# A Statewide Total Maximum Daily Load Analysis for Bacteria Impaired Waters

**FINAL - September 19, 2012**

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

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Connecticut Department of
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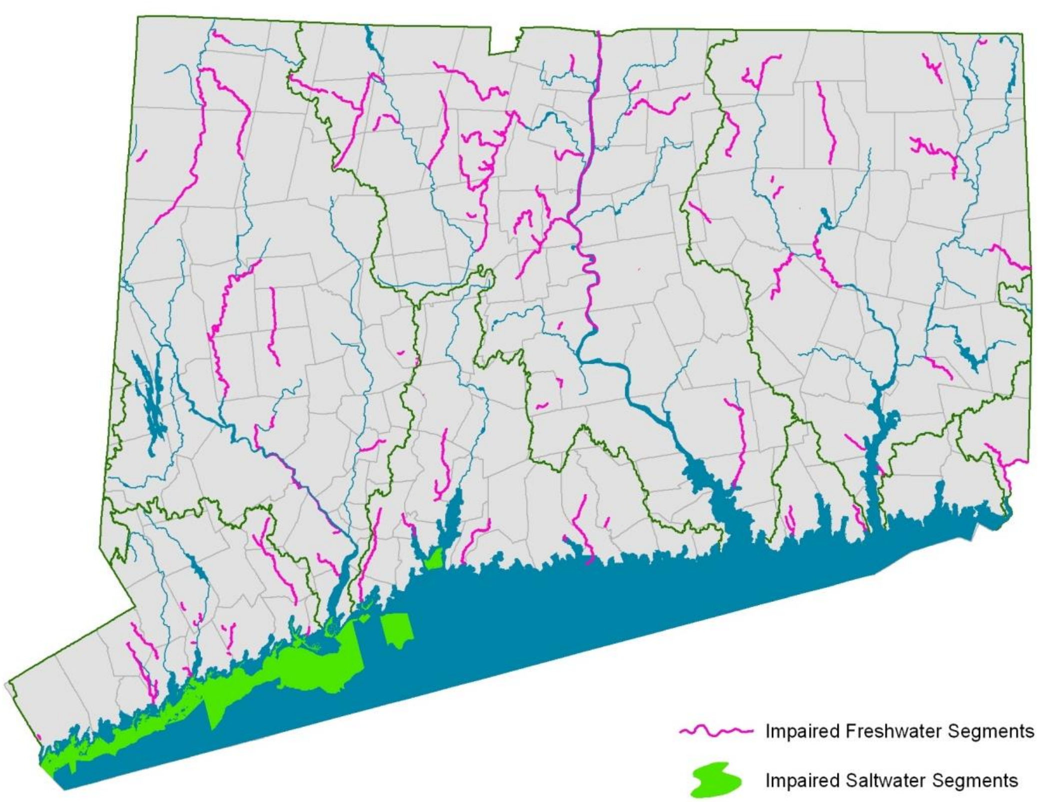
# Connecticut Statewide
# Total Maximum Daily Load (TMDL)

*for Bacteria-Impaired Waters*



# Connecticut Statewide
# Total Maximum Daily Load (TMDL)

## *for Bacteria Impaired Waters*

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| | |
|---|---|
| AFO | Animal Feeding Operation |
| AU | Assessment Unit |
| BMP | Best Management Practice |
| CALM | Consolidated Assessment and Listing Methodology |
| CDBG | Community Development Block Grant |
| CFR | Code of Federal Regulations |
| CNMP | Comprehensive Nutrient Management Plan |
| CSO | Combined Sewer Overflow |
| CT DEEP | Connecticut Department of Energy and Environmental Protection |
| CWA | Clean Water Act |
| CWF | Clean Water Fund |
| CWRP | Connecticut Corporate Wetlands Restoration Partnership |
| GM | Geometric Mean |
| GMWQS | Geometric Mean Water Quality Standard |
| HUC | Hydrologic Unit Code |
| IDDE | Illicit Discharge Detection and Elimination |
| LA | Load Allocation |
| LID | Low Impact Development |
| MOS | Margin of Safety |
| MS4 | Municipal Separate Storm Sewer Systems |
| MSD | Marine Sanitation Device |
| NA | Not Applicable |
| NDA | No Discharge Area |
| NOAA | National Oceanic & Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Non Point Source |
| NRCS | Natural Resource Conservation Service |
| NSSP | National Shellfish Sanitation Program |
| OBD | Overboard Discharge |
| PPP | Pollution Prevention Plan |
| PS | Point Source |
| SSO | Sanitary Sewer Overflow |
| SSWQS | Single Sample Water Quality Standard |
| SWMP | Stormwater Management Plan |
| TMDL | Total Maximum Daily Load |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USFDA | United States Food and Drug Administration |
| WLA | Waste Load Allocation |
| $WLA_c$ | Waste Load Allocation from continuous sources |
| WQS | Water Quality Standards |
| WWTP | Wastewater Treatment Plant |

# 1. Introduction

The *Connecticut Statewide Bacteria Total Maximum Daily Load (TMDL)* is designed to support action to reduce bacteria pollution and public health risk from waterborne disease-causing organisms in the surface waters of the State, including rivers and streams, impoundments, lakes, ponds, estuaries, and Long Island Sound. Bacterial contamination of surface waters results from a variety of sources including waste from humans via failing, sub-standard, antiquated, or improperly sited onsite wastewater treatment systems or malfunctioning sewer infrastructure, farm animals, waterfowl, wildlife, and domestic pets. In coastal systems, illicit discharges from boats can also be a concern. Bacterial contamination can degrade aquatic ecosystems and negatively affect public health, and may ultimately result in closures of shellfish beds, beaches, and drinking water supplies (MADEP, 2007; USEPA, 2001a).

Specific types of non-pathogenic bacteria are used as indicator organisms, or surrogates, for these pathogens in water. Waterborne pathogens (bacteria, viruses, etc.) enter surface waters from a variety of sources, including human sewage and the feces of warm-blooded wildlife. These pathogens can pose a risk to human health due to gastrointestinal illness through different exposure routes, including contact with and ingestion of recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish (clams, mussels, etc.).

The purpose of a TMDL is to calculate the amount of a pollutant a waterbody can assimilate without exceeding water quality standards or impairing designated uses, such as swimming, shellfishing, or providing drinking water. Connecticut's bacteria TMDL consists of two formats of targets for allowable levels of bacteria:

- Concentrations of bacteria (expressed as bacteria counts/100mL of water)
- Loads of bacteria (expressed as numbers of bacteria/day)

Both formats express targets designed to attain the designated uses of swimming, shellfishing, and drinking water to meet the associated criteria in Connecticut's water quality standards. These TMDLs set a goal of meeting bacteria water quality criteria in surface waters at the point of discharge for all sources in order to meet water quality standards throughout the waterbody. Achievement of the goal will be assessed by ambient water quality monitoring.

The Connecticut Department of Energy and Environmental Protection (DEEP) believes that the concentration-based TMDL approach is the most useful format for guiding both remediation and protection efforts in the impaired watersheds. A concentration target is more readily understandable allows interested citizens and/or watershed groups to determine easily whether any particular source is exceeding its allocation.

This bacteria TMDL provides documentation of impairment and information on pollutant sources that are not only required for TMDL approval, but are also intended to provide a guide for future TMDL implementation by watershed stakeholders, as well as protection for waters that are not currently impaired or not assessed for bacteria. As future monitoring identifies additional bacteria-impaired segments of Connecticut waters, these bacteria TMDLs may be applied to those waters and made available for public comment.

This document provides (1)documentation for the impaired waters listing status and the need for a TMDL, (2) the water quality target that needs to be attained to restore the health of the waterbody, (3) details regarding sources of bacteria in the impaired waterbodies, and (4) estimated percent reductions, calculated from existing data, needed to meet the concentration-based water quality target.

TMDL information applicable to all waters appears in the main body of the report, and more detailed waterbody-specific information is organized by watershed in the appendices. Although not required for TMDL approval, this report also provides a broad array of tools to get communities, watershed groups, and other stakeholders started implementing bacterial controls. This report is intended to inform, promote, and encourage, local community action for water quality improvement and protection of public health by addressing sources of bacterial contamination.

In the future, additional bacteria-impaired segments that receive TMDLs will be listed and described in more detail by CT DEEP staff in Appendix A. This Appendix is primarily a tracking device for CT DEEP but will also allow end users an easier understanding of when a specific bacteria-impaired segment was included in a TMDL document.

# 2. Background

This section provides an overview of bacteria and the State of Connecticut's water quality standards (WQS) for bacteria. Bacteria water quality standards are designed to protect surface waters and associated water users from the potentially adverse impacts of harmful bacteria.

## 2.1 Pathogens & Indicator Bacteria

Waterborne disease-causing organisms, known as pathogens, can cause a risk to public health. Pathogens may be transported to surface waterbodies by stormwater runoff or persistent sources, such as failing septic systems, untreated agricultural runoff, and illicit discharge pipes. Once in a waterbody, they can infect humans through skin contact, ingestion of water, or consumption of contaminated fish and shellfish.

Wastes from warm-blooded animals are a source for many types of bacteria found in waterbodies, including the coliform group and Streptococcus, Lactobacillus, Staphylococcus, and Clostridia. Each gram of human feces contains approximately 12 billion bacteria that may include pathogenic bacteria, such as Salmonella, associated with gastroenteritis. In addition, feces may contain pathogenic viruses, protozoa, and parasites (MADEP, 2007).

The numbers of pathogenic organisms present in waters are generally difficult to identify and isolate, and are often highly varied in their characteristic or type. Therefore, scientists and public health officials usually monitor nonpathogenic bacteria that are typically associated with harmful pathogens in fecal contamination and are most easily sampled and measured. These associated bacteria are called indicator organisms. Indicator bacteria are not themselves a health risk, but are used to indicate the presence of pathogenic organisms. High densities of indicator bacteria increase the likelihood of the presence of pathogenic organisms (USEPA, 2001).

Connecticut uses *Escherichia coli* (*E. coli)* as indicator organisms of potential harmful pathogens in fresh waters and Enterococci for estuarine or marine recreational waters. To determine risk in shellfish harvesting areas, fecal coliform organisms are used (criteria recommended under the National Shellfish Sanitation Program; NSSP, 2005). Total coliform bacteria are used to determine risk for existing and proposed public drinking water supplies. The relationship of indicator organisms is diagrammed in Figure 2-1, and Connecticut's indicators are highlighted. Specific indicator criteria are provided in the Water Quality Standards Section (Section 3) of this report.

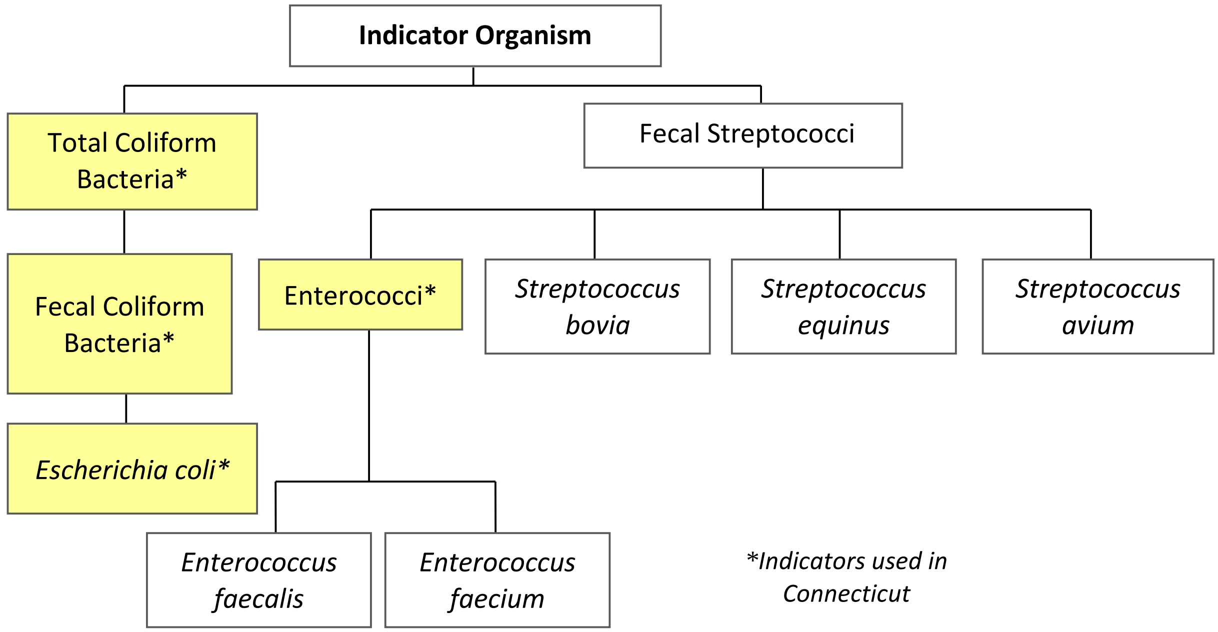


**Figure 2-1: Relationship among Indicator Organisms (USEPA, 2001).**

## 2.2 Bacteria Pollution Sources

The federal Clean Water Act (CWA) categorizes sources of pollutants into two major groups: *point source (PS)* pollution and *non-point source (NPS)* pollution. A stormwater discharge can be categorized as either a point source or a non-point source, depending on whether or not the discharge is regulated under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program. For this reason, stormwater is listed as a source of bacteria in both categories of pollution below.

