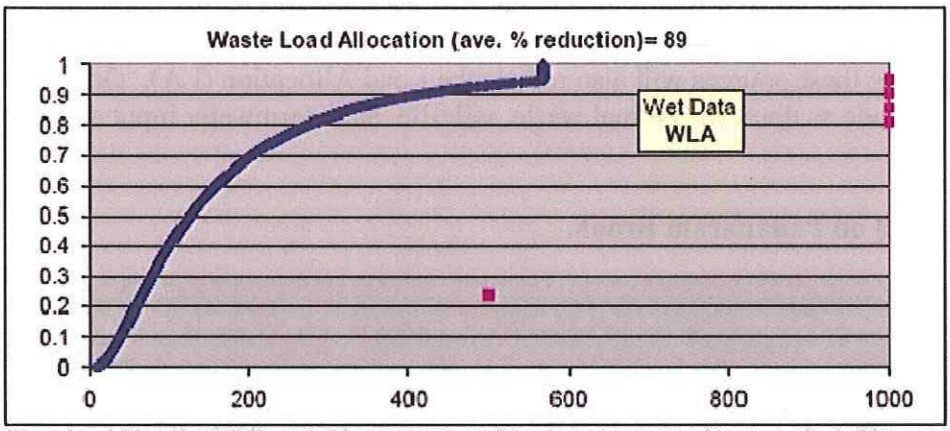
Wet (WLA)	89
Dry (LA)	84
Total (TMDL)	85

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

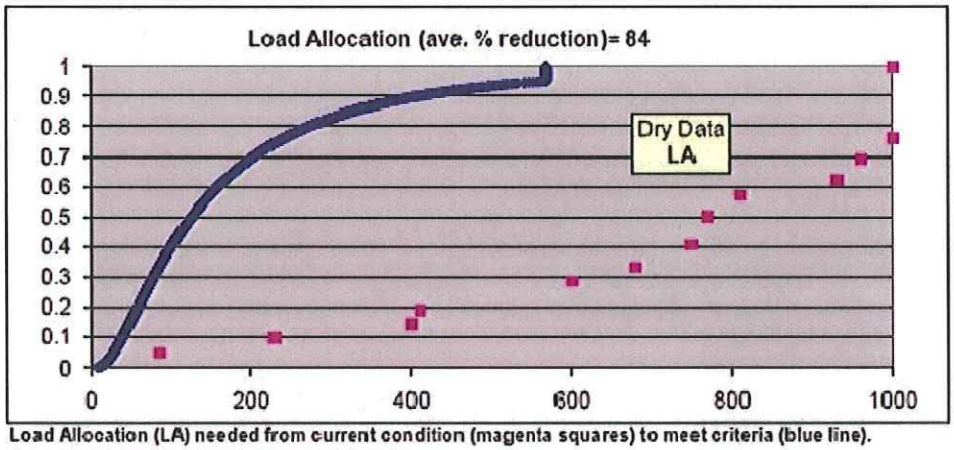
Padanaram Brook Criteria Curve for Monitoring Site 613
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-4
Padanaram Brook
TMDL Summary

The TMDL analysis was conducted at one representative site for segment CT6603-00_01 on Padanaram Brook. The analysis indicates that the site is similarly influenced by sources of bacteria active under both wet weather and dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. This action can be beneficial to reducing the WLA but to a lesser degree than those formerly mentioned. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include as domestic animal waste, wildlife, and stormwater input as sheet flow.

Upstream view at Site 613 on Padanaram Brook.

Appendix B-5
Sympaug Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Sympaug Brook
Waterbody Segment IDs: CT6604-00_01
Waterbody Description: From Greatpasture Road crossing downstream to the confluence with the Still River (Naugatuck).
Waterbody Segment Size: 0.60 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class B

Watershed Description:
Total Drainage Basin Area: 4,638 Acres
Subregional Basin Name & Code: Sympaug Brook, 6604
Regional Basin: Still River
Major Basin: Housatonic River Basin
Watershed Towns: Danbury, Bethel, Redding
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	4.8
Forest	48.9
Urban	40.8
Water	5.5

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

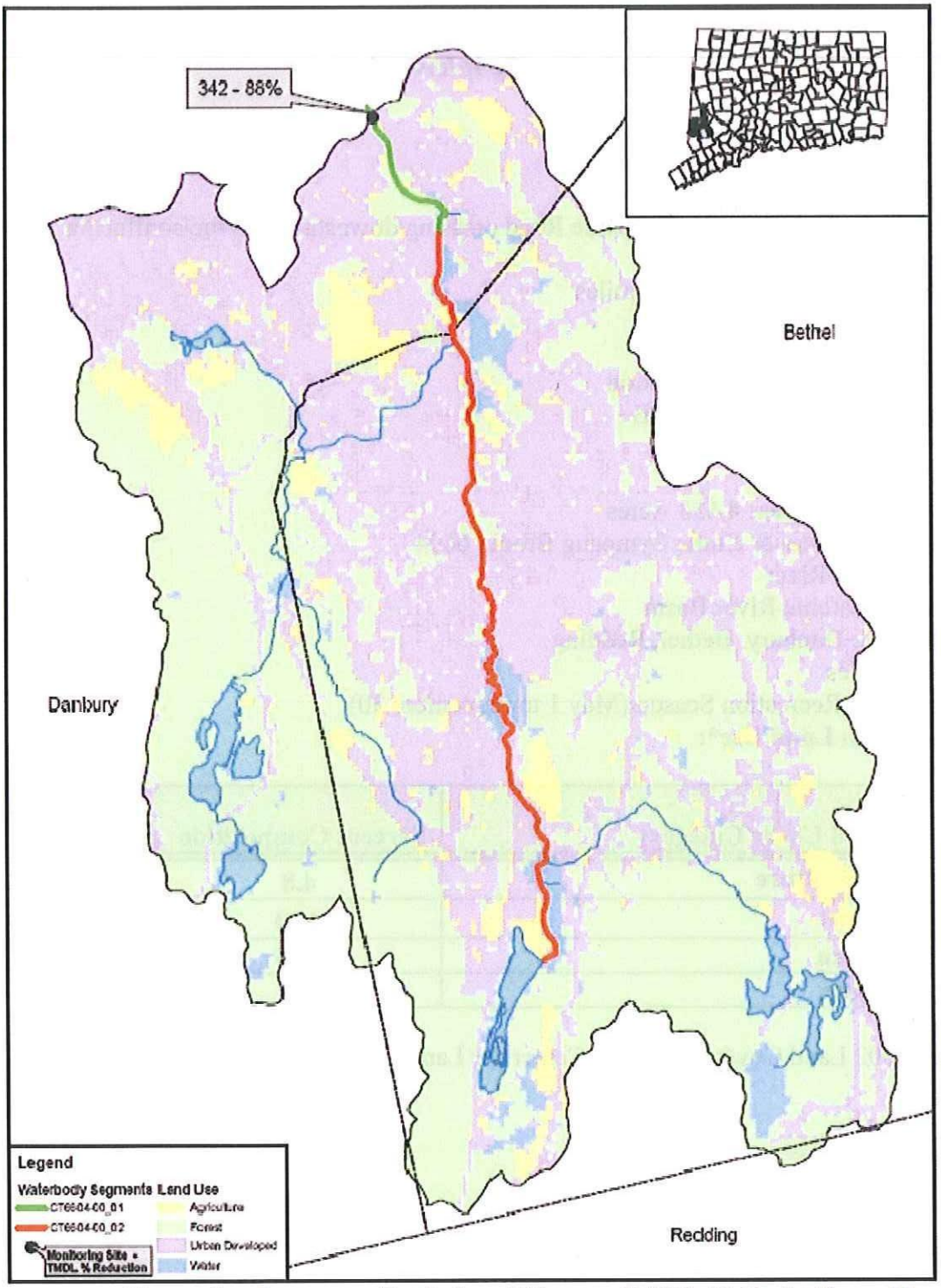


Figure 8 : Sympaug Basin Land Use and TMDL % Reductions Map

Map Data: CTDEP
Map Created: July 2008

Sympaug Brook
CT6604-00_01

Data Used in the Analysis

Monitoring Site: 342, Symbaug Brook - at Shelter Rock road crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.43	0.46	WET	560	7.0	0.3333	85	85
6/20/05	0.00	0.00	0.24	DRY	1200	13.0	0.6190	167	86
7/6/05	0.31	0.31	0.32	WET	24000	20.5	0.9762	576	98
7/20/05	0.00	2.93	2.97	WET	1400	14.0	0.6667	187	87
8/3/05	0.00	0.00	0.01	DRY	730	9.0	0.4286	107	85
8/17/05	0.00	0.00	1.38	DRY	910	12.0	0.5714	149	84
8/31/05	0.00	0.00	0.00	DRY	2600	18.0	0.8571	337	87
9/14/05	0.00	0.00	0.01	DRY	590	8.0	0.3810	95	84
9/27/05	0.24	0.24	0.26	WET	11400	19.0	0.9048	421	96
5/3/06	0.08	0.09	0.09	DRY	2200	15.0	0.7143	212	90
5/20/06	0.08	0.08	0.09	DRY	770	11.0	0.5238	133	83
7/27/06	0.00	0.00	0.01	DRY	470	4.0	0.1905	56	88
8/28/06	0.00	0.00	0.77	DRY	2200	15.0	0.7143	212	90
5/17/07	0.00	0.01	0.01	DRY	480	5.0	0.2381	65	86
6/19/07	0.00	0.00	0.00	DRY	750	10.0	0.4762	119	84
6/26/07	0.00	0.00	0.00	DRY	420	3.0	0.1429	47	89
7/17/07	0.00	0.03	0.11	DRY	400	2.0	0.0952	38	91
9/22/07	0.77	0.92	0.93	WET	2400	17.0	0.8095	262	88
9/11/07	0.00	0.00	0.00	DRY	24000	20.5	0.9762	576	98
9/13/07	0.00	0.00	0.00	DRY	540	6.0	0.2857	75	86
9/26/07	0.00	0.00	0.00	DRY	290	1.0	0.0476	27	91