This section describes bacteria pollution sources within the regulatory context. Types of bacteria sources are defined and the process of regulating bacteria pollution is described. Later in this document (Section 6), strategies for assessing bacteria pollution sources and taking mitigative action to reduce the adverse impacts of bacteria pollution are described.

### 2.2.1 Point Source Pollution

Point source pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal treatment plant, permitted stormwater outfall or a feedlot, making this type of pollution relatively easy to identify. According to the CWA and Appendix A of the Connecticut WQS, a point source is defined as follows (CTDEEP, 2011b):

> *"Point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.*

Section 402 of the CWA requires all such point source discharges to be regulated under the NPDES permit program to control the type and quantity of pollutants discharged. NPDES is the national program for regulating point sources through issuance of permit limitations specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and 405 of the CWA.

In Connecticut the DEEP has been delegated the authority to implement the NPDES program. Permit limits issued for a discharge to an impaired waterbody must be consistent with any relevant TMDLs approved for that waterbody.

Bacteria point sources of pollution include:

***Unauthorized Point Sources of Untreated Wastewater***

This category includes all point source discharges that are not authorized under the NPDES permit program or by the State because they will not meet water quality standards or have not obtained necessary permits or authorization. Examples include the discharge of untreated wastewater from sources such as sanitary sewer overflows (SSOs) and illicit discharges to storm drains. Untreated discharges of sewage (i.e., wastewater) to waters of the State are prohibited. Since such point discharges will not meet water quality standards, they must be eliminated (or treated) once discovered. As discussed below, this category also includes discharges of sewage from boats which is prohibited by State law.

- ***Sanitary Sewer Overflows (SSOs):*** Sanitary sewer overflows (SSOs) are discharges of untreated wastewater from municipal sewer systems. SSOs can be caused by blocked or cracked sewer pipes, excess infiltration and inflow, an undersized sewer system (piping and/or pumps), or equipment failure. Such untreated wastewater can find its way to surface waters and cause bacteria violations.
- ***Illicit Discharges (to Stormwater Systems):*** Illicit discharges include any discharges to stormwater systems that are not entirely composed of stormwater (NEIWPCC, 2003). These include intentional or unknown illegal connections from commercial or residential buildings, and improper disposal of sewage from campers and boats. This often includes sanitary wastewater piping that is directly connected from a home to a storm drainage pipe or a cross-connection between the municipal sewers to the storm sewer systems. As a result of these illicit connections, contaminated wastewater can enter into storm drains and be conveyed to surface waters. These sources can contribute significantly to the load of bacteria in stormwater, particularly during periods of dry flow.
- ***Boat Discharges****:* Boats have the potential to discharge pathogens in sewage from installed toilets and graywater (includes drainage from sinks, showers, and laundry). Sewage and graywater discharged from boats can contain pathogens (including bacteria, viruses, and protozoans), nutrients, and chemical products which can lead to water quality violations. The State of Connecticut requires boats equipped with a marine sanitation device (MSD) to have a wastewater holding system to prevent the discharge of waste products into surrounding waters. MSDs can be emptied at specified pump out facilities on shore. For more information on pump out facility locations and

properly maintaining MSDs, go to the DEEP’s Clean Vessel Act Program website: [http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323750&depNav_GID=1711].

No Discharge Areas (NDAs) are designated bodies of water that prohibit the discharge of treated and untreated boat sewage. Connecticut has designated NDAs in all of Connecticut's coastal waters from the Rhode Island State boundary in the Pawcatuck River to the New York State Boundary in the Byram River and extending from shore out to the New York State boundary (CTDEEP, 2011c). In these waters the discharge of any sewage from any vessel is prohibited. Additionally, the Connecticut Water Quality Standards (WQS)identify that the discharge of sewage from any vessel to any water is prohibited.

- ***Illegal disposal of pumped septage:*** Septic pump trucks can illegally discharge their waste from on-site sewage disposal systems. CT Department of Public Health (DPH) licenses the individuals that conduct the pumping of sewage from septic systems. DPH also pursues enforcement actions against individuals that improperly dispose their septage.

***Wastewater Treatment Facilities (WWTFs)***

The Permitting and Enforcement Division of the Bureau of Materials Management and Compliance Assurance and the Municipal Facilities Section of the Bureau of Water Protection and Land Reuse administer the NPDES program for discharges from individual, municipal, and industrial WWTFs, and regulated stormwater to State surface waters. Potentially harmful bacteria may enter surface waters via improperly treated wastewater discharges, This wastewater, which contains a variety of organic and inorganic pollutants, is treated by WWTFs in order to remove harmful waste products and to render it environmentally acceptable and consistent with State WQS and Criteria

***Combined Sewer Overflows (CSOs)***

Combined Sewer Overflows (CSOs) discharge a combination of untreated sanitary sewer and stormwater to wastewater treatment facilities and can be a significant source of bacterial pollution during wet weather. Combined sewer systems convey sanitary and stormwater flows to wastewater treatment facilities. During dry weather, all of the sewage in a combined system is conveyed to the treatment plant for adequate treatment. However, during rainstorms or snow-melt periods, stormwater mixes with the sanitary sewage, causing flows that exceed the capacity of the sewer system. This results in combined sewer overflows (CSOs), which vary extensively in pollutant types, concentrations and loads, as well as in volume of overflow and severity of impact to the receiving waterbodies.

Connecticut has established a program, coordinated with USEPA's CSO program, to assist communities in evaluating the design, condition, activity, and effects of combined sewer systems and overflows (CTDEEP, 2011d). In 1986, the State established the Connecticut Clean Water Fund (CWF). The CWF provides a combination of grants and loans to municipalities that undertake water pollution control projects at the direction of the DEEP. Generally, projects receive a grant for up to 20% of the total project cost and a loan for remaining project costs. CSO projects receive grants up to 50% of the total project cost and loans for remaining project costs. CSO projects are given special consideration under the CWF due to their high cost and Statewide significance for public health and water quality.

There are 4 communities with CSOs in Connecticut (Figure 2-2). The status for these CSOs in each community is presented in Table 2-1.

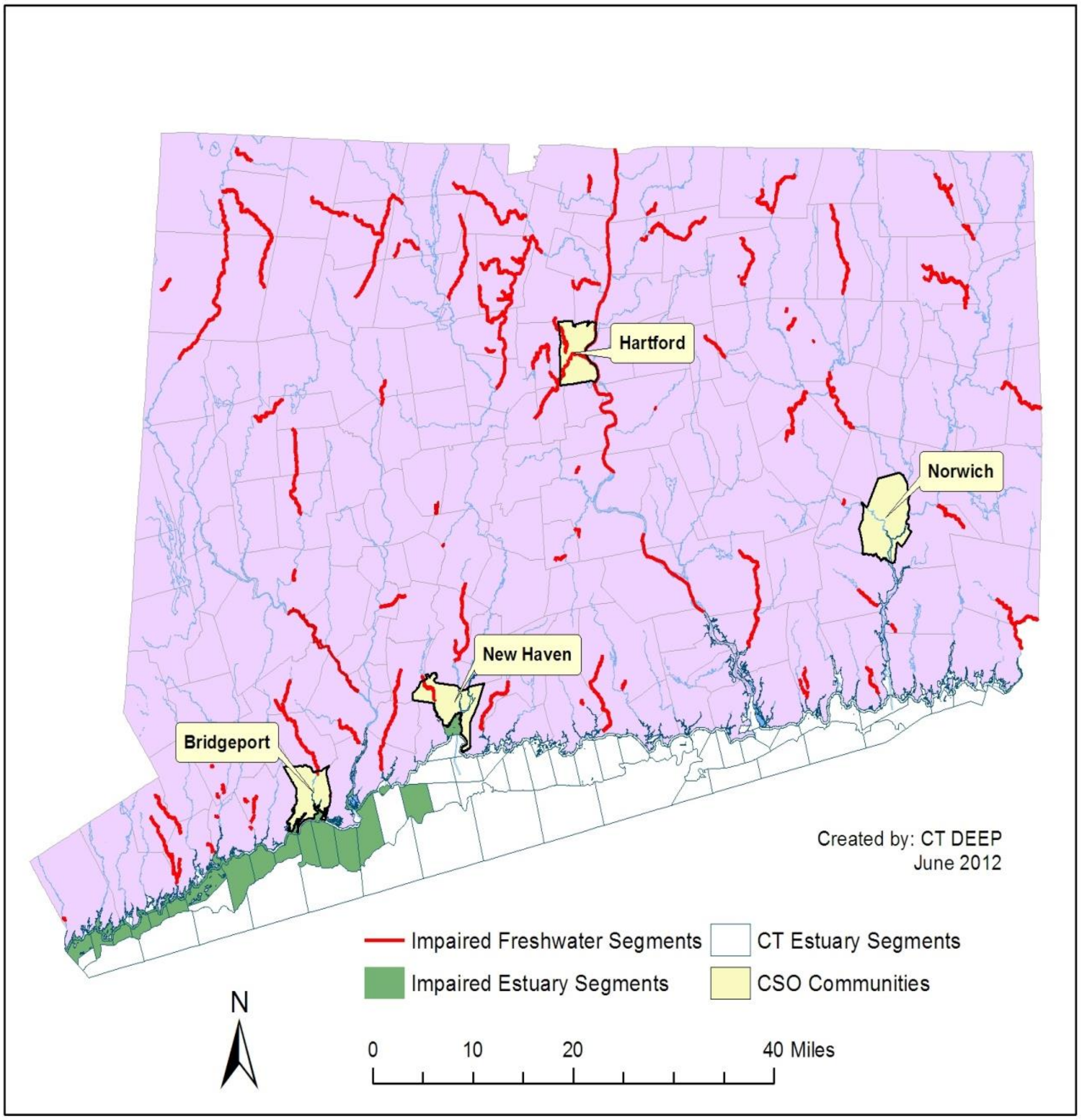


**Figure 2-2: CSO Communities in Connecticut. The impairments displayed in ths map do not include any segments provided in Appendix A.**

**Table 2-1: Combined Sewer Overflow (CSO) Regulator Status.**

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Bridgeport | Active | 8 | Waterview Avenue and Ann Street | Yellow Mill Pond |
| Bridgeport | Active | 12 | Church Street W of Waterview Avenue (formerly: Waterview Avenue and Church Street) | Yellow Mill Pond |
| Bridgeport | Active | 15 | Seaview Avenue and Crescent Street | Yellow Mill Pond |
| Bridgeport | Active | 17 | Seaview Avenue and Deacon Street | Yellow Mill Pond |
| Bridgeport | Active | 18 | Connecticut Avenue and Stratford Avenue | Yellow Mill Pond |
| Bridgeport | Active | 28 | Bay Street and Mildner Drive | Johnson's Creek |
| Bridgeport | Active | 30 | Seaview Avenue and Barnum Avenue | Pequonnock River |
| Bridgeport | Active | 33 | Huntington Road and Vernon Street | Pequonnock River |
| Bridgeport | Active | 38 | Brewster Street and Seabright Avenue | Black Rock Harbor |
| Bridgeport | Active | 40 | Howard Avenue and Wordin Avenue | Cedar Creek |
| Bridgeport | Active | 49 | John Street West of Water Street | Pequonnock River |
| Bridgeport | Active | 50 | Water Street and Fairfield Avenue | Pequonnock River |
| Bridgeport | Active | 51 | Water Street and Golden Hill Street | Pequonnock River |
| Bridgeport | Active | 75 | Housatonic Avenue between Commercial and Grand Street | Pequonnock River |
| Bridgeport | Active | 76 | Housatonic Avenue and North Washington Avenue | Pequonnock River |
| Bridgeport | Active | 77 | Housatonic Avenue and Grand Street | Pequonnock River |
| Bridgeport | Active | 78 | Housatonic Avenue and City Yard | Pequonnock River |
| Bridgeport | Active | 79 | Housatonic Avenue and Washington Avenue | Pequonnock River |
| Bridgeport | Active | 80 | Congress Street and Main Street | Pequonnock River |
| Bridgeport | Active | 84 | Admiral Street and Harbor Street | Cedar Creek |
| Bridgeport | Active | 87 | Saint Stephens Road and Anthony Street | Burr Creek |
| Bridgeport | Active | 91 | State Street and Dewey Street | Ash Creek |
| Bridgeport | Active | 101 | Main Street and Capital Avenue | Island Brook |
| Bridgeport | Active | 145 | Henry Street and South of Atlantic Street | Bridgeport Harbor |
| Bridgeport | Active | 195 | Congress Street at DPW Yard | Pequonnock River |
| Bridgeport | Active | 196 | Main Street and Fairview Avenue | Island Brook |
| Bridgeport | Active | 207 | State Street and Water Street | Pequonnock River |
| Bridgeport | Active | 217 | West Side Plant | Burr Creek |
| Bridgeport | Active | 48 47 | Water Street and Union Square | Pequonnock River |
| Bridgeport | Active | 68 68 | Pulaski Street, Congress Street and Crescent Avenue | Pequonnock River |
| Bridgeport | Active | 81 192 | Broad Street and Railroad crossing | Bridgeport Harbor |
| Bridgeport | Active | Unknown | Mt. Grove Cemetery Dewey Square | Ash Creek |
| Hartford | Active | 002 | Granby Street at Pembroke Street of North Branch Park River | North Branch Park River |
| Hartford | Active | 003 | Granby Street South of Cornwall Street at North Branch of Park River | North Branch Park River |