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

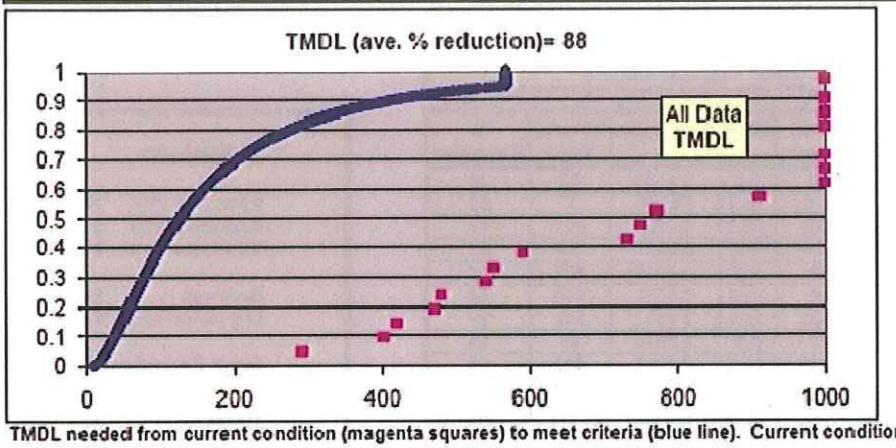
Statistics

# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	1300
Log std deviation	0.5600

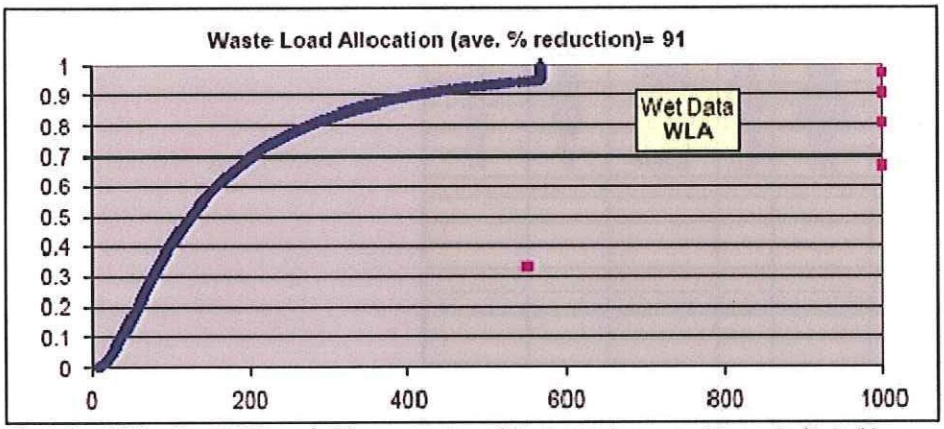
Avg % Reduction

Wet (WLA)	91
Dry (LA)	88
Total (TMDL)	88

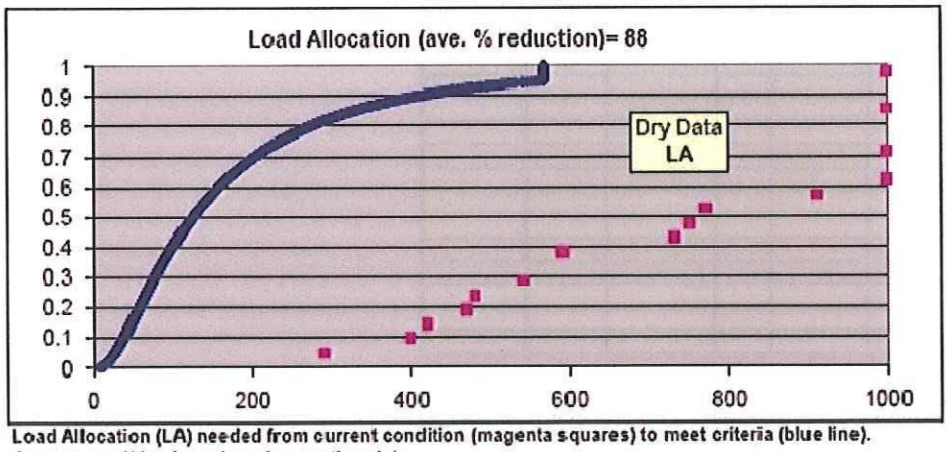
Sympaug Brook Criteria Curve for Monitoring Site 342
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

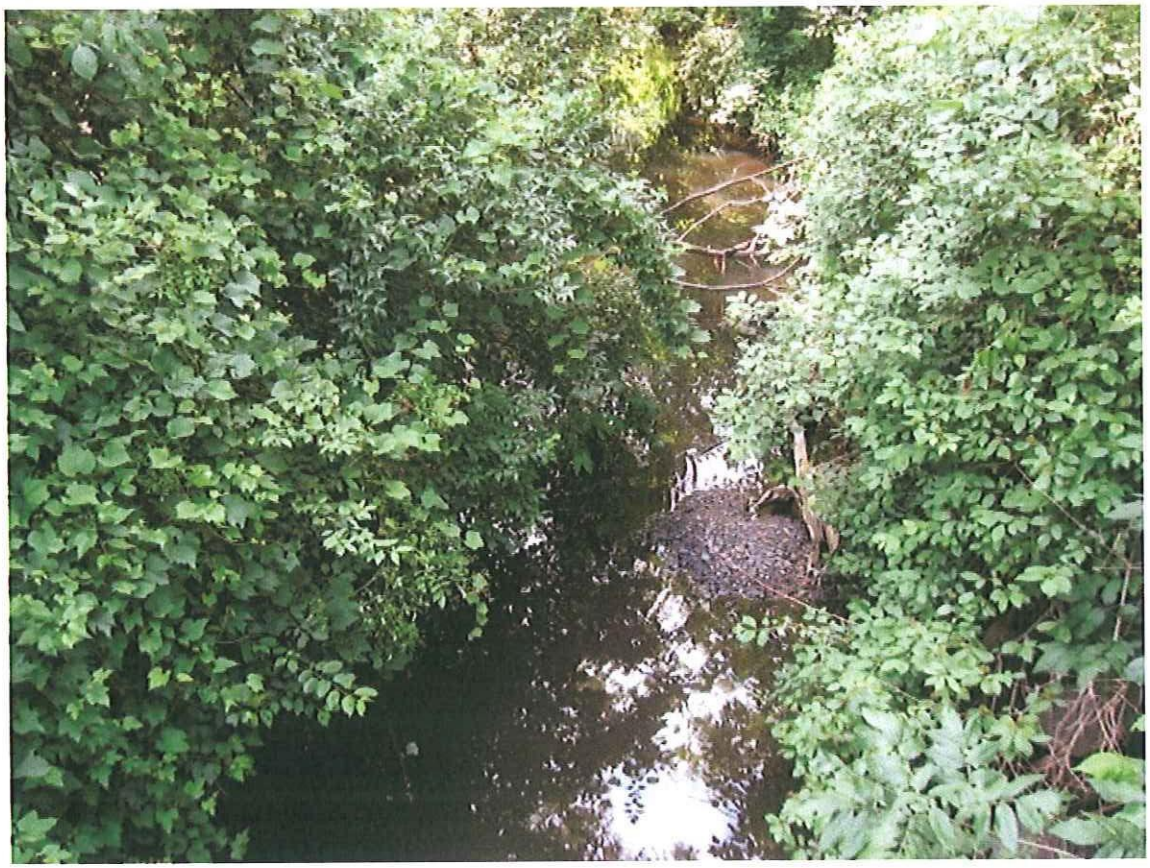


Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Appendix B-5
Sympaug Brook
TMDL Summary

The TMDL analysis for Sympaug Brook was conducted at one site, which is representative of one river segment. The analysis indicates that the site is influenced equally by sources of bacteria active under both wet weather and dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. This action can be beneficial to reducing the WLA but to a lesser degree than those formerly mentioned. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include as domestic animal waste, wildlife, and stormwater input as sheet flow.

Downstream view at Site 342 on Sympaug Brook.