**Table 2-1, cont'd: Combined Sewer Overflow (CSO) Regulator Status.**

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|
| Hartford | Active | 005 | Girard Avenue N of Elizabeth Street | North Branch Park River |
| Hartford | Active | 006 | Asylum Avenue Regulator Chamber | North Branch Park River |
| Hartford | Active | 007 | Oxford Street at Cone Street and Farmington Ave at Tremont Street (2 regulators - 1 NPDES #) | North Branch Park River |
| Hartford | Active | 008 | Farmington Avenue W of Woodland Street | North Branch Park River |
| Hartford | Active | 009 | South Whitney at Warrenton Avenue and Warrenton Avenue S of S Whitney Avenue (2 regulators 1 NPDES #) | North Branch Park River |
| Hartford | Active | 010 | Hawthorne Street at South Marshall Street | North Branch Park River |
| Hartford | Active | 012 | Park Street at Orange Street and Park Street at Francis Street (2 regulators 1 NPDES #) | South Branch Park River |
| Hartford | Active | 014 | Hamilton Street at Brookfield Street | South Branch Park River |
| Hartford | Active | 016 | New Park Avenue S of Kane Street | Kane Brook |
| Hartford | Active | 017 | Saybrooke Street at Brookfield Street | South Branch Park River |
| Hartford | Active | 018 | Brookfield Street at Ward Place Ext and Wilson Street between Zion Street and Hillside Street (2 regulators 1 NPDES #) | South Branch Park River |
| Hartford | Active | 019 | Flatbush Avenue W of Chandler Avenue | Cemetery Brook |
| Hartford | Active | 020 | Flatbush Avenue E and W of Chandler Avenue (2 regulators 1 NPDES #) | Cemetery Brook |
| Hartford | Active | 022 | Arlington St at Stone Street and Natick Street at Arlington Street (2 regulators, 1 NPDES #) | South Branch Park River |
| Hartford | Active | 024 | New Britain Avenue (8 regulators 1 NPDES # at Giddings Street, Nepaug Street, Wilbur Street, Goshen Street, Montrolse Street, Grant Street, and 2 at Roslyn Street) | S Branch Park River |
| Hartford | Unknown | 025 | Gully Brook Conduit (14 regulators 1 NPDES # at Spruce Street at Church Street, Westland Street, Rockville Street, Capen W of Gull Street, Capen E of Gull Street, Mansfield Street E, Enfield Street, 2 at Albany Avenue W of Brook Street, Garden Street N of Bedford Street, Brook Street N of Liberty Street, High Street at Walnut Street, Asylum Street at Garden Street, Vine Street at Mansfield Street) | Gully Brook |
| Hartford | Active | 027 | Commerce Street at Sheldon Street | Park River |
| Hartford | Active | 028 | Main Street at Sheldon Street | Park River |
| Hartford | Active | 029 | Main Street at Arch Street | Park River |
| Hartford | Active | 030 | Pulaski Circle | Park River |
| Hartford | Active | 031 | Park River Storm (6 regulators - 1 NPDES # at Wells Street, Jewell Street at Ann Street, Asylum Street at High Street, High Street N of Asylum Street, Asylum Street at Gully Brook N, Asylum Street at Gully Brook S) | Park River |
| Hartford | Active | 032 | Capitol Avenue West of Hungerford Street | Park River |

**Table 2-1, cont'd: Combined Sewer Overflow (CSO) Regulator Status.**

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|
| Hartford | Active | 033 | Broad Street South of Capitol Avenue | Park River |
| Hartford | Active | 034 | Capitol Avenue (4 regulators 1 NPDES # at Broad Street and Capitol Avenue, Capitol Avenue at Flower Street, Capitol Avenue E of Columbia Street, Capitol Avenue at Park Terrace) | Park River |
| Hartford | Active | 035 | Park Street At Broad Street & Park St West of Broad St (2 regulators 1 NPDES #) | Park River |
| Hartford | Active | 036 | Flower Street N of Capitol Avenue | Park River |
| Hartford | Active | 038 | Main Street at Buckingham Street | Park River |
| Hartford | Active | 039 | Frank Avenue (8 regulators 1 NPDES # at private lands opposite Tredeau Street, Franklin Street at Cromwell Street, Franklin Street at Hamner Street, Franklin Street at Brown Street, Franklin Street at Bodwell Street, Sout Street at Hubbard Street, Franklin Street at Adelaide Street, West Preston Street at Broad Street) | Folly Brook |
| Hartford | Active | 040 | Regulators F-29, F-30, F-31, F-32 & F-33 may discharge at this DSN | Unknown |
| Hartford | Active | 041 | Tower Brook (3 regulators 1 NPDES # at Tower Brook at Main Street, Main Street at Tower Brook, Main Street S of Fishfry) | Tower Brook Conduit at Meadows Storage Pond |
| Hartford | Active | 042 | Sanford Street (3 regulators 1 NPDES # at Windsor Street at Sanford Street, Bellevue Street at Sanford Street, Sanford Street at Main Street) | Connecticut River |
| Hartford | Active | 043 | Market Street (2 regulators 1 NPDES # at Market Street at Trumbull Street, State Street E of Market Street) | Connecticut River |
| Hartford | Active* | 044 | Masseek Street at Van Block Avenue | Connecticut River |
| Hartford | Active | 046 | Bartholomew Avenue at Park Street | North Branch Park River |
| Hartford | Active | 047 | Capitol Avenue at Sigourney Street | Park River |
| Hartford | Active* | 043A | Market Street at Trumbull Street | Connecticut River |
| Hartford | Unknown | Unknown | Asylum Avenue at North Branch of Park River | Park River |
| Hartford | Unknown | Unknown | Broad Street N of Capitol Avenue over Park River Conduit | Park River |
| Hartford | Unknown | Unknown | Capitol Avenue N of Hungerford Street | Unknown |
| Hartford | Unknown | Unknown | E of I 91 West Connecticut River S of Founders Bridge I 84 | Connecticut River |
| Hartford | Unknown | Unknown | E of I 91 West Connecticut River opposite Maseek Street at Vanblock Avenue | Connecticut River |
| Hartford | Unknown | Unknown | E of Liebert Road where Weston Street would intersect W of Pond | Unknown |
| Hartford | Unknown | Unknown | E side of I 84 at Boulevard Exit on Park River Conduit | Park River |
| Hartford | Unknown | Unknown | Farmington Avenue at North Branch of Park River Conduit | Park River |

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|
| Hartford | Unknown | Unknown | N of Roslyn Street and New Britain Avenue on South Branch Park River | South Branch Park River |

**Table 2-1, cont'd: Combined Sewer Overflow (CSO) Regulator Status.**

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|
| Hartford | Unknown | Unknown | NW of Pulaski Circle between Wells and Elm Street on Park River | Park River |
| Hartford | Unknown | Unknown | Main Street at Whitehead Highway between Elm and Wells Street | Unknown |
| Hartford | Unknown | Unknown | N of Natick and Dart Street on South Branch Park River | South Branch Park River |
| Hartford | Unknown | Unknown | Prospect Street between Sheldon Street and Whitehead Highway | Unknown |
| Hartford | Unknown | Unknown | S of Pulaski Circle at Hudson Street | Unknown |
| Hartford | Unknown | Unknown | Whitehead Highway and Sheldon Street | Unknown |
| Hartford | Unknown | Unknown | Park Street at Park River Conduit | Park River |
| Hartford | Unknown | Unknown | S end of playground underpass between Bolton Street, Victoria Road, Wethersfield Avenue and Franklin Avenue | Unknown |
| Hartford | Unknown | Unknown | S of Farmington Avenue at North Branch of Park River Conduit | North Branch Park River |
| Hartford | Unknown | Unknown | West Connecticut River E of I 91 between Exit 29 Capitol Avenue and Exit 30 | Connecticut River |
| Hartford | Unknown | Unknown | West Connecticut River E of I 91 N of Exit 52 opposite Pequot Street | Connecticut River |
| Hartford | Unknown | Unknown | W of Hawthorne Street at Forest Street | Unknown |
| Hartford | Unknown | Unknown | W of Hawthorne Street at North Branch Park River Conduit | North Branch Park River |
| Hartford | Unknown | Unknown | W of Niles Street on W side of North Branch Park River | North Branch Park River |
| Hartford | Unknown | Unknown | W of Trinity Street and N of Elm Street at Bushnell Park and Park River Conduit | Park River |
| Hartford | Unknown | Unknown | W of Wilbur Cross Exit off I 91, N of Hartford-Wethersfield border | Unknown |
| Hartford | Unknown | Unknown | West Park Terrace at Russ Sigourney Street ramp at Park River Conduit | Park River |
| New Haven | Active | 1 | East Shore WPAF | New Haven Harbor |
| New Haven | Active | Unknown | Greene Street | New Haven Harbor |
| New Haven | Active | 003 | E.T.G.Boulevard at Orange Avenue | West River |
| New Haven | Active | 004 | E.T.G. Boulevard at Legion Avenue | West River |
| New Haven | Active | 005 | E.T.G. Boulevard at Derby Avenue | West River |
| New Haven | Active | 005 (A) | University Place | Unknown |
| New Haven | Active | 005 (B) | Elm Street / University Place | Unknown |
| New Haven | Active | 006 | Whalley Avenue at Fitch Street | West River |

| | | | | |
|---|---|---|---|---|
| New Haven | Active | 008 | Munson Street at Orchard Street | Mill River |
| New Haven | Active | 009 | Grand Avenue at James Street | Mill River |
| New Haven | Active | 010 | East Street at I-91 | Mill River |
| New Haven | Active | 010 (A) | East Street at I-91 | Mill River |

**Table 2-1, cont'd: Combined Sewer Overflow (CSO) Regulator Status.**

| Town | CSO Status | CSO Reference # | Address | CSO Receiving Water |
|---|---|---|---|---|
| New Haven | Active | 011 | Humphrey Street at I-91 | Mill River |
| New Haven | Active | 012 | Mitchell Drive E of Nicoll Street | Mill River |
| New Haven | Active | 013 | Everitt Street at East Rock Road | Mill River |
| New Haven | Active | 013 (A) | East Rock Road at Everitt Street | Unknown |
| New Haven | Active | 014 | Trumbull Street at Orange Street | Mill River |
| New Haven | Active | 015 | James Street siphon | Quinnipiac River |
| New Haven | Active | 016 | Poplar Street at River Street | Quinnipiac River |
| New Haven | Active | 019 | Pine Street at North Front Street | Quinnipiac River |
| New Haven | Active | 020 | Quinnipiac Avenue at Clifton Street | Quinnipiac River |
| New Haven | Active | 021 | East Street Pump Station | New Haven Harbor |
| New Haven | Active | 024 | Boulevard Pump Station | New Haven Harbor |
| New Haven | Active | 025 | Union Pump Station | New Haven Harbor |
| New Haven | Active | 025 (A) | Elm Street / University Place | New Haven Harbor |
| New Haven | Active | 026 | Humphrey Pump Station | Mill River |
| New Haven | Active | 028 | Mitchell Pump Station | Mill River |
| New Haven | Active | 032 | Port Sea / Liberty Street | New Haven Harbor |
| New Haven | Active | 034 | George Street / Temple Street | New Haven Harbor |
| New Haven | Active* | Unknown | George Street / Temple Street | Unknown |
| New Haven | Active* | Unknown | Woodward Pump Station | Unknown |
| Norwich | Active* | Unknown | Crown Street | Unknown |
| Norwich | Active* | Unknown | Eighth Street | Unknown |
| Norwich | Active* | Unknown | North Main Street | Unknown |
| Norwich | Active* | Unknown | River Avenue Extension | Unknown |
| Norwich | Active* | Unknown | Shipping Street | Unknown |
| Norwich | Active* | Unknown | South Golden Street and Erin Street | Unknown |
| Norwich | Active* | Unknown | South Thames Street off West Thames Terrace | Unknown |
| Norwich | Active* | Unknown | Talman Street and Winchester Place | Unknown |
| Norwich | Active* | Unknown | Yantic Street | Unknown |
| Norwich | Active* | Unknown | West Thames Street | Unknown |
| Norwich | Active* | Unknown | Rose Alley | Unknown |
| Norwich | Active* | Unknown | Shetucket Interceptor | Unknown |
| Norwich | Active* | Unknown | Roosevelt Avenue | Unknown |
| Norwich | Active* | Unknown | Roath Street | Unknown |

*** Permits that were confirmed or added in 2012, but no status was indicated. Assumed active.**

***Stormwater***

Stormwater runoff is water that does not soak into the ground during a rain storm, but instead flows over the surface of the ground or enters a drainage system until it reaches a waterbody. As the runoff moves, it picks up and carries away natural and anthropogenic pollutants, such as soil and manure, and eventually deposits them into surface waters. Stormwater runoff is one of the leading sources of impairment of our nation's waters and often contains high concentrations of various pollutants including bacteria. Urbanization and associated impervious surfaces have a significant impact on the hydrology within a watershed by increasing stormwater runoff rate and volume to receiving surface waters. Stormwater discharges in urbanized municipalities that are federally designated under the Stormwater Phase I or II programs are considered point sources under the CWA and require NPDES permits along with certain stormwater discharges from other sources, identified in the below listings.

The EPA has mandated a number of permit programs, administered by Connecticut DEEP, to deal with stormwater pollution (CTDEEP, 2011e).

1. The **General Permit for the Discharge of Stormwater Associated with Industrial Activity** ("Industrial General Permit") regulates industrial facilities with point source discharges that are engaged in specific activities listed in the permit. To comply with this program, these facilities must submit a registration form, implement a Stormwater Pollution Prevention Plan (SWPPP) and conduct wet weather sampling twice a year.

2. The **Stormwater Associated with Construction Activities General Permit**, requires developers and builders disturbing one or more total acres of land to implement stormwater pollution control plans (SWPCPs) that will prevent the movement of soil and sediments off construction sites and into nearby streams and waterbodies.

3. The **Stormwater Associated with Commercial Activities General Permit**, requires operators of large paved commercial sites such as malls, movie theaters, and supermarkets to undertake actions such as parking lot sweeping and catch basin cleaning to keep stormwater clean before it reaches waterbodies. DEEP was not mandated to implement this type of permit by EPA, but the program was implemented through DEEP's own initiatives in August of 1995 to help track impacts on water quality from commercial development across Connecticut. Sites authorized by this permit must develop and implement a Stormwater Management Plan (SMP).

4. The **Stormwater from Small Municipal Separate Storm Sewer Systems (MS4) General Permit** requires municipalities with urbanized areas to take steps to minimize stormwater pollutants from discharging to waterbodies from the municipal drainage system. One important element of this permit is the requirement that towns implement public education programs to make residents aware that stormwater pollutants emanate from many of their everyday living activities, and to inform them of

steps they can take to reduce pollutants in stormwater runoff. Each municipality covered by the MS4 permit must develop a Stormwater Management Plan (SMP) that incorporates control mesasures in six categories. These measures are a collection of best management practices (BMPs) to address the sources of stormwater pollution assoscitae with municipal drainage systems.

In 2012, the Water Permitting & Enforcement Division of DEEP will begin efforts to reissue the General Permit for the Discharge of Stormwater from Municipal Separate Storm Sewer Systems, which expires January 8, 2013. Currently, the permit regulates stormwater discharges from 113 municipalities; these municipalities are regulated under the current permit due to the presence of urbanized areas as defined by the most recent U.S. Census and required by US EPA. As part of the permit reissuance process, WPED will consider the inclusion of additional municipalities that: do not fall into the definition of urbanized areas but have dense urban population clusters, and have stormwater discharges to impaired waters where such discharges have been determined to be a source of the impairment.

As Connecticut's only municipality with a population greater than 100,000 the discharges through a municipal separate storm sewer (as opposed to combined sewers), the City of Stamford's storm sewer discharges are regulated by an individual NPDES permit as required by EPA's Phase 1 regulations. Currently, 113 of Connecticut's 169 municipalities are regulated by the General Permit for the Discharge of Stormwater from Municipal Separate Storm Sewer Systems (MS4 permit). Several more municipalities may be regulated by the next reissuance of the MS4 permit in an effort to address water quality issues for waterbodies that are impaired or receive stormwater from urban clusters. For municipalities that continue to be unregulated by the MS4 Permit, CT DEEP recommends that municipalities implement the six minimum measures specified in the MS4 permit to the extent possible. In particular, measures such as public education and outreach, public involvement and participation, construction site stormwater runoff control, post-construction stormwater management, and pollution prevention/good housekeeping can be implemented to achieve improved stormwater quality without a significant cost.

### 2.2.2 Non-Point Source Pollution

Non-point source (NPS) pollution comes from many diffuse sources and is more difficult to identify and control than point sources. NPS pollution can result from overland runoff (e.g. agricultural runoff, or stormwater runoff in unregulated suburban and rural areas), groundwater flow or direct deposition of pollutants to receiving waters. NPSs are diffuse and are often associated with land-use practices. These sources carry pollutants to waters of the State. Municipal stormwater discharges located outside of federally designated urban areas are considered non-point source discharges and typically are not regulated under the NPDES program (unless they are covered by a NPDES general or individual permit).

Examples of NPSs that can contribute bacteria to surface waters via stormwater runoff, groundwater, and direct deposition include insufficient septic systems, agricultural activities, pet waste, wildlife, and contact recreation (swimming or wading). Each of these is described below.

***Stormwater Runoff***

As discussed above, stormwater can be categorized as both point and non-point source pollution. Non-point source (NPS) stormwater discharges are generally characterized as diffuse or sheet flow runoff and are not categorically regulated under the NPDES program. This is stormwater runoff from areas outside of the federally designated MS4 urbanized areas or regulated under other specific NPDES permits for stormwater

***Insufficient Subsurface Sewage Disposal Systems (Septic Systems)***

Untreated discharges of sewage (i.e. domestic wastewater) are prohibited regardless of point or non-point source origin. An example of a NPS discharge of untreated wastewater is bacteria from insufficient subsurface sewage disposal systems, commonly referred to as septic systems. When properly designed, installed, operated, and maintained, subsurface sewage disposal systems effectively reduce bacteria concentrations in sewage. However, age, overloading, or poor maintenance can result in system failure and the release of bacteria and other pollutants into surface waters (USEPA, 2006). Bacteria from insufficient subsurface sewage disposal systems can enter surface waters through surface overflow or breakout, stormwater runoff or groundwater. There are several specific types of systems that may be installed at a facility. The following definintions highlight the major differences in function and type of systems that are available for consideration at sites across Connecticut.

A "**conventional subsurface sewage treatment and disposal system**" - consists of a house sewer, septic tank followed by a leaching system, any necessary pumps or siphons, and any ground water control system on which the operation of the leaching system is dependent.

A "**community subsurface sewage treatment and disposal system**" - consists of one subsurface sewage disposal system serving two or more residential buildings, regardless of system size.

An "**alternative treatment system**" - consists of a sewage treatment system serving one or more buildings that utilizes a method of treatment other than a subsurface sewage disposal system and that involves a discharge to the groundwaters of the state.

The following table describes different types of systems and with entities are responsible for oversight and regulations of each system.

**Table 2-2. Description of system type and jurisdictions**

| Type/Size of System | Contact Information |
|---|---|
| **Systems regulated by the Department of Energy & Environmental Protection (DEEP)** | |

| | |
|---|---|
| Conventional systems with design flows greater than 5000 gallons per day, including sites where multiple smaller systems on a single "lot" have a combined flow greater than 5000 gallons per day. | DEEP Subsurface Sewage Disposal Program<br>860-424-3018 |
| Community systems. | DEEP Subsurface Sewage Disposal Program<br>860-424-3018 |
| Any system utilizing alternative treatment, regardless of size. | DEEP Subsurface Sewage Disposal Program<br>860-424-3018 |
| **Systems regulated by the Connecticut Department of Public Health (DPH)** | |
| Conventional system with design flow less than 2000 gallons per day. | Local health department in the town the site is located |
| Conventional system with design flow greater than 2000 gallons per day but less than 5000 gallons per day. | DPH Sewage Program<br>860-509-7296 |

***Agriculture***

Agricultural activities include dairy farming, raising livestock and poultry, growing crops and keeping horses and other animals for pleasure or profit. Activities and facilities associated with agricultural land use can be sources of bacteria impairment to surface waters. Direct deposition of fecal matter from farm animals standing or swimming in surface waters and the runoff of farm animal waste from land surfaces are considered the primary sources of agricultural bacteria pollution in surface waters. Most agricultural discharges are considered to be NPS. However, certain agricultural activities are regulated under the NPDES permit program as point sources.

Connecticut is able to offer technical and financial support to farm businesses in their farm waste efforts through the "Partnership for Assistance on Agricultural Waste Management Systems". This partnership includes the following agencies: USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency, University of Connecticut Cooperative Extension System, Connecticut Conservation Districts, the Connecticut Department of Energy and Environmental Protection and the Connecticut Department of Agriculture.

Through this partnership, a farm business may obtain waste management planning, structure design and qualify for financial assistance as well as help in procuring required permits.

Agricultural activities and facilities with the potential to contribute to bacteria impairment include:

- Manure storage and application;
- Livestock grazing;
- Animal feeding operations and barnyards; and
- Paddock and exercise areas for horses and other animals.

***Pets***

In residential areas, fecal matter from pets can be a significant contributor of bacteria to surface waters. For example, each dog is estimated to produce 200 grams of feces per day and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (CWP, 1999). If pet feces are not properly disposed, these bacteria can be washed off the land and transported to surface waters by stormwater runoff. Pet feces can also enter surface waters by direct deposition of fecal matter from pets standing or swimming in surface water.

***Wildlife***

Fecal matter from wildlife may be a significant source of bacteria in some watersheds. Several studies have documented the existence of bacteria in waterbodies in "pristine" environments, even under non-storm conditions. This is particularly true when human activities, including the feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP, 1999). Concentrations of geese, gulls, and ducks are of particular concern because they often deposit their fecal matter directly into surface waters.

***Contact Recreation (Swimming or Wading)***

Bacteria from people swimming or wading in surface waters can contribute to bacteria loads. When people enter the water, residualsmay be washed from the body and contaminate the water with pathogens. In addition, small children with diapers may contribute to bacterial contamination of surface waters.

# 3. Water Quality Standards for Bacteria

Water quality standards determine the baseline water quality that all surface waters of a State must meet in order to protect the intended uses for each waterbody. The Connecticut Water Quality Standards (WQS) are the foundation for the State's surface water pollution control and surface water quality management efforts. Section 22a-426 of the Connecticut General Statutes requires that the Commissioner of Environmental Protection adopt standards of water quality consistent with the federal Clean Water Act. The Water Quality Standards establish a goal of restoring and maintaining the chemical, physical, and biological integrity of Connecticut surface waters and, wherever attainable, providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water (CTDEEP, 2011a). These standards are composed of three parts: classification and designated uses; water quality criteria; and antidegradation regulations. Each of these parts is described below.

## 3.1 Classification and Designated Uses

Connecticut's designated uses consist of Existing or Proposed Drinking Water Supply, Potential Drinking Water Supply, Habitat for Fish and Other Aquatic Life and Wildlife, Recreation, Navigation, Industrial Water Supply, Agricultural Water Supply, Shellfish Harvesting for direct human consumption, Commercial Shellfish Harvesting, and Fish Consumption. All surface waters of the State have been categorized according to the Water Quality Classifications of the Connecticut WQS which assigns all surface waters to one of three freshwater (Class AA, A, B), or one of two saltwater (Class SA, SB), classifications (CTDEEP, 2011a). Each classification is defined by the designated uses that are the most sensitive, and therefore governing, water uses to be protected. In addition, the State has incorporated anti-degradation principles into its WQS. This policy protects ground and surface waters whose actual water quality exceeds the quality associated with its classification.

Water Quality Classifications denote the water quality ***uses*** for the waterbody, which may not reflect the present condition or environmental quality of the waterbody (CTDEEP, 2011b). Assessments of the present water quality conditions are determined for each waterbody through water quality data and information compiled in preparation of the most recent Integrated Water Quality Report (Integrated Report). The Integrated Report is developed biennially and reports both water quality assessment information in accordance with Section 305(b) of the Clean Water Act and lists impaired waterbodies in accordance with Section 303(d) of the Clean Water Act.

The complete list of designated uses for Connecticut's surface waters is provided in Table 3-1 (CTDEEP, 2011b).

**Freshwater Classifications**

**Class AA**

- Designated as a source of existing or proposed drinking water supply;
- Designated as habitat for fish and other aquatic life and wildlife;
- Designated for recreation;
- Designated for industrial and agricultural water supply; and
- Shall have excellent aesthetic value.