Appendix B-6
East Swamp Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: East Swamp Brook
Waterbody Segment IDs: CT6605-00_01
Waterbody Description: From confluence of Wolf Pit Brook downstream to the confluence with the Limekiln Brook.
Waterbody Segment Size: 2.34 linear miles

Impairment Description:
Designated Use Impairment: Recreation
Surface Water Classification: Class A

Watershed Description:
Total Drainage Basin Area: 3,273 Acres
Subregional Basin Name & Code: East Swamp Brook, 6605
Regional Basin: Still River
Major Basin: Housatonic River Basin
Watershed Towns: Bethel, Danbury, Redding
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	7.8
Forest	62.5
Urban	26.1
Water	3.6

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

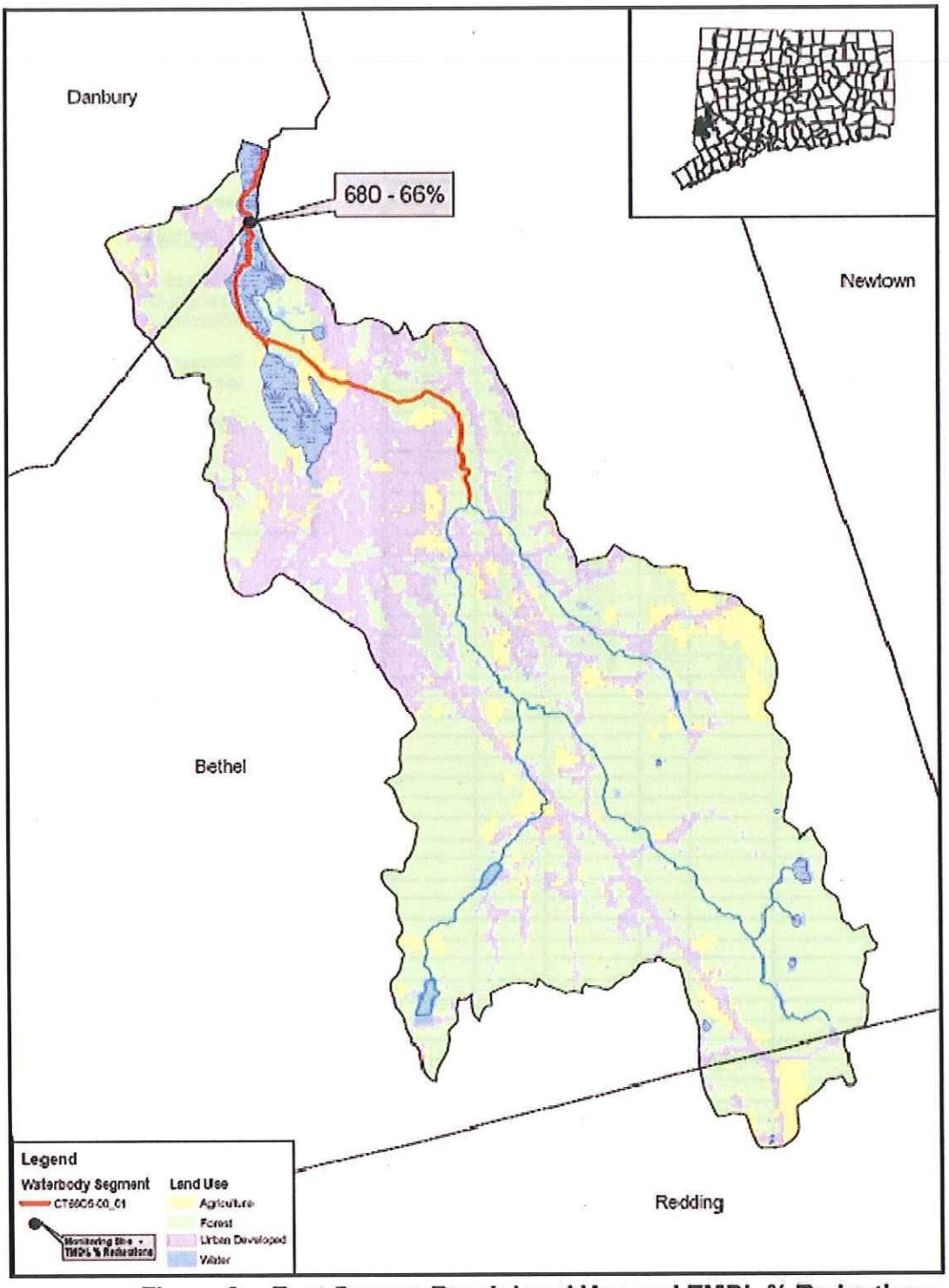


Figure 9 : East Swamp Brook Land Use and TMDL % Reductions

East Swamp Brook
CT6605-00_01

Data Used in the Analysis

Monitoring Site: 680, East Swamp Brook - at Shelter Rock Road

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.45	WET	270	8.5	0.4048	101	63
6/20/05	0.00	0.00	0.24	DRY	220	7.0	0.3333	85	61
7/6/05	0.31	0.31	0.32	WET	13000	20.0	0.9524	676	96
7/20/05	0.00	2.95	2.97	WET	1900	18.0	0.8571	337	82
8/3/05	0.00	0.00	0.01	DRY	170	3.0	0.1429	47	72
8/17/05	0.00	0.00	1.38	DRY	98	2.0	0.0952	38	62
8/31/05	0.00	0.00	0.00	DRY	450	15.0	0.7143	212	53
9/14/05	0.00	0.00	0.01	DRY	30	1.0	0.0476	27	10
9/27/05	0.24	0.24	0.25	WET	290	10.0	0.4762	119	59
5/3/06	0.06	0.09	0.09	DRY	190	4.5	0.2143	61	68
6/20/06	0.06	0.06	0.09	DRY	1000	17.0	0.8095	282	72
7/27/06	0.00	0.00	0.01	DRY	310	11.0	0.5238	133	57
8/28/06	0.00	0.00	0.77	DRY	6500	19.0	0.9048	421	94
5/17/07	0.00	0.01	0.01	DRY	630	16.0	0.7619	243	61
6/19/07	0.00	0.00	0.00	DRY	190	4.5	0.2143	61	68
6/26/07	0.00	0.00	0.00	DRY	210	6.0	0.2857	75	64
7/17/07	0.00	0.03	0.11	DRY	270	8.5	0.4048	101	63
8/22/07	0.77	0.92	0.93	WET	24000	21.0	1.0000	676	98
9/11/07	0.00	0.00	0.00	DRY	400	13.0	0.6190	167	58
9/13/07	0.00	0.00	0.00	DRY	430	14.0	0.6667	187	56
9/26/07	0.00	0.00	0.00	DRY	390	12.0	0.5714	149	62

Statistics

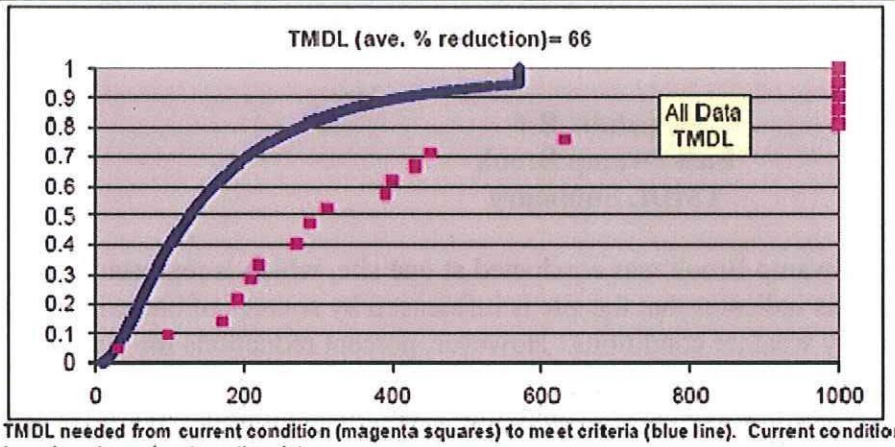
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	496
Log std deviation	0.6932

Avg % Reduction

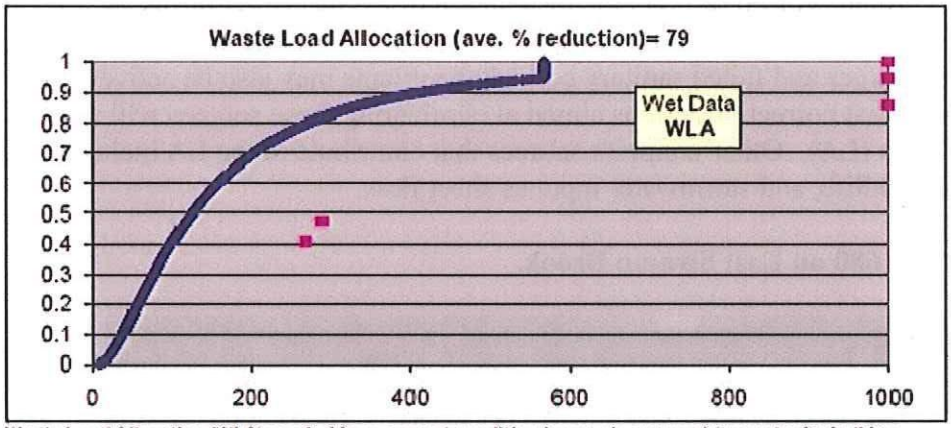
Wet (WLA)	79
Dry (LA)	61
Total (TMDL)	66

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

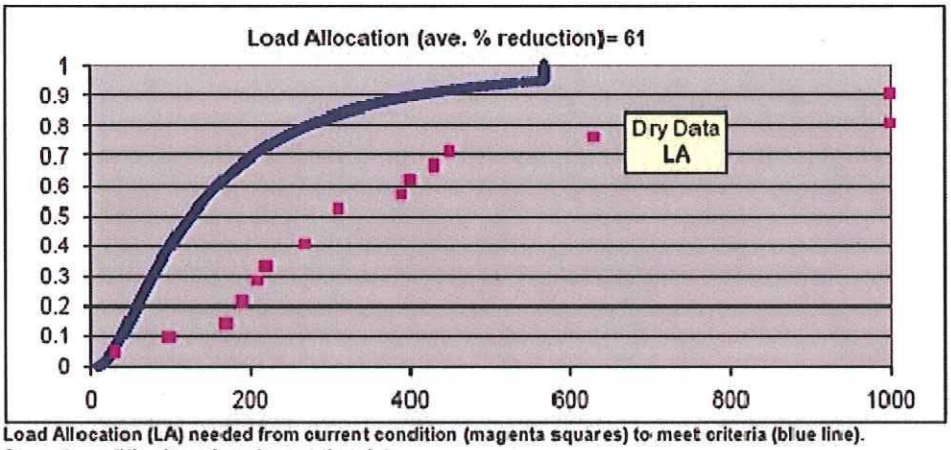
East Swamp Brook Criteria Curve for Monitoring Site 680
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-6
East Swamp Brook
TMDL Summary

The TMDL analysis for East Swamp Brook was conducted at one site, which is representative of one river segment. The analysis indicates that the site is influenced by sources of bacteria active under both wet weather and dry weather conditions. However, percent reductions for wet weather conditions were found to be higher than dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other nonpoint sources that contribute to the LA include domestic animal waste, wildlife, and stormwater input as sheet flow.