**Class A**

- Designated for potential drinking water supply;
- Designated as habitat for fish and other aquatic life and wildlife;
- Designated for recreation;
- Designated for navigation;
- Designated for industrial and agricultural water supply; and
- Shall have excellent aesthetic value.

**Class B**

- Designated as habitat for fish and other aquatic life and wildlife;
- Designated for recreation;
- Designated for navigation;
- Designated for industrial and agricultural water supply; and
- Shall have good to excellent aesthetic value.

**Marine and Estuarine Classifications**

**Class SA**

- Designated for shellfish harvesting for direct human consumption;
- Designated for recreation;
- Designated as habitat for marine fish, other aquatic life and wildlife;
- Shall be suitable for industrial water supply and navigation; and
- Shall have excellent aesthetic value.

**Class SB**

- Designated for commercial shellfish harvesting;
- Designated for recreation;
- Designated as habitat for marine fish, other aquatic life and wildlife;
- Shall be suitable for industrial water supply and navigation; and
- Shall have good to excellent aesthetic value.

**Table 3-1: Applicable Designated uses by Waterbody Class.**

| Designated Use | Definition | Applicability |
|---|---|---|
| Recreation | Swimming, water skiing, surfing or other full body contact activities (primary contact), as well as boating, canoeing, kayaking, fishing, aesthetic appreciation or other activities that do not require full body contact (secondary contact). | All surface waters |
| Habitat for fish and other aquatic life and wildlife | Water suitable for the protection, maintenance and propagation of a viable community of aquatic life and associated wildlife. | All surface waters |
| Existing or proposed drinking water supplies | Waters presently used for public drinking water supply or officially proposed for future public water supply. | AA |
| Potential drinking water supplies | Waters that have not been identified, officially, but may be considered for public drinking water supply in the future. | A |
| Fish Consumption | Waters supporting fish populations that are free of contaminants at concentrations that would limit human consumption. | All surface waters |
| Commercial shellfish harvesting | Waters supporting commercial shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption (may be conditionally approved); also support seed oyster harvesting. | SB |
| Shellfish harvesting for direct human consumption | Waters from which shellfish can be harvested both recreationally and commercially and consumed directly without depuration or relay. Waters may be conditionally approved. | SA |
| Navigation | Waters capable of being used for shipping, travel or other transportation by private, military or commercial vessels. | All surface waters |
| Water Supply for Industry | Waters suitable for industrial supply. | All surface waters |
| Water Supply for Agriculture | Waters suitable for general agricultural purposes. | AA, A, B |

## 3.2 Water Quality Criteria for Bacteria

Connecticut's WQS establish narrative and numeric criteria to support designated and existing uses. The narrative criteria describe acceptable water quality conditions such that those uses provided in Table 3-1 can be supported. Numeric criteria are typically concentrations of pollutants representing maximum acceptable levels of pollutants. Concentrations of pollutants above the numeric criteria represent potentially harmful levels and violate the WQS.

The State of Connecticut has three tiers of water quality classification for rivers and streams (AA, A, B) and two tiers for estuarine and marine waters (SA, SB), each with varying designated uses and numeric water quality criteria providing different levels of protection. The designated uses in the Connecticut WQS applicable to bacteria-impaired waters include:

- Public Drinking Water Supply (Existing and Proposed);
- Recreation (Designated Swimming Areas, Non-Designated Swimming Areas, and other uses); and
- Shellfish Consumption (Direct and Indirect).

Ambient numeric criteria for bacteria for Connecticut surface waters are presented in Table 3-2. The State of Connecticut uses multiple indicator organisms of potential pathogen contamination (CTDEEP, 2011a).

- **Total coliform** bacteria are used to determine risk for existing and proposed public drinking water supplies. Total coliform are expressed as an instantaneous or single sample concentration and as a **monthly moving average**;
- ***E.coli*** bacteria are used as Connecticut's primary bacteria indicator for assessing recreation uses in the State's fresh waterbodies. *E.coli* are expressed as a **geometric mean concentration** and an instantaneous or single sample concentration;
- **Fecal coliform** bacteria are used to determine risk for shellfish consumption. Fecal coliform are expressed as a **geometric mean concentration** and **90 % of samples less than**; and
- **Enterococci** bacteria are used to assess recreation uses in the State's salt waterbodies. Enterococci are expressed as a **geometric mean concentration** and an instantaneous or single sample concentration.

*A **geometric mean** is a way to average a set of values, and is commonly used with bacterial water assessments, which often show a great deal of variability. Unlike the arithmetic mean, a geometric mean reduces the effect of an occasional high or low value on the average.*

*The **90%of samples less than** is a measure that a dataset must have no more than 10% of included samples exceeding the appropriate criteria*

*The **monthly moving average** is a way to average a set of values to reduce the effects of random variation by averaging consecutive values in a time series of a specified duration.*

**Table 3-2: Numeric Criteria for Indicator Bacteria by Waterbody Class and Designated Use in Connecticut.**

| **Waterbody Class** *Designated Use* | **Total Coliform (MPN/100 mL)** | | ***E. coli*** **(colonies/100 mL)** | | **Fecal Coliform (MPN/100mL)** | | **Enterococci (MPN/100 mL)** | |
|---|---|---|---|---|---|---|---|---|
| | *Monthly Moving Average[1]* | *Single Sample Maximum* | *Geometric Mean[1]* | *Single Sample Maximum* | *Geometric Mean[1]* | *90% of samples less than[1]* | *Geometric Mean[1]* | *Single Sample Maximum* |
| **Class AA** *Public Drinking Water Supply (Existing and Proposed)* | **100[2]** | **500[2]** | -- | -- | -- | -- | -- | -- |
| **Classes AA, A, B** *Recreation* | -- | -- | **126** | **DS[3]: 235** **NDS[4]: 410** **Other: 576** | -- | -- | -- | -- |
| **Classes SA[5]** *Shellfish (Direct) Consumption* | -- | -- | -- | -- | **14** | **31** | -- | -- |
| **Classes SB[5]** *Shellfish (Indirect) Consumption* | -- | -- | -- | -- | **88** | **260** | -- | -- |
| **Classes SA and SB** *Recreation* | -- | -- | -- | -- | -- | -- | **35** | **DS[3]: 104** **Other: 500** |

[1]The monthly moving average, geometric mean, and 90% of samples metrics are statistically based

[2]Only at the drinking water intake structure

[3]Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protection and the Department of Public Health, May 1989, revised April 2003 and updated December 2008.

[4]Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely

[5]Criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document Guide for the Control of Molluscan Shellfish 2009.

**DS** denotes Designated Swimming Area

**NDS** denotes Non-Designated Swimming Area

**Other** denotes All Other Recreational Uses

## 3.3 Antidegradation Provisions

Antidegradation provisions are designed to preserve and protect the existing and designated uses of the State's surface waters and to limit the degradation of such waters. Connecticut's Antidegradation Policy expressedin in Stadnards 2 through 5 in Connecticut's WQS, focuses on the maintenance, protection, and improvement of water quality of all waters and provides additional protection for High Quality and Outstandard National Resource Waters. Guidance on the implementation of the Antidegradation Policy is provided in Appendix E of the Connecticut WQS.

The implementation of the Antidegradation Policy follows a tiered approach pursuant to federal regulations (Title 40 Part CFR 131.12). The purpose of Antidegradation Evaluation and Implementation Review is to ensure that existing and designated uses of surface waters and the water quality necessary for their protection are maintained and preserved consistent with Connecticut's WQS. The following review tiers have been established to protect all surface waters in Connecticut (CTDEEP, 2011a):

- Tier 1: All waters including high quality waters and wetlands and outstanding national resource waters;
- Tier 2: High quality waters and wetlands; and
- Tier 3: Outstanding National Resource waters.

The purpose of Tier 1 evaluation and implementation is to ensure that existing and designated uses of surface waters and the water quality necessary for their protection are maintained and preserved consistent with Connecticut Water Quality Standard 2. The tier 2 evaluation and implementation is for all wetlands and surface waters with existing water quality better than the Standards and Criteria are maintained at their existing high quality, pursuant to Connecticut Water Quality Standard 3. Tier 3 evaluation and implementation is to ensure that water quality of Outstanding National Resources Waters is maintained and protected pursuant to Connecticut Water Quality Standard 5. In summary, tier 1 evaluation covers all waters, while tiers 2 & 3 cover the waterbodies that specifically meet the qualifications of High Quality waters or Outstanding National Resource waters as defined in the CT Water Quality Standards (CTDEEP, 2011a).

## 3.4 Numeric Water Quality Target

The Connecticut WQS for bacteria are used as the numeric water quality targets for the bacteria TMDLs as shown in Table 3-2. Numeric bacteria targets vary depending on a specific waterbody's use classification (e.g., recreational, or shellfish harvesting), level of protection (e.g., AA, A, or B), and the applicable indicator organism (*E. coli* for freshwater, *Enterococci* for estuaries and marine recreational waters, and fecal coliform for shellfish harvesting areas). The shellfish criteria apply on a year round basis and all recreation criteria apply during the disinfection season of May 1 to October 1(CT Water Quality Standards 2011).

# 4. Bacteria-Impaired Waters

These waterbodies are included on the *2010 List of Connecticut Waterbodies Not Meeting Water Quality Standards* (*2010 List*) due to exceedances of the indicator bacteria criteria contained within the State *Water Quality Standards* (WQS). Under section 303(d) of the Federal Clean Water Act (CWA), States are required to develop TMDLs for waters impaired by pollutants that are included on the *2010 List, or subsequent revisions to the list*. Please refer to the most recent Impaired Waters List for more information on impaired waterbodies throughout the State. The *2010 List* is included as Appendix C in the *2010 Integrated Water Quality Report (IWQR) to Congress*, which contains information regarding all assessed waterbodies in the State.

The "*Consolidated Assessment and Listing Methodology"* (CT CALM) is included in the IWQR and describes the procedure by which DEEP assesses the quality of the State's waters relative to attainment of the WQS. This includes the protocols used by DEEP to assess water quality data, and to establish minimum standards to insure that only credible data are used to perform the assessments (CTDEEP, 2011b).

## 4.1 Monitoring for Compliance with Water Quality Standards & Source Identification

The Connecticut DEEP is responsible for assessing Connecticut's water quality and attainment of WQS. Assessment of impairment due to bacteria is based on repeated measures collected and processed according to quality assurance protocols.

In general, monitoring bacteria indicator organisms for source identification involves sampling ambient water quality under both dry and wet conditions because many sources of bacteria are diffuse and intermittent (rather than flowing from an identifiable pipe on a regular basis). High levels of bacteria during dry conditions indicate the presence of direct wastewater discharges, or contamination from groundwater leachate (from agriculture, leaking sewer pipes, illicit connections to stormdrains and septic systems), from recreational activities (swimmers and boaters), or from wildlife (including birds). High levels of bacteria during wet conditions (rainfall) indicate contamination from wildlife and domesticated animals (including pets), stormwater runoff (including municipal separate storm systems or MS4s), or discharges from combined sewer overflows (CSOs). Trying to monitor bacteria sources directly for accurate quantitative estimates of contributions from various sources is extremely difficult, time consuming, and expensive. A more reasonable monitoring approach is to use ambient data collected during both wet and dry conditions to estimate the bacteria levels from all contributing sources.

Although DEEP relies most heavily on data collected as part of the State's Ambient Monitoring Program, data from other State and federal agencies, local governments, drinking water utilities, volunteer organizations, and academic sources are also solicited and considered when making assessments.

The primary sources of assessment information to protect recreational uses on rivers are monitoring data collected by DEEP Planning and Standards staff and bacteria data collected at fixed sites by the United

States Geological Survey (USGS). For estuaries, use assessments are based primarily on bacterial monitoring for shellfish sanitation by the CT Department of Agriculture, Bureau of Aquaculture (CT DA/BA), and bathing beach monitoring by State and local authorities.

Once a waterbody is assessed as impaired TMDLs are developed including a load reduction for the segment to meet Water Quality Standards. As potential sources of pollutant loading are confirmed and monitored, additional programs at DEEP will utilize their regulatory responsibilities for getting the waterbody to attain its designated use standards.

For waterbodies with designated bathing areas, beach closure information rather than actual indicator bacteria data is generally used to determine use support (CTDEEP, 2011b). Closures of public bathing areas may be based on actual sampling data or based on administrative policies regarding rain events or other considerations. A complete discussion of Connecticut's practices related to beach monitoring and closure may be found in *Guidelines for Monitoring Bathing Waters and Closure Protocol* (http://www.ct.gov/dep/lib/dep/water/beach_monitoring/beachguide.pdf).