Downstream view at Site 680 on East Swamp Brook.

Appendix B-7
Limekiln Brook
Waterbody Specific Information

Impaired Waterbody
Waterbody Name: Limekiln Brook
Waterbody Segment IDs: CT6606-00_01
Waterbody Description: From confluence with Danbury WPCF outfall downstream to the confluence with the Still River.
Waterbody Segment Size: 0.45 linear miles

Impairment Description:
Designated Use Impairment: Recreation, Aquatic Life Support
Surface Water Classification: Class B

Watershed Description:
Total Drainage Basin Area: 5,421 Acres
Subregional Basin Name & Code: Limekiln Brook, 6606
Regional Basin: Naugatuck
Major Basin: Housatonic River Basin
Watershed Towns: Brookfield, Danbury, Bethel, Newtown
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	12.4
Forest	42
Urban	40.9
Water	4.7

*Data Source: 2002 Land Cover, CLEAR - Center for Land Use Education and Research.

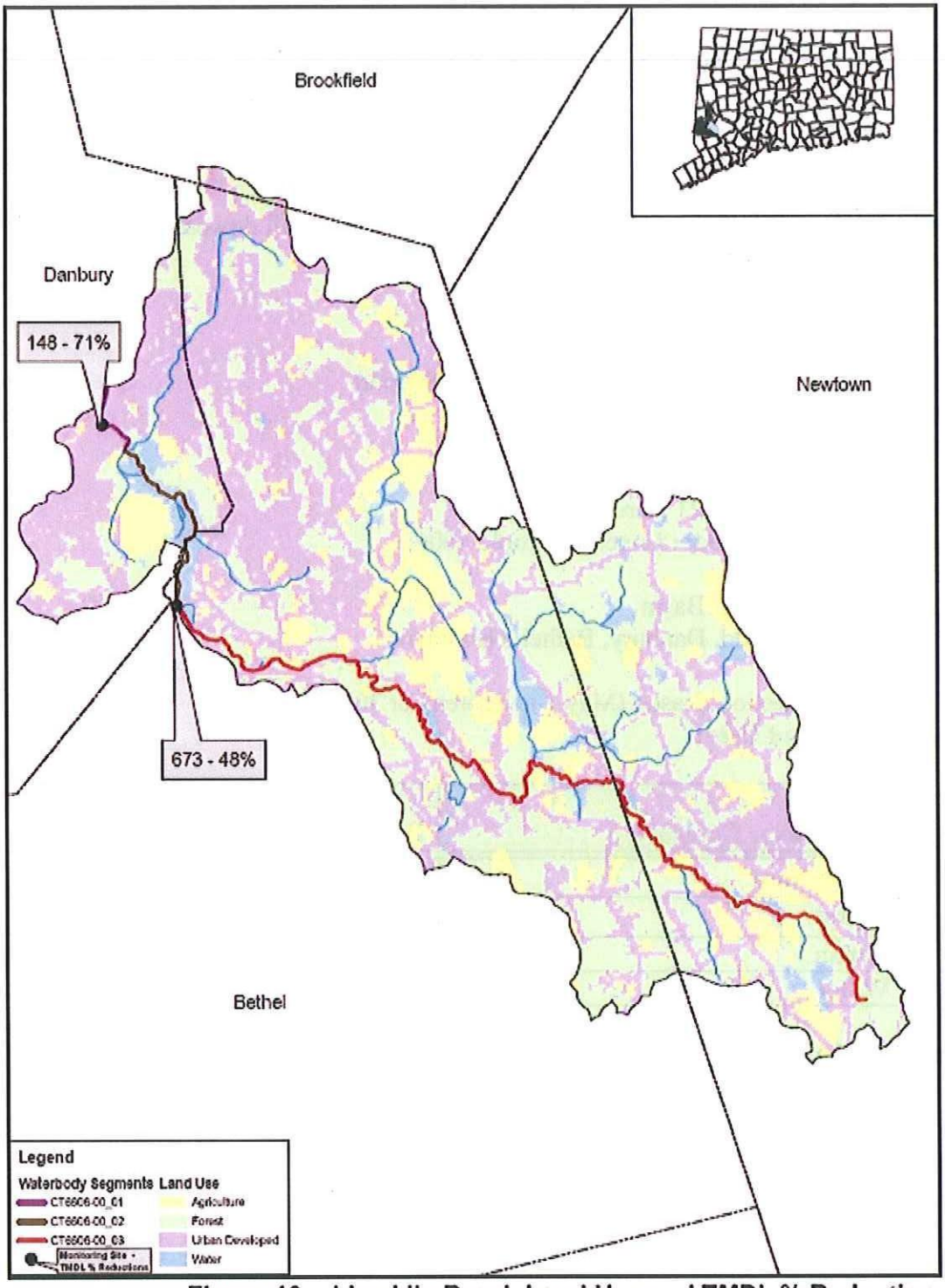


Figure 10 : Limekiln Brook Land Use and TMDL % Reductions

Limekiln Brook
CT6606-00_01

Data Used in the Analysis

Monitoring Site: 148, Limekiln Brook - upstream side of Route 6 Crossing

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	520	14.0	0.6667	187	64
6/20/05	0.00	0.00	0.24	DRY	260	9.0	0.4286	107	59
7/6/05	0.31	0.31	0.32	WET	2800	18.0	0.8571	337	88
7/20/05	0.00	2.98	2.97	WET	460	13.0	0.6190	167	64
8/3/05	0.00	0.00	0.01	DRY	200	6.5	0.2619	70	65
8/17/05	0.00	0.00	1.38	DRY	260	9.0	0.4286	107	59
8/31/05	0.00	0.00	0.00	DRY	4100	19.0	0.9048	421	90
9/14/05	0.00	0.00	0.01	DRY	200	6.5	0.2619	70	65
9/27/05	0.24	0.24	0.25	WET	260	7.0	0.3333	85	68
5/3/06	0.09	0.09	0.09	DRY	86	1.0	0.0476	27	68
6/20/06	0.08	0.08	0.09	DRY	260	9.0	0.4286	107	59
7/27/06	0.00	0.00	0.01	DRY	96	2.0	0.0952	38	62
8/26/06	0.00	0.00	0.77	DRY	1200	16.0	0.7619	243	80
5/17/07	0.00	0.01	0.01	DRY	1000	15.0	0.7143	212	79
6/19/07	0.00	0.00	0.00	DRY	24001	21.0	1.0000	576	98
6/26/07	0.00	0.00	0.00	DRY	20000	20.0	0.9524	576	97
7/17/07	0.00	0.03	0.11	DRY	330	11.0	0.5238	133	60
8/22/07	0.77	0.92	0.93	WET	1600	17.0	0.8095	252	84
9/11/07	0.00	0.00	0.00	DRY	400	12.0	0.5714	149	63
9/13/07	0.00	0.00	0.00	DRY	140	3.0	0.1429	47	66
9/26/07	0.00	0.00	0.00	DRY	160	4.0	0.1905	56	63

Statistics

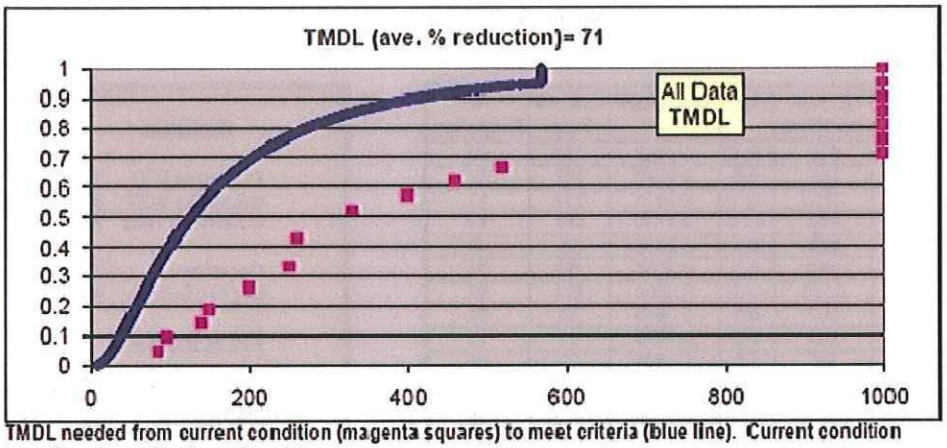
# Samples DRY	16
# Samples WET	5
# Samples Total	21
Geomean	582
Log std deviation	0.6927

Avg % Reduction

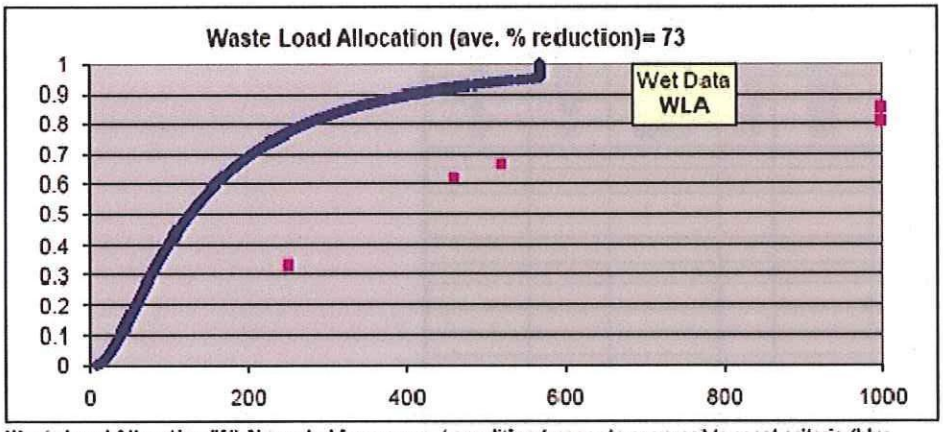
Wet (WLA)	73
Dry (LA)	71
Total (TMDL)	71