## 4.2 Waterbody Descriptions and Priority Ranking

This Statewide Bacteria TMDL report provides TMDL documentation for 134 bacteria-impaired freshwater segments and 46 bacteria-impaired saltwater segments on Connecticut’s 2010 303(d) List (Table 4-1). This is a total of 180 waterbody segments in the TMDL with 183 TMDLs due to three saltwater segments being impaired for both recreation and shellfishing. Additional bacteria-impaired segments identified and analyzed in the future will be listed and described in more detail by CT DEEP in Appendix A. Figure 4-1 shows the current Connecticut bacteria-impaired waterbody locations within 7 of the 8 major watersheds in the State based on the 2010 List. Detailed descriptions, maps and calculations to support the TMDL for impaired waters are provided in the appendices of this report.

Appendices include summaries of available bacteria data and GIS-based maps showing sampling locations and surrounding watershed areas. These appendices also provide a summary of the impaired watershed and known or suspected pollutant sources. The watershed summaries are intended to guide the process of further assessment and ultimate mitigation or elimination of bacteria sources in impaired waterbodies.

Section 303(d) of the Clean Water Act requires that waters on the 303(d) List be ranked in order of TMDL development priority. For the 2010 reporting cycle, DEEP provided a table in its *Integrated Water Quality Report* to indicate the TMDL development priority by year for specific waterbodies. According to this table, development of TMDLs for the several of the bacteria-impaired waters in this report was planned for 2011 and 2012. Additional impaired segments were able to have TMDLs developed for inclusion in this document. This segment expansion was possible due to reallocation of TMDL staff resources and the availability of additional datasets for calculating load reductions.

**Figure 4-1: Bacteria-Impaired Waterbodies Included in Initial TMDL and Major Watersheds in Connecticut.**

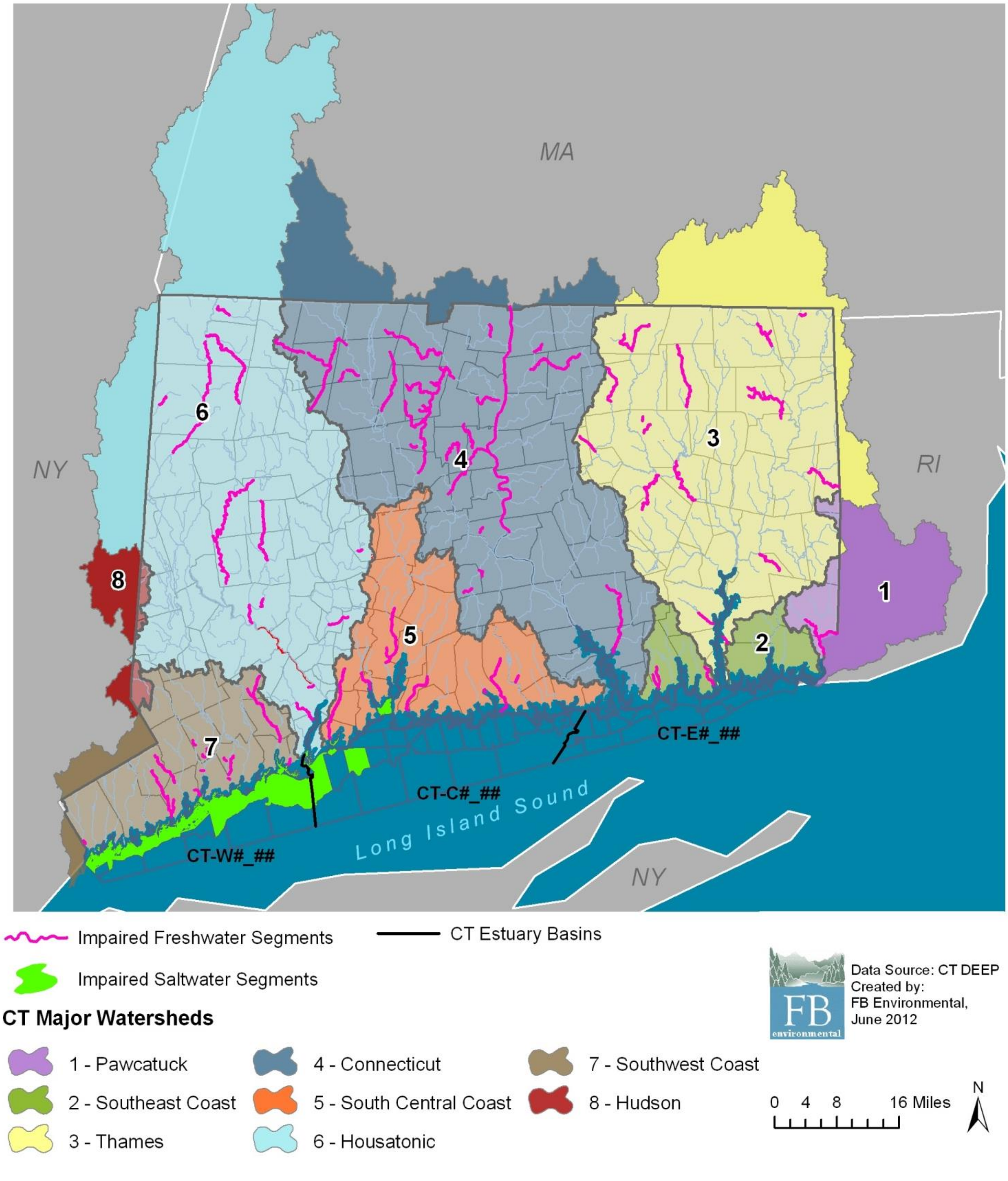

**Table 4-1: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT1004-00_01 | Shunock River | A | North Stonington | 4.37 | FULL | NOT | FULL* |
| CT2000-30_01 | Fenger Brook | A | New London | 3.47 | NOT | NOT | FULL* |
| CT2206-00_01 | Bride Brook | A | East Lyme | 0.7 | NOT | NOT | FULL* |
| CT2206-00_02 | Bride Brook | A | East Lyme | 2.13 | NOT | NOT | FULL |
| CT2206-03_01 | Bride Brook | A | East Lyme | 1.71 | U | NOT | U |
| CT3000-08_01 | Thames River / Flat Brook | A | Ledyard | 1.09 | U | NOT | FULL* |
| CT3004-00_01 | Oxoboxo Brook | B | Montville | 2.62 | U | NOT | FULL* |
| CT3100-00_06 | Willimantic River | B | Stafford | 0.4 | FULL | NOT | FULL |
| CT3100-17_03 | Willimantic River / Cedar Swamp Brook | A | Mansfield | 0.61 | U | NOT | FULL |
| CT3100-19_02 | Willimantic River / Eagleville Brook | A | Mansfield | 1.67 | NOT | NOT | FULL |
| CT3102-00_01 | Middle River | B | Stafford | 0.23 | FULL | NOT | FULL |
| CT3102-00_02 | Middle River | A | Stafford | 3.92 | FULL | NOT | FULL |
| CT3103-00_01 | Furnace Brook | B | Stafford | 0.18 | NOT | NOT | FULL |
| CT3103-00_02 | Furnace Brook | B | Stafford | 4.93 | FULL | NOT | FULL |
| CT3106-00_01b | Skungamaug River | A | Tolland | 6.29 | FULL | NOT | FULL |
| CT3106-06-1-L2_01 | Skungamaug River / Crandall Pond | A | Tolland | 2.63 | U | NOT | FULL* |
| CT3108-00_01b | Hop River | A | Andover, Coventry, Bolton | 3.22 | FULL | NOT | FULL |
| CT3110-00_01 | Tenmile River | A | Lebanon | 8.67 | FULL | NOT | FULL |
| CT3200-00_01 | Natchaug River / Lauter Park Beach | A | Windham, Chaplin, Eastford | 3.38 | U | NOT | FULL* |
| CT3206-00_02 | Mount Hope River | AA | Ashford, Mansfield | 9.99 | U | NOT | FULL* |
| CT3207-16-1-L1_01 | Fenton River / Bicentennial Pond | A | Mansfield | 6.05 | U | NOT | FULL* |
| CT3300-00_01 | French River / Long Branch Brook | B | Thompson | 4.61 | U | NOT | FULL* |
| CT3500-00_03 | Moosup River | B | Plainfield, Sterling | 7.36 | U | NOT | FULL* |
| CT3708-01_01 | Little River / Muddy Brook | AA | Woodstock | 5.44 | U | NOT | FULL* |
| CT3708-08_01 | Little River / Peckham Brook | AA | Woodstock | 0.89 | U | NOT | U |
| CT3710-00_02 | Mashamoquet Brook | A | Pomfret | 4.36 | FULL | NOT | FULL* |
| CT3710-00_01 | Mashamoquet Brook | A | Pomfret | 3.06 | FULL | NOT | FULL |

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**Table 4-1, cont'd: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT3710-11_01 | Mashamoquet Brook / Abington Brook | A | Pomfret | 1.75 | U | NOT | U |
| CT3710-13_01 | Mashamoquet Brook / Sap Tree Run | A | Pomfret | 1.09 | U | NOT | U |
| CT3710-18_01 | Mashamoquet Brook / White Brook | A | Pomfret, Brooklyn | 3.07 | U | NOT | U |
| CT3716-00_01 | Broad Brook | A | Preston | 4.73 | NOT | NOT | FULL* |
| CT3800-00_05 | Shetucket River | B | Norwich, Scotland, Sprague, Windham | 4.99 | NOT | NOT | FULL* |
| CT3800-02_01 | Shetucket River / Obwebetuck Brook | A | Windham, Lebanon | 0.55 | | *** | |
| CT4000-00_01 | Connecticut River | B | Suffield, Enfield, Windsor, Windsor Locks, South Windsor, East Hartford | 10.27 | U | NOT | NOT |
| CT4000-00_03 | Connecticut River | B | Glastonbury, Wethersfield, Hartford | 35.26 | U | NOT | NOT |
| CT4009-00-2-L4_01 | Roaring Brook / Angus Park Pond | A | Glastonbury | 9.35 | U | NOT | U |
| CT4101-00_01 | Muddy Brook | A | Suffield | 2.23 | NOT | NOT | FULL* |
| CT4205-00_01 | Buckhorn Brook | A | Enfield | 2.02 | U | NOT | FULL* |
| CT4206-00_01 | Broad Brook | A | East Windsor | 1.01 | NOT | NOT | FULL* |
| CT4206-00_02 | Broad Brook | A | East Windsor, Ellington | 9.01 | NOT | NOT | FULL* |
| CT4300-00_02 | Farmington River | B | East Granby, Simsbury, Avon, Farmington | 19.38 | FULL | NOT | FULL* |
| CT4300-32_01 | Farmington River / Minister Brook | A | Simsbury | 1.82 | U | NOT | FULL* |
| CT4300-33_01 | Farmington River / Russell Brook | A | Simsbury | 1.25 | U | NOT | FULL* |
| CT4300-39_01 | Farmington River / Owens Brook | A | Simsbury | 1.05 | U | NOT | FULL* |
| CT4300-44_01 | Farmington River / Munnisunk Brook | A | Simsbury, Granby | 0.89 | U | NOT | FULL* |
| CT4302-00_01 | Mad River | B | Winchester, Norfolk | 2.24 | NOT | NOT | FULL* |
| CT4302-00_02a | Mad River | A | Winchester, Norfolk | 1.77 | U | NOT | FULL* |
| CT4302-00_03 | Mad River | AA | Winchester, Norfolk | 5.17 | FULL | NOT | FULL* |
| CT4303-00_02 | Still River | B | Winchester, Colebrook, Torrington | 2.67 | NOT | NOT | FULL* |
| CT4303-00_03 | Still River | B | Winchester, Colebrook, Torrington | 1.67 | NOT | NOT | FULL* |

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**Table 4-1, cont'd: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT4303-00_04 | Still River | A | Winchester, Colebrook, Torrington | 7.56 | U | FULL** | FULL* |
| CT4304-00_01a | Sandy Brook | B | Colebrook, Norfolk | 1.35 | FULL | NOT | FULL* |
| CT4305-00_01 | Morgan Brook | A | Barkhamsted | 0.69 | FULL | NOT | FULL* |
| CT4305-00_02 | Morgan Brook | A | Barkhamsted | 1.41 | U | NOT | FULL* |
| CT4305-00_04 | Morgan Brook | A | Barkhamsted | 1.52 | FULL | NOT | FULL* |
| CT4309-00_01 | Cherry Brook | A | Canton | 2.05 | FULL | NOT | FULL* |
| CT4309-00_02 | Cherry Brook | A | Canton | 0.66 | U | NOT | FULL* |
| CT4316-00_02 | Thompson Brook | A | Avon | 1.24 | U | U** | FULL* |
| CT4317-00_01 | Nod Brook | A | Avon, Simsbury | 6.61 | U | NOT | FULL* |
| CT4318-00_01 | Hop Brook | A | Simsbury | 6.74 | FULL | NOT | FULL* |
| CT4319-00_01a | West Branch Salmon Brook | A | Granby, Hartland | 1.4 | FULL | NOT | FULL* |
| CT4319-00_01b | West Branch Salmon Brook | A | Granby, Hartland | 11.29 | FULL | NOT | FULL* |
| CT4321-00_01 | Mill Brook | A | Windsor, Bloomfield | 4.56 | NOT | NOT | FULL* |
| CT4400-00_01 | Park River | B | Hartford | 2.39 | NOT | NOT | FULL |
| CT4400-01_01 | S Branch Park River | B | Hartford | 0.32 | NOT | NOT | FULL |
| CT4400-01_02 | S Branch Park River | B | Hartford | 2.62 | NOT | NOT | FULL |
| CT4402-00_01 | Piper Brook | B | West Hartford | 0.05 | NOT | NOT | FULL |
| CT4402-00_02 | Piper Brook | B | West Hartford, New Britain | 5.81 | NOT | NOT | FULL |
| CT4403-00_01 | Trout Brook | A | West Hartford | 1.07 | NOT | NOT | FULL |
| CT4403-00_02 | Trout Brook | A | West Hartford | 0.88 | NOT | NOT | FULL |
| CT4403-00_03 | Trout Brook | A | West Hartford | 5.95 | NOT | NOT | FULL |
| CT4404-00_01 | N Branch Park River | A | Hartford | 0.51 | NOT | NOT | FULL |
| CT4404-00_02 | N Branch Park River | A | Bloomfield, Hartford, West Hartford | 5.39 | NOT | NOT | FULL |