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

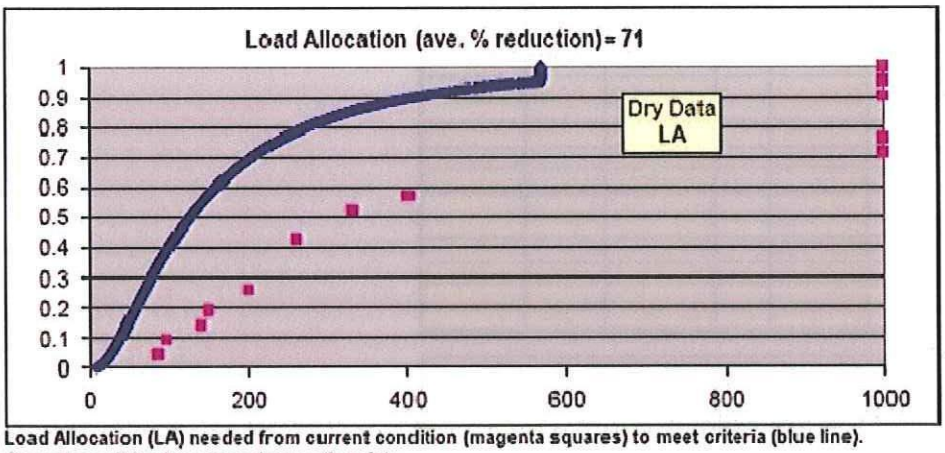
Limekiln Brook Criteria Curve for Monitoring Site 148
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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.

Limekiln Brook
CT6606-00_03

Data Used in the Analysis

Monitoring Site: 673, Limekiln Brook - upstream at Shelter Rock Road

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/8/05	0.00	0.45	0.46	WET	31	2.0	0.0465	27	13
6/20/05	0.00	0.00	0.24	DRY	74	7.0	0.1628	51	31
7/6/05	0.31	0.31	0.32	WET	11000	43.0	1.0000	576	95
7/20/05	0.00	2.96	2.97	WET	1200	38.5	0.8953	400	67
8/3/05	0.00	0.00	0.01	DRY	120	11.5	0.2674	71	41
8/17/05	0.00	0.00	1.38	DRY	220	23.0	0.5349	137	38
8/31/05	0.00	0.00	0.00	DRY	1200	38.5	0.8953	400	67
9/14/05	0.00	0.00	0.01	DRY	85	9.0	0.2093	60	30
9/27/05	0.24	0.24	0.25	WET	340	27.0	0.6279	170	50
5/3/06	0.08	0.09	0.09	DRY	31	2.0	0.0465	27	13
6/1/06	0.27	0.27	0.27	WET	160	16.0	0.3721	93	42
6/14/06	0.00	0.00	0.01	DRY	490	30.0	0.6977	203	59
6/20/06	0.08	0.08	0.09	DRY	41	4.0	0.0930	37	9
6/29/06	0.25	1.76	2.36	WET	1500	40.0	0.9302	491	67
7/12/06	0.03	0.03	0.04	DRY	430	28.0	0.6512	180	58
7/19/06	0.14	0.14	0.15	WET	760	33.0	0.7674	247	68
7/26/06	0.00	0.00	0.01	DRY	150	14.5	0.3372	86	43
7/27/06	0.00	0.00	0.01	DRY	200	20.5	0.4767	119	40
8/2/06	0.00	0.00	0.00	DRY	150	14.5	0.3372	86	43
8/9/06	0.00	1.42	4.26	WET	320	26.0	0.6047	161	50
8/14/06	0.00	0.01	0.01	DRY	170	17.5	0.4070	101	40
8/23/06	0.01	0.01	0.52	DRY	210	22.0	0.5116	129	38
9/28/06	0.00	0.00	0.77	DRY	3100	42.0	0.9767	576	81
5/17/07	0.00	0.01	0.01	DRY	580	32.0	0.7442	231	60
6/6/07	0.00	0.00	1.35	DRY	230	24.5	0.5698	148	36
6/12/07	0.05	0.18	0.23	DRY	460	29.0	0.6744	191	58
6/19/07	0.00	0.00	0.00	DRY	180	19.0	0.4419	110	39
6/26/07	0.00	0.00	0.00	DRY	230	24.5	0.5698	148	36
6/27/07	0.00	0.00	0.00	DRY	1170	37.0	0.8605	341	71
7/5/07	0.95	1.32	1.32	WET	2600	41.0	0.9535	576	78
7/10/07	0.00	0.00	0.24	DRY	170	17.5	0.4070	101	40
7/17/07	0.00	0.03	0.11	DRY	120	11.5	0.2674	71	41
7/17/07	0.00	0.03	0.11	DRY	74	7.0	0.1628	51	31
7/25/07	0.00	0.00	1.20	DRY	200	20.5	0.4767	119	40
8/2/07	0.00	0.00	0.02	DRY	63	5.0	0.1163	42	33
8/9/07	0.01	0.73	0.73	WET	570	31.0	0.7209	216	62
8/22/07	0.77	0.92	0.93	WET	1100	35.0	0.8140	287	74
8/30/07	0.00	0.00	0.00	DRY	74	7.0	0.1628	51	31
9/6/07	0.00	0.00	0.00	DRY	31	2.0	0.0465	27	13
9/11/07	0.00	0.00	0.00	DRY	780	34.0	0.7907	266	66
9/13/07	0.00	0.00	0.00	DRY	140	13.0	0.3023	78	44
9/13/07	0.00	0.00	0.00	DRY	110	10.0	0.2326	64	42
9/26/07	0.00	0.00	0.00	DRY	1120	36.0	0.8372	312	72

Statistics

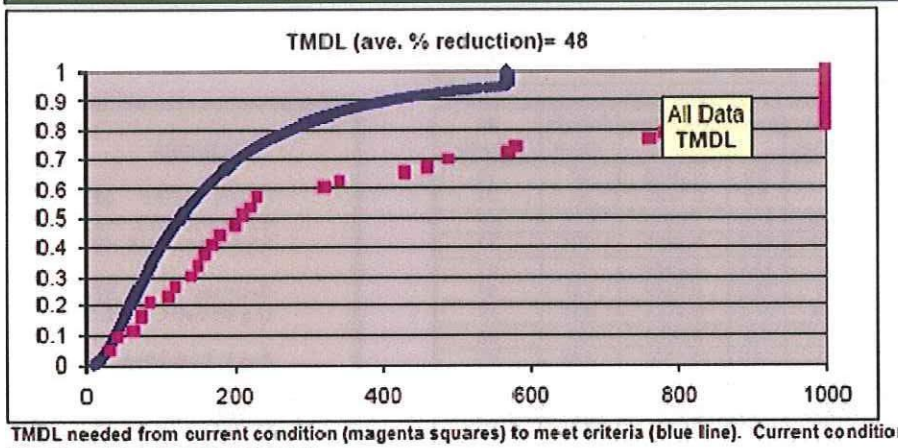
# Samples DRY	32
# Samples WET	11
# Samples Total	43
Geomean	273
Log std deviation	0.5732

Avg % Reduction

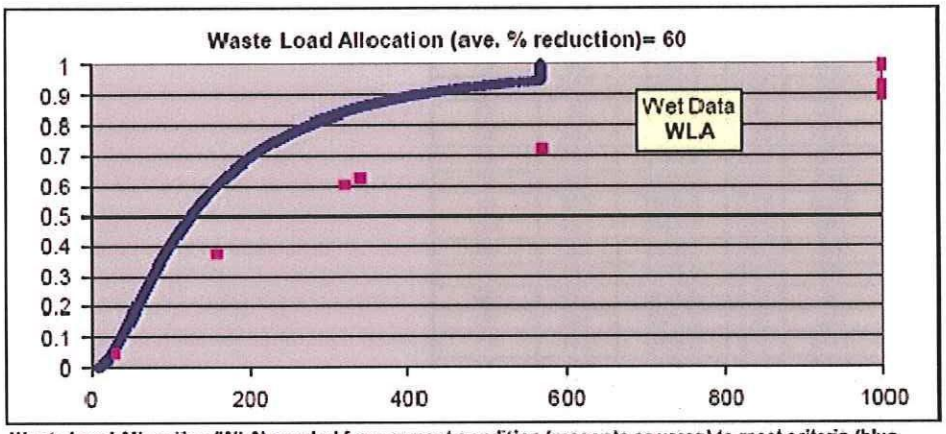
Wet (WLA)	60
Dry (LA)	43
Total (TMDL)	48

Precipitation data provided by the National Weather Service and CTDEP. E. coli data provided by CTDEP. 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.