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**Table 4-1, cont'd: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT4600-27_trib_01 | Mattabesset River/ Willow Brook East Branch | A | Cromwell | 0.76 | U | NOT | FULL* |
| CT4607-00-UL_pond_01 | Coginchaug River / Wadsworth Falls SP pond | A | Middletown, Middlefield | 1.37 | U | NOT | U |
| CT4607-08_01 | Coginchaug River / Lyman Meadows Brook | A | Middletown, Middlefield | 1.43 | U | NOT | FULL* |
| CT4607-13_01 | Coginchaug River / Laurel Brook | A | Middletown, Middlefield | 1.17 | U | NOT | FULL* |
| CT4800-00_01 | Eightmile River | A | Lyme, East Haddam | 12.22 | FULL | NOT | FULL* |
| CT5105-00_01 | Chatfield Hollow Brook | A | Killingworth | 1.03 | FULL | NOT | FULL* |
| CT5107-00_01 | Neck River | A | Madison | 9.49 | U | NOT | FULL* |
| CT5108-00_01 | East River | A | Guilford | 0.67 | U | NOT | FULL* |
| CT5112-00_01 | Farm River | A | East Haven, North Branford | 6.14 | NOT | NOT | FULL* |
| CT5112-00_02 | Farm River | AA | East Haven, North Branford | 1.24 | NOT | NOT | FULL* |
| CT5202-00-1-L3_01 | Tenmile River / Mixville Pond | A | Cheshire | 10.68 | U | NOT | FULL* |
| CT5302-00_02 | Mill River | AA | Hamden, Cheshire, North Haven | 9.06 | U | NOT | FULL* |
| CT5302-06_01 | Mill River / Shepard Brook | AA | Hamden, Cheshire, North Haven | 1.75 | U | NOT | U |
| CT5305-00_01 | West River | A | New Haven | 3.23 | NOT | NOT | FULL* |
| CT5305-00-3-L1_01 | Edgewood Park Pond | A | New Haven | 2.72 | FULL | NOT | FULL* |
| CT5307-00_01 | Wepawaug River | A | Milford, Orange, Woodbridge | 0.77 | U | NOT | FULL* |
| CT5307-00_02 | Wepawaug River | A | Milford, Orange, Woodbridge | 4.2 | U | NOT | FULL* |
| CT5307-00_03 | Wepawaug River | A | Milford, Orange, Woodbridge | 2.33 | FULL | NOT | FULL |
| CT5307-00_04 | Wepawaug River | AA | Milford, Orange, Woodbridge | 3.05 | /// | NOT | FULL |
| CT5307-00_05 | Wepawaug River | AA | Milford, Orange, Woodbridge | 0.99 | U | NOT | FULL |
| CT6000-00_06 | Housatonic River | B | Cornwall, Kent, Salisbury | 18.23 | FULL | NOT | NOT |

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**Table 4-1, cont'd: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT6000-00-5+L2_01 | Housatonic River /Lake Zoar | B | Southbury | 580.57 | FULL | NOT | NOT |
| CT6000-00-5+L4_01 | Housatonic River / Lake Housatonic | B | Shelton | 346.29 | FULL | NOT | NOT |
| CT6000-73_01 | Housatonic River / Curtiss Brook | AA | Shelton | 0.8 | | *** | |
| CT6025-00_02 | Farmill River | B | Stratford, Shelton | 3.99 | FULL | NOT | FULL* |
| CT6100-00_02a | Blackberry River | B | North Canaan, Norfolk | 2.75 | FULL | NOT | NOT |
| CT6200-00_01 | Hollenbeck River | A | Canaan | 18.32 | FULL | NOT | FULL* |
| CT6302-00_02 | Mill Brook | A | Sharon | 1.66 | U | NOT | FULL* |
| CT6700-20_01 | Shepaug River / Walker Brook | AA | Washington, Roxbury, New Milford | | | *** | |
| CT6705-00_01 | Bantam River | AA | Morris, Litchfield | 4.53 | FULL | U** | FULL* |
| CT6800-00_03 | Pomperaug River | A | Southbury, Woodbury | 1.31 | U | NOT | FULL* |
| CT6800-01_01 | Pomperaug River | B | Southbury, Woodbury | 2.74 | FULL | U** | FULL* |
| CT6804-00_01 | Weekeepeemee River | A | Woodbury, Bethlehem | 9.61 | FULL | U** | FULL* |
| CT6900-28_01 | Naugatuck River / Hockanum Brook | A | Beacon Falls | 3.17 | FULL | NOT | FULL* |
| CT6914-06-1-L1_01 | Mad River / Hitchcock Lake | A | Waterbury, Wolcott | 100.3 | FULL | NOT | FULL* |
| CT6914-06_01 | Mad River / Lilly Brook | A | Waterbury | 0.74 | | *** | |
| CT7000-22_01 | Indian River | A | Westport | 0.53 | U | NOT | FULL* |
| CT7000-22_02 | Indian River | A | Westport | 0.94 | U | NOT | FULL* |
| CT7102-00_02 | Bruce Brook | B | Stratford, Bridgeport | 0.22 | NOT | NOT | FULL* |
| CT7105-00_05 | Pequonnock River | A | Bridgeport, Trumbull | 2.35 | U | NOT | FULL* |
| CT7105-00_02 | Pequonnock River | A | Bridgeport, Trumbull | 2.92 | NOT | NOT | FULL |
| CT7105-00_03 | Pequonnock River | A | Bridgeport, Trumbull | 4.19 | NOT | NOT | FULL |
| CT7105-00_04 | Pequonnock River | A | Bridgeport, Trumbull | 1.83 | U | NOT | FULL |
| CT7105-01_01 | West Branch Pequonnock River | A | Bridgeport, Trumbull | 1.51 | U | NOT | FULL |
| CT7109-00-trib_01 | Sasco Brook / Great Brook | A | Fairfield | 0.61 | FULL | U** | FULL* |
| CT7109-06_01 | Sasco Brook / Great Brook | A | Fairfield | 0.72 | U | NOT | FULL* |

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**Table 4-1, cont'd: Freshwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Length (miles or acres) | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|---|
| CT7109-02_01 | Sasco Brook / Unnamed Tributary | A | Fairfield | 0.61 | FULL | NOT | FULL |
| CT7109-06_02 | Sasco Brook / Great Brook | A | Fairfield | 2.2 | U | NOT | FULL |
| CT7200-22_01 | Saugatuck River / Beaver Brook | A | Weston | 1.02 | U | NOT | FULL* |
| CT7200-24_01 | Saugatuck River / Kettle Creek | A | Weston | 0.62 | U | NOT | FULL* |
| CT7200-26_01 | Saugatuck River / Poplar Plain Brook | A | Westport | 0.5 | U | NOT | FULL* |
| CT7203-04_01 | West Branch Saugatuck River / Cobbs Mill Brook | A | Weston | 0.89 | U | NOT | FULL |
| CT7302-00_02 | Silvermine River | A | Norwalk | 5.49 | U | NOT | FULL* |
| CT7401-00_02 | Fivemile River | B | New Canaan | 0.23 | NOT | NOT | FULL* |
| CT7401-00_01 | Fivemile River | B | New Canaan | 5.62 | U | NOT | FULL |
| CT7401-00_03 | Fivemile River | A | New Canaan | 1.82 | NOT | NOT | FULL |
| CT7401-02_01 | Fivemile River / Unnamed Tributary | A | New Canaan | 0.2 | U | NOT | U |
| CT7401-05_01 | Fivemile River / Holy Ghost Father's Brook | A | Norwalk | 0.61 | U | NOT | U |
| CT7401-06_01 | Fivemile River / Keelers Brook | A | Norwalk | 1.08 | U | NOT | U |
| CT7401-07_01 | Fivemile River / Unnamed Tributary to Keelers Brook | A | Norwalk | 1.03 | U | NOT | U |
| CT7411-00_01 | Byram River | B | Greenwich | 0.49 | NOT | NOT | FULL* |

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**Table 4-2: Saltwater Segments Included in this TMDL Report (2010 303(d) List).**

| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Square Miles | Marine Aquatic Life | Recreation | Direct Shellfish | Commercial Shellfish | Fish Consumption |
|---|---|---|---|---|---|---|---|---|---|
| CT-W1_013-SB | LIS WB Inner - Norwalk Harbor (Marvin Beach) | SB | Norwalk | 0.04 | NOT | NOT | /// | FULL | FULL |
| CT-W2_011 | LIS WB Shore - Canfield Island | SA | Westport | 0.43 | U | U | NOT | /// | FULL* |
| CT-W2_012 | LIS WB Shore - Outer Norwalk Harbor(East) | SA | Norwalk | 0.26 | NOT | FULL | NOT | /// | FULL |
| CT-W2_013 | LIS WB Shore - Outer Norwalk Harbor(West) | SA | Norwalk | 0.37 | NOT | FULL | NOT | /// | FULL |
| CT-W2_014 | LIS WB Shore - Wilson Cove, Farm Creek | SA | Norwalk | 0.42 | U | FULL | NOT | /// | FULL |
| CT-W3_008-I | LIS WB Midshore - Norwalk Islands | SA | Westport, Norwalk | 5.94 | NOT | U | NOT | /// | FULL |
| CT-W1_022-SB | LIS WB Inner - Byram River | SB | Greenwich | 0.04 | U | NOT | /// | NOT | FULL |
| CT-W2_018 | LIS WB Shore - Westcott Cove | SA | Stamford | 0.37 | U | FULL | NOT | /// | FULL |
| CT-W2_019 | LIS WB Shore - Stamford Harbor | SA | Stamford | 0.52 | U | U | NOT | /// | FULL |
| CT-W2_020 | LIS WB Shore - Stamford Harbor (West) | SA | Stamford | 0.54 | U | FULL | NOT | /// | FULL |
| CT-W2_021 | LIS WB Shore - Greenwich Cove | SA | Greenwich | 1.24 | U | U | NOT | /// | FULL |
| CT-W2_022 | LIS WB Shore - Cos Cob Harbor | SA | Greenwich | 0.70 | U | U | NOT | /// | FULL |
| CT-W2_024 | LIS WB Shore - Byram Harbor | SA | Greenwich | 0.34 | U | NOT | NOT | /// | FULL |
| CT-W2_025 | LIS WB Shore - Byram Harbor (West) | SA | Greenwich | 0.24 | U | U | NOT | /// | FULL |
| CT-W3_011 | LIS WB Midshore - Outer Westcott Cove | SA | Stamford | 2.40 | NOT | U | NOT | /// | FULL |
| CT-W3_012 | LIS WB Midshore - Outer Stamford Harbor | SA | Stamford, Greenwich | 2.10 | NOT | U | NOT | /// | FULL |
| CT-W3_015-I | LIS WB Midshore - Captain Harbor | SA | Greenwich | 3.42 | NOT | FULL | NOT | /// | FULL |
| CT-W2_015 | LIS WB Shore - Fivemile River Estuary | SA | Norwalk, Darien | 0.34 | U | FULL | NOT | /// | FULL |