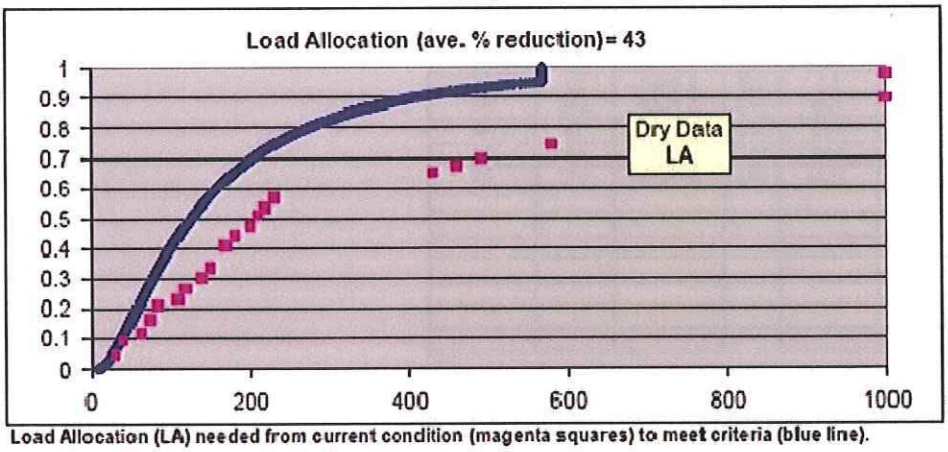
Limekiln Brook Criteria Curve for Monitoring Site 673
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



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 B-7
Limekiln Brook
TMDL Summary

The TMDL analysis for Limekiln Brook was conducted at two sites, which is representative of two river segments. The analysis indicates that the sites are influenced by sources of bacteria active under both wet weather and dry weather conditions. Percent reductions for wet weather conditions at Site 148 were found to be slightly higher than dry weather conditions. However, percent reductions for wet weather conditions were found to be significantly higher at Site 673 compared to dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers or directly to the river. The WLA also includes regulated stormwater and can be further reduced through the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality. Since illicit discharges and failed sanitary collection systems may also be active under dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other nonpoint sources that contribute to the LA include domestic animal waste, wildlife, and stormwater input as sheet flow.

Upstream view at Site 148 on Limekiln Brook.

Downstream view at Site 673 on Limekiln Brook.

Appendix C. Municipal Stormwater alternative monitoring guidance

Guidance for Implementing Bacteria-based TMDLs within the CTDEP Stormwater Permitting Program

CTDEP investigates impaired waterbodies to determine the major causes of impairment. This information is expressed as Total Maximum Daily Load (TMDL). TMDLs provide the framework for restoring impaired waters by establishing the maximum amount of a pollutant that a waterbody can take in without adverse impact to fish, wildlife, recreation, or other public uses. If a TMDL includes requirements for control of stormwater discharges it is the responsibility of the municipalities within the watershed to implement the recommendations of the TMDL (typically bacteria reduction). Management of stormwater quality within the municipality is governed by the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit).

The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the state. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures.

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within 4 months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established within the TMDL. For the discharges to the TMDL waterbody(ies), the municipality must assess the six minimum measures of its plan and modify the plan to implement additional, necessary controls for each appropriate measure. Particular focus should be placed on the following plan components: public education program, illicit discharge detection and elimination, stormwater structures cleaning, priority for the repair, upgrade, or retrofit of storm sewer structures. The goal of the modifications is to establish a program to improve water quality consistent with the requirements of the TMDL. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of CTDEP for review and approval.

Also required under the MS4 General Permit is annual stormwater monitoring. The permit provides a general framework for monitoring stormwater quality within a municipality. At minimum, stormwater from six sample locations are to be collected annually: two outfalls from commercial areas, two from industrial areas, and two from residential areas. These six sample locations are point source discharges that drain areas with distinct characteristics. Each

stormwater sample is tested for 12 parameters using methods prescribed in Title 40, CFR, Part 136.

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

However, CTDEP encourages municipalities affected by the establishment of a TMDL to develop an alternative stormwater monitoring plan to assess progress in meeting the goals of the TMDL. Alternate monitoring programs are established in accordance with Section 6(h)(1)(B) of the MS4 permit which allows towns to submit written requests to the Commissioner for the review and approval of alternate stormwater monitoring plans of equivalent or greater scope. This gives towns freedom to develop a plan that better assesses the stormwater quality in their watershed. 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. Monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. In order to secure DEP approval, 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.

DEP strongly recommends that stream monitoring be performed at the same locations DEP sampled during TMDL development. Samples should also be collected at other key locations within the watershed, such as above and below potential contributing sources or areas slated for BMP implementation. Since watershed borders and TMDLs do not follow town borders there is a possibility DEP did not sample locations in your town. If this is the case collecting a sample where the waterbody enters your town and another where the waterbody leaves your town maybe helpful to determine how stormwater from your town influences water quality. In all cases, 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.

Appendix D. Cumulative Frequency Distribution Function Method

DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR INDICATOR BACTERIA IN CONTACT RECREATION AREAS USING THE CUMULATIVE FREQUENCY DISTRIBUTION FUNCTION METHOD

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Mary E. Becker, Environmental Analyst
CT Department of Environmental Protection
Total Maximum Daily Load Program

Last revised: November 8, 2005

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 surface waters. 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 indicator bacteria (*Escherichia coli*) are represented by a statistical distribution of the geometric mean 126 and log standard deviation 0.4 for purposes of the 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 wet weather allocation and dry weather allocation components by quantifying the contribution of ambient monitoring data collected during periods of high stormwater influence and minimal stormwater influence to the current condition. The partition is used to determine the effect of high stormwater influence on the contribution of sources to the waterbody. 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 waters that are identified as impaired on the *List of Connecticut Water Bodies Not Meeting Water Quality Standards* [1]. It is expected that implementation of these TMDLs will be accomplished through implementing the provisions of the Small Municipal Separate Storm Sewer System general permit (MS4 permit) [2] in designated urban areas, as well as through measures that address non-point sources. The method as described here 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, *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

Connecticut's adopted water quality criteria for the indicator bacteria *Escherichia coli (E.coli)* in the CT Water Quality Standards [4] include a geometric mean and upper confidence limit (i.e. single sample maximum), which are based on three recreational use categories. The categories include designated swimming, non-designated swimming, and all other recreational uses. 'Designated swimming' includes areas that have been designated by State or Local authorities. 'Non-designated swimming' includes waters suitable for swimming but have not been designated by State or Local authorities, as well as water that support recreational activities where full body contact is likely, such as tubing or water skiing. 'All other recreational uses' include waters that support recreational activities where full body contact is infrequent, such as fishing, boating, kayaking, and wading. The recreational uses and applicable criteria are provided in the following table.

Recreational Use Category	Indicator Bacteria	Geometric Mean	Single Sample Maximum Upper Confidence Limit
Designated Swimming	*E.coli*	126col/100mls	235col/100mls 75th Percentile
Non-designated Swimming			410col/100mls 90th Percentile
All Other Recreational Uses			576col/100mls 95th Percentile

Table 1. Applicable indicator bacteria (*E.coli*) water quality criteria for recreational uses

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 235 col/100mls, 410 col/100mls, and 576 col/100mls adopted by Connecticut represents the 75th, 90th, and 95th percentile upper confidence limit, respectively, for a statistical distribution of data with a geometric mean of 126 and a log standard deviation of 0.4 as recommended by EPA [5].

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.

Connecticut's adopted criteria 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 figures 1a through1c for each of the specified recreational uses in Connecticut's bacteria criteria.

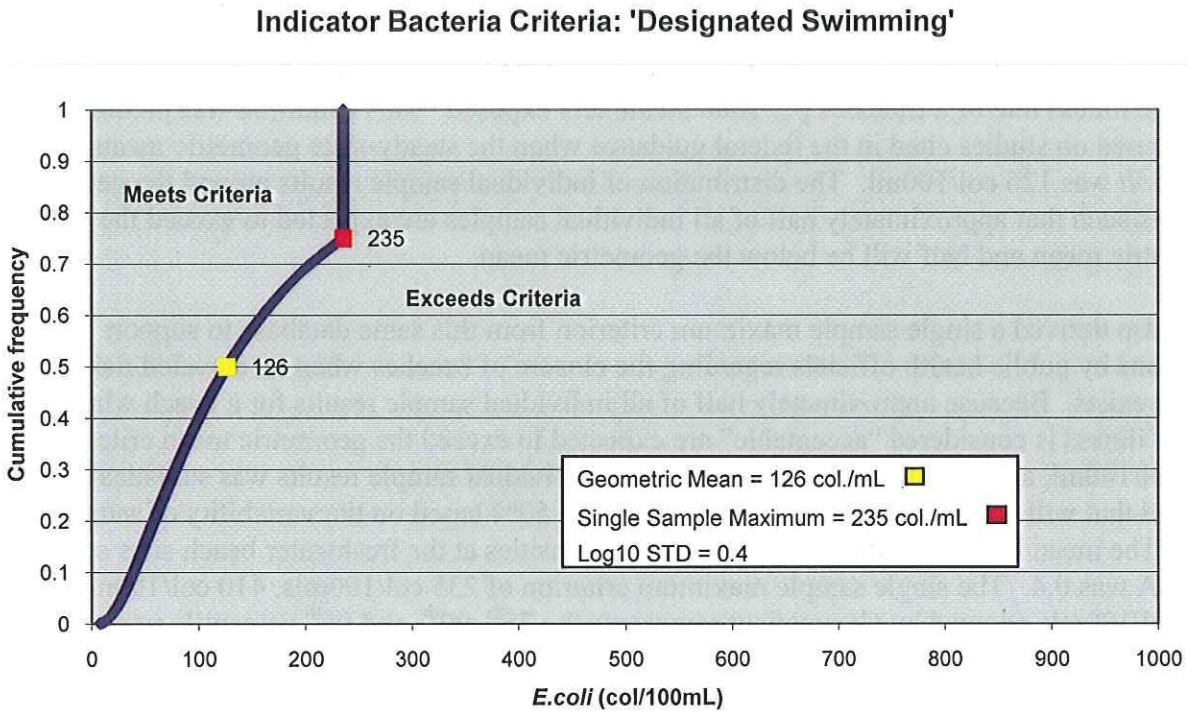

Figure 1a. Cumulative Relative Frequency Distribution representing water quality to support designated swimming use.

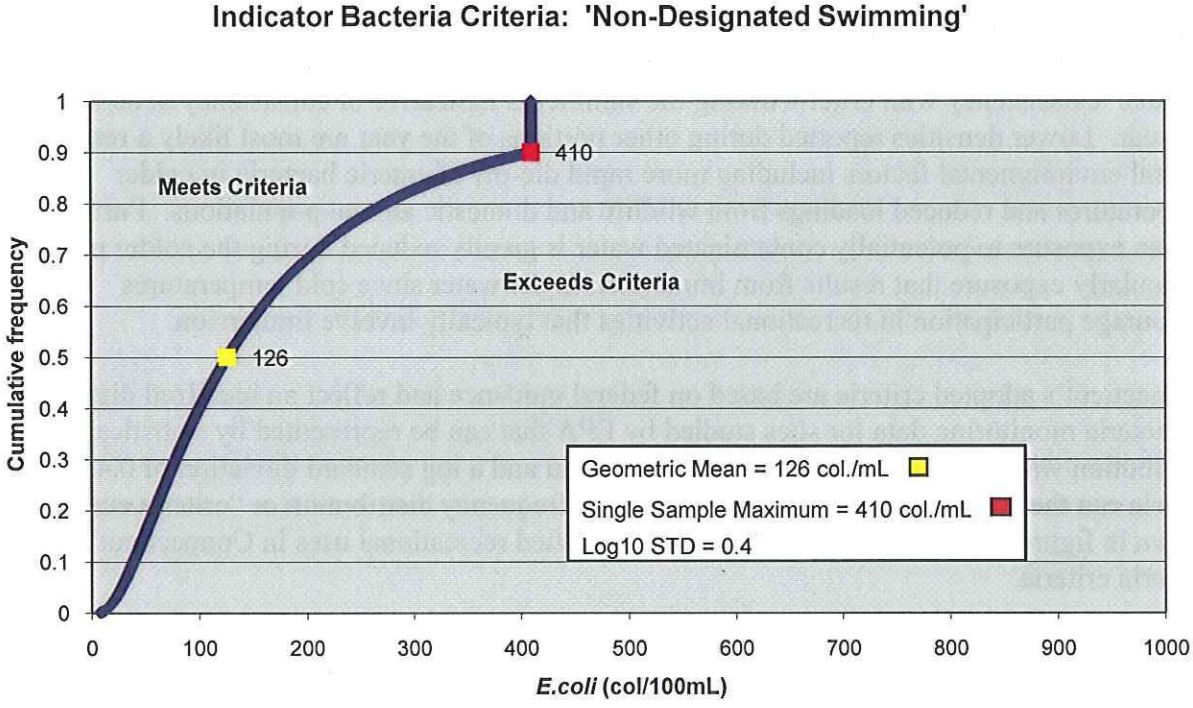

Figure 1b. Cumulative Relative Frequency Distribution representing water quality to support non-designated swimming use.

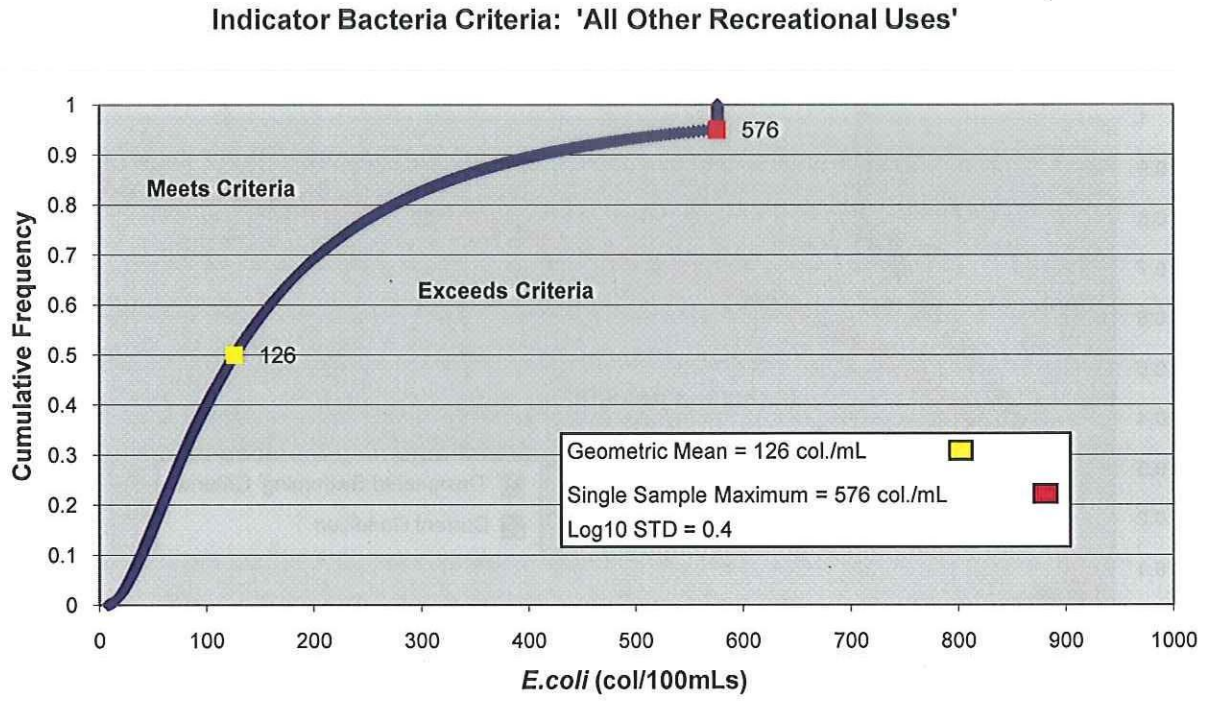

Figure 1c. Cumulative Relative Frequency Distribution representing water quality criteria to support all other recreational uses.

TMDL

As with the cumulative relative frequency curves representing the criteria shown in Figure 1a through 1c, 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 Figures 2a through 2c. 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.

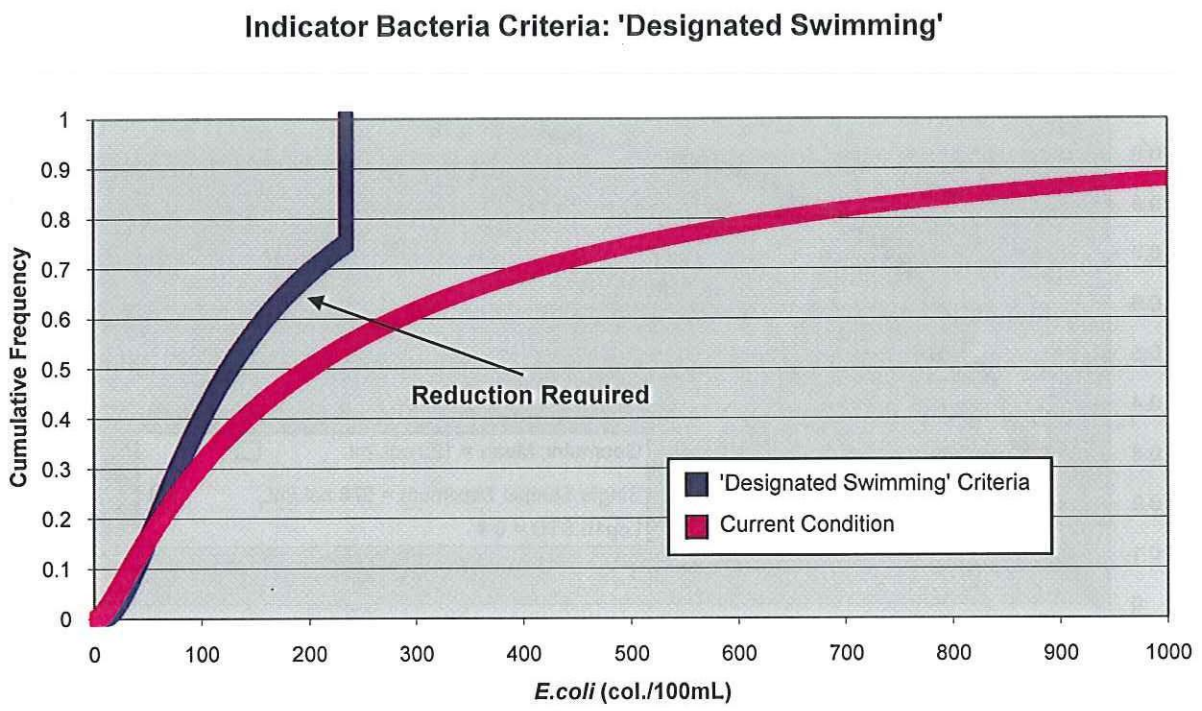

Figure 2a. Reduction indicator bacteria density needed from current condition to meet 'designated swimming' criteria based on cumulative relative frequency distribution.

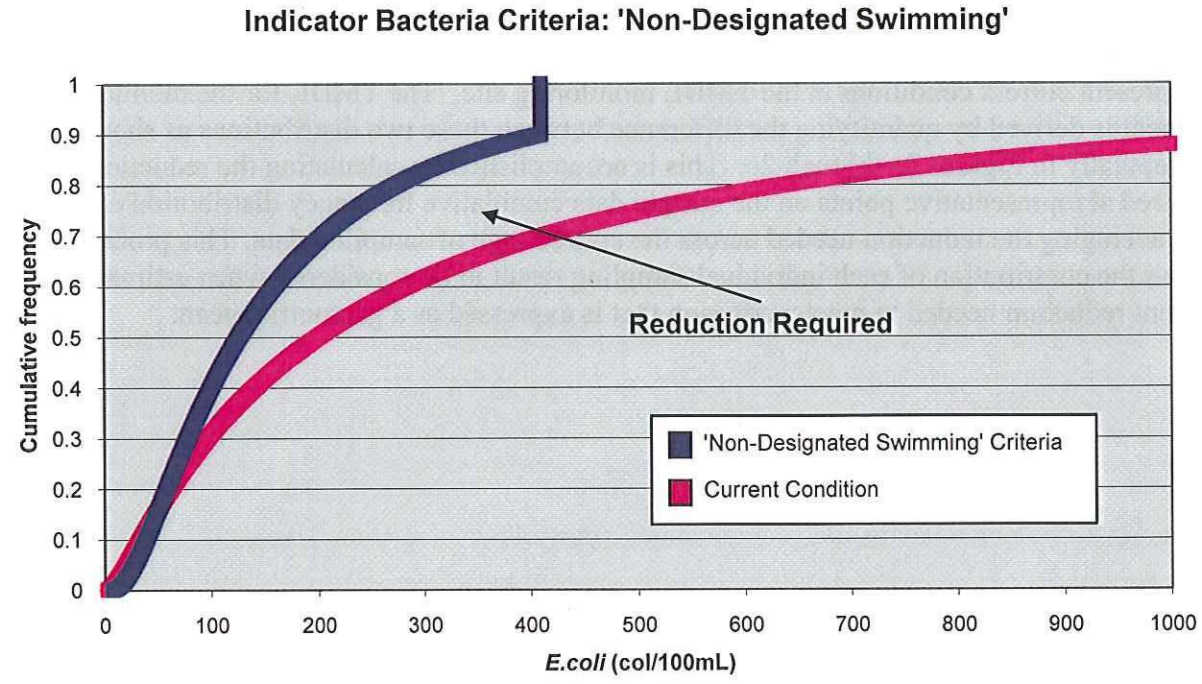

Figure 2b. Reduction indicator bacteria density needed from current condition to meet 'non-designated swimming' criteria based on cumulative relative frequency distribution.

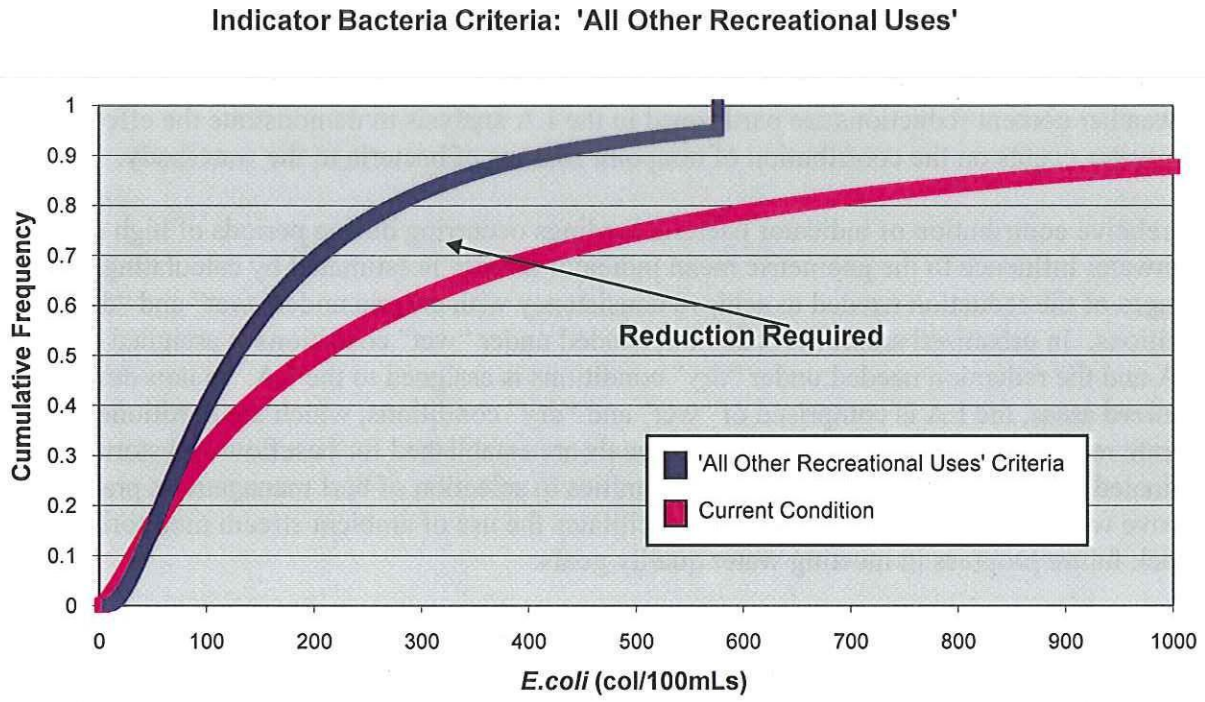

Figure 2c. Reduction indicator bacteria density needed from current condition to meet 'all other recreational uses' criteria based on cumulative relative frequency distribution.

TMDL ALLOCATIONS

Federal regulations require that the TMDL analysis identify the portion of the total loading which is allocated to point source discharges and the portion attributed to non-point sources, which contribute that pollutant to the waterbody. Stormwater runoff is considered a point source subject to regulation under the NPDES permitting program in designated urbanized areas. Designated urban areas, as defined by the US Census Bureau [7], 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. 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. 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.

A WLA for stormwater discharges is not warranted in non-designated urbanized areas and in waterbody segments where there are no stormwater outfalls. As such, sources of bacteria in these waterbodies segments are attributed solely to nonpoint sources. However, wet weather and dry weather percent reductions are partitioned in the LA analysis to demonstrate the effect of stormwater events on the contribution of nonpoint sources of bacteria to the waterbody.

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. In urbanized areas, the reduction needed under "wet" conditions is assigned to the WLA and the reduction needed under "dry" conditions is assigned to the LA. In non-designated urbanized areas, the LA is comprised of "wet" and "dry" conditions, which are partitioned into separate reduction goals. 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 2). Some existing sources such as dry weather flows from stormwater collections systems, illicit discharges to stormwater systems, and combined sewer overflows are allocated "100 percent 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. The management goal for point sources in designated swimming areas is elimination when the source is determined to be the main contributor of bacteria to the swimming area. This is consistent with the United States Environmental Protection Agency's (EPA) advisory for swimmers to avoid areas with discharge pipes [8] and a recent study indicating an increased potential for health risk to people swimming in areas near storm drains [9].

Source	Critical Conditions	Assigned To
On-Site Septic	Baseflow (DRY)	LA
Domestic Animal	Baseflow (DRY)	LA
Natural (Wildlife)	Baseflow (DRY)	LA
Wastewater Treatment Plants	Baseflow (DRY)	WLA
Regulated Urban Runoff/Storm Sewers	Wet Weather Flow (WET)	WLA
Dry Weather Overflow	Baseflow (DRY)	None
Illicit Discharges	Baseflow (DRY)	None
Combined Sewer Overflow	Wet Weather Flow (WET)	None

Table 2: Establishing WLA and LA Pollutant Sources

MARGIN OF SAFETY

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 nonpoint 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 illicit discharges 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 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 five 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 according to the specified recreational use (designated swimming, non-designated swimming, or all other) in a waterbody segment from the statistical distribution used to represent the criteria following the procedure described in steps **3 - 6** below:

3.

Designated Swimming	**Non-Designated Swimming**	**All Other Recreational Uses**
If the sample proportion is ≥ 0.75, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (235 col/100ml)	If the sample proportion is ≥ 0.90, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (410 col/100ml)	If the sample proportion is ≥ 0.95, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (576 col/100ml)

4.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is less than 0.75, and greater than 0.50, the single sample criteria reference value is calculated as:	If the sample proportion is less than 0.90, and greater than 0.50, the single sample criteria reference value is calculated as:	If the sample proportion is less than 0.95, and greater than 0.50, the single sample criteria reference value is calculated as:

$$\textit{criteria reference value} = \text{antilog}_{10}\,[\log_{10} 126\ \text{col/100ml} + (F * 0.4)]$$

N.B. 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).

5.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is equal to 0.50, the single sample reference criteria value is equal to the geometric mean criterion adopted into the Water Quality Standards (126 col/100 ml)		

6.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is less than 0.50, the single sample reference criteria value is calculated as:		

$$\textit{criteria reference value} = \text{antilog}_{10}\,[\log_{10} 126\ \text{col/100ml} - (F * 0.4)]$$

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:

$$\textit{percent reduction} = [(\textit{monitoring result} - \textit{criteria reference value})/\textit{monitoring result}] * 100$$

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 – WET AND DRY WEATHER EVENTS

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, "wet" conditions are typically defined as greater than 0.1 inches precipitation in 24 hours or 0.25 inches precipitation in 48 hours, or 2.0 inches precipitation in 96 hours.

In designated urbanized areas 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.

In areas that do not have point sources, the average percent reduction for all sampling events used to derive the TMDL that are designated "wet" is computed as the wet weather LA, and the average percent reduction for all sampling events used to derive the TMDL that are designated as "dry" is computed as the dry weather LA.

ANALYTICAL PROCEDURE – SPREADSHEET MODEL

An Excel(tm) spreadsheet has been developed that performs all calculations necessary to derive a TMDL using this procedure. Copies of the spreadsheet in electronic form may be obtained from DEP by contacting Mary Becker at (860) 424-3262 or by email at mary.becker@ct.gov.

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.

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

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8. Environmental Protection Agency, 2004. http://www.epa.gov/beaches/.

9. Haile, RW et al, 1999. *The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff.* Epidemiology. 10 (4) 355-363.