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| 305B Seg # | Waterbody | WQ Class | Waterbody Towns | Square Miles | Marine Aquatic Life | Recreation | Direct Shellfish | Commercial Shellfish | Fish Consumption |
|---|---|---|---|---|---|---|---|---|---|
| CT-W2_016 | LIS WB Shore - Scott Cove | SA | Darien | 0.72 | U | U | NOT | /// | FULL |
| CT-W2_017 | LIS WB Shore - Darien Cove | SA | Darien, Stamford | 0.50 | U | FULL | NOT | /// | FULL |
| CT-W3_009 | LIS WB Midshore - Outer Fivemile River Estuary | SA | Norwalk, Darien | 2.45 | NOT | U | NOT | /// | FULL |
| CT-W3_010 | LIS WB Midshore - Outer Cove Harbor | SA | Darien, Stamford | 2.11 | NOT | U | NOT | /// | FULL |
| CT-W1_005 | LIS WB Inner - Southport Harbor | SA | Fairfield | 0.07 | U | U | NOT | /// | FULL |
| CT-W1_008 | LIS WB Inner - Sherwood Millpond | SA | Westport | 0.17 | U | U | NOT | /// | FULL |
| CT-W1_010-SB | LIS WB Inner - Saugatuck River (Mouth) | SB | Westport | 0.64 | U | U | /// | NOT | FULL |
| CT-W2_006 | LIS WB Shore - Southport Harbor (East) | SA | Fairfield | 0.18 | U | FULL | NOT | /// | FULL |
| CT-W2_007 | LIS WB Shore - Southport Harbor (West) | SA | Fairfield | 0.19 | U | FULL | NOT | /// | FULL |
| CT-W2_009 | LIS WB Shore - Compo Cove, SISP | SA | Westport | 0.32 | U | FULL | NOT | /// | FULL |
| CT-W2_010 | LIS WB Shore - Compo Beach, Cedar Point | SA | Westport | 0.42 | U | FULL | NOT | /// | FULL |
| CT-W3_005 | LIS WB Midshore - Southport Harbor | SA | Fairfield, Westport | 5.27 | NOT | U | NOT | /// | FULL |
| CT-W3_006 | LIS WB Midshore - Sherwood Point | SA | Westport | 9.69 | NOT | U | NOT | /// | FULL |
| CT-C1_018-SB | LIS CB Inner - Milford Harbor & Gulf Pond | SB | Milford | 0.27 | U | U | /// | NOT | FULL |
| CT-C1_019-SB | LIS CB Inner - Housatonic River (Mouth) | SB | Milford | 0.81 | NOT | U | /// | NOT | FULL |
| CT-C2_023 | LIS CB Shore - Walnut Beach | SA | Milford | 0.58 | U | FULL | NOT | /// | FULL |

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|---|---|---|---|---|---|---|---|---|---|
| CT-C3_017 | LIS CB Midshore - Milford | SA | Milford, West Haven | 8.09 | NOT | U | NOT | /// | FULL |
| CT-C3_019-I | LIS CB Midshore - Outer Silver Sand Beach | SA | Milford | 0.57 | U | U | NOT | /// | FULL |
| CT-C3_020 | LIS CB Midshore - Milford Point | SA | Milford | 10.66 | NOT | U | NOT | /// | FULL |
| CT-C1_013-SB | LIS CB Inner - New Haven Harbor | SB | New Haven | 2.34 | NOT | NOT | /// | NOT | FULL |
| CT-W1_001-SB | LIS WB Inner - Bridgeport Harbor | SB | Bridgeport | 1.43 | NOT | NOT | /// | NOT | FULL |
| CT-W1_002-SB | LIS WB Inner - Black Rock Harbor | SB | Bridgeport | 0.44 | NOT | NOT | /// | NOT | FULL |
| CT-W2_004 | LIS WB Shore - Outer Bridgeport Harbor | SA | Fairfield | 0.41 | U | FULL | NOT | /// | FULL |
| CT-W3_001 | LIS WB Midshore - Lordship | SA | Stratford | 7.92 | NOT | U | NOT | /// | FULL |
| CT-W3_002 | LIS WB Midshore - Bridgeport Harbor (East) | SA | Stratford, Bridgeport | 8.08 | NOT | U | NOT | /// | FULL |
| CT-W3_003 | LIS WB Midshore - Bridgeport Harbor (West) | SA | Bridgeport | 6.06 | NOT | U | NOT | /// | FULL |
| CT-W3_004 | LIS WB Midshore - Shoal Point | SA | Bridgeport, Fairfield | 4.15 | NOT | U | NOT | /// | FULL |

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I= Insufficient Information to assess use.
FULL*= No water body specific fish consumption advisory other than applicable statewide or regional advisories. Refer to Connecticut Department of Environmental Protection Angler's Guide, or online at www.ct.gov/dep for more information about fish consumption advisories.
U** or FULL** = Based on 2010 data , these segments have been deemed Not Supporting for Recreation by DEEP, which will be reflected on the 2012 303(d) List.
*** = Based on 2010 data , these segments have been deemed Not Supporting for Recreation by DEEP and will be added to the 2012 303(d) List.

# 5. TMDL

## 5.1 TMDL Definition

A TMDL identifies the amount of a pollutant that a receiving water can assimilate without exceeding water quality criteria or impairing the designated use. It is the loading capacity of a waterbody including a margin of safety (MOS) to account for uncertainty in target-setting. The TMDL allocates pollutant loads among permitted point source discharges, under Section 402 of the CWA National Pollutant Discharge Elimination System, and nonpoint source discharges. A TMDL can be represented as:

$$TMDL = Loading\ Capacity = \sum WLA + \sum LA + MOS$$

Where:

$\sum WLA$ = sum of the Waste Load Allocations (i.e., point sources including NPDES-regulated stormwater)

$\sum LA$ = sum of the Load Allocations (i.e., natural background, nonpoint sources, and stormwater not regulated by NPDES)

$MOS$ = Margin of Safety

The loading allocations can be expressed as a mass per unit time, concentration, or other appropriate measures. The WLA and LA both need to account for existing and future loads.

The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a reserved portion of the loadings), discussed in more detail below.

## 5.2 Loading Capacity, MOS, and Allocations

Connecticut's bacteria TMDLs consist of two formats of targets for allowable levels of bacteria:

- Concentrations of bacteria (expressed as bacteria counts/100mL of water)
- Loads of bacteria (expressed as numbers of bacteria/day)

Both formats express targets designed to attain the designated uses of recreation (e.g., swimming and boating) and shellfishing, and to meet the associated criteria in Connecticut's water quality standards (WQS). Connecticut considers these targets to apply every day. Both formats of the TMDLs are considered by DEEP to be daily targets. The targets apply on any given day to assure achievement of bacteria water quality criteria whenever the WQS are in effect.

These TMDLs set a goal of meeting bacteria water quality criteria at the point of discharge for all sources in order to meet WQS throughout the waterbody. Of the two TMDL formats presented, Connecticut DEEP believes that the concentration-based TMDL is most useful format for guiding both remediation and protection efforts in watersheds. A concentration target is more readily understandable, and allows interested stakeholders, citizens and/or watershed groups to determine easily whether any particular source is exceeding its allocation. Appendix 1 contains graphs, tables, and equations that express the TMDLs as daily loads in terms of numbers of organisms/day.

As mentioned above, the MOS, which accounts for assumptions or lack of knowledge about linking loading allocations with water quality impairment, can be explicit or implicit. The two types or forms of the bacteria TMDL targets described in more detail below have different types of MOS due to the different calculations used for TMDL development.

### 5.2.1 Concentration TMDLs

The concentrations of bacteria are expressed in terms of colony forming units or bacteria counts per 100mL sample (counts/100mL) for the indicator bacterium of concern (e.g., *E coli*, Enterococcus, Fecal Coliform, or Total Coliform). The TMDL is based on the assumption that the amount of bacteria expressed in concentration units is equal to the loading capacity.

The TMDLs contain an implicit MOS by using the following conservative assumptions during the analysis: The TMDLs are set equal to the appropriate WQS for each waterbody segment and include the goal of meeting bacteria water quality criteria at the point of discharge for all sources. This means the TMDLs do not rely on dilution in the waterbody to meet WQS. In addition, the TMDLs do not rely on in-stream processes such as bacteria die-off and settling, which are known to reduce in-stream bacteria concentrations. Consequently, the Connecticut bacteria TMDLs represent very conservative TMDL target-setting, so there is a high level of confidence that the TMDLs established are consistent with WQS, and the entire loading capacity can be allocated among sources. For these reasons, the MOS is implicit, and the explicit MOS shown in the general TMDL formula above is set equal to zero. For concentration TMDLs which are independent of flow, the standard formula changes to:

*TMDL = Loading Capacity = Water Quality Criterion*

*(The TMDL or water quality criterion is applied to the WLA for allowable regulated sources, and to the LA for allowable nonpoint sources.)*

The TMDL allocates the load among sources, identifying wasteload allocations (WLA) for NPDES-regulated sources, and load allocations (LA) for nonpoint sources and natural background. The numeric value of the TMDL, WLA, and LA depends on whether the source of bacteria is prohibited or allowable, and the appropriate water quality criterion for the receiving water, as follows:

- If the **source** of the bacteria load is **prohibited** (e.g., failing septic systems, or illicit discharges), **the WLA or LA is set equal to zero.**
- If the **source** of the bacteria load is **allowable**, **the WLA or LA is set equal to the applicable water quality criterion for bacteria in the receiving water** (depending on its classification).

The underlying assumption in setting a concentration TMDL for bacteria is that if all sources are below the WQS, then the concentration of bacteria within the receiving water will attain WQS. Using this methodology implies a goal of meeting bacteria standards at the point of discharge for all sources. Although end of pipe bacteria measurements can identify and help prioritize sources that require attention, compliance with this TMDL will be based on ambient water quality and not water quality at the point of discharge (i.e., end of pipe). All numeric values in the following tables (5-1 through 5-4) are listed as targets for discharge outfalls, unless otherwise specified by other regulatory programs or statutes. However, the WLA for non-stormwater NPDES discharges are expected to used as regulatory limits on discharge quality at the end of pipe. In all cases, these numeric WLA and LA values will not replace the use of ambient instream monitoring data for determining compliance with this TMDL.

Table 3-2 in Section 3.2 provides a summary of the water quality criteria applicable to Connecticut surface waters. There are two types of criteria for fresh and marine waters (non-shellfish harvesting areas) in the State: instantaneous sample and geometric mean. Shellfish harvesting waters have two additional standards that have been adopted by the State from the National Shellfish Sanitation Program. These additional shellfish area standards are based on geometric means or sample number percentages under either a random sampling or adverse pollutant condition (e.g., wet weather, during effluent discharge, etc). According to Connecticut Water Quality Standards number 8, all Water Quality Criteria do not apply to environmental conditions brought about by natural causes or conditions (CT DEEP 2011a).

Tables 5-1 through 5-4 present the loading allocations concentration bacteria TMDLs by waterbody class and potential bacteria source. These tables represent WLAs and LAs based on WQS current as of the publication date of these TMDLs. If the bacteria criteria change in the future, DEEP intends to revise the TMDL to reflect the revised criteria, with opportunity for public review and comment. There are no permitted NPDES discharges, other than stormwater, allowed in Class AA or SA, therefore these sources are not listed in the tables for those classes.

The estimated percent reduction needed to achieve the TMDLs for each included impaired segment is provided in Table 8-2 and the corresponding appendix. The reduction calculations are based on estimates of current loadings. The estimated percent reduction needed is calculated based on the difference between measured bacteria data and the water quality criteria for bacteria. Future development activities and land use changes have the potential to increase levels of bacteria or stormwater runoff associated with bacterial pollutants. These future activities will need to meet the TMDLs and be addressed in applicable watershed management plans and by State and/or local requirements.

**Table 5-1: Bacteria (*E. coli)* TMDLs, WLAs, and LAs for Fresh Water (not drinking water supply).**

| | | Instantaneous *E. coli* (#/100mL) | | | | | | Geometric Mean *E. coli* (#/100mL) | |
|---|---|---|---|---|---|---|---|---|---|
| **Class** | **Bacteria Source** | **WLA[6]** | | | **LA[6]** | | | **WLA[6]** | **LA[6]** |
| | **Recreational Use** | 1 | 2 | 3 | 1 | 2 | 3 | **All** | **All** |
| AA | Illicit sewer connection | 0 | 0 | 0 | | | | 0 | |
| | Leaking sewer lines | 0 | 0 | 0 | | | | 0 | |
| | Stormwater (MS4s) | 235[7] | 410[7] | 576[7] | | | | 126[7] | |
| | Stormwater (non-MS4) | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Wildlife direct discharge | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Human or domestic animal direct discharge[5] | | | | 235 | 410 | 576 | | 126 |
| A | Non-Stormwater NPDES | 0 | 0 | 0 | | | | 0 | |
| | CSOs | 0 | 0 | 0 | | | | 0 | |
| | SSOs | 0 | 0 | 0 | | | | 0 | |
| | Illicit sewer connection | 0 | 0 | 0 | | | | 0 | |
| | Leaking sewer lines | 0 | 0 | 0 | | | | 0 | |
| | Stormwater (MS4s) | 235[7] | 410[7] | 576[7] | | | | 126[7] | |
| | Stormwater (non-MS4) | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Wildlife direct discharge | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Human or domestic animal direct discharge[5] | | | | 235 | 410 | 576 | | 126 |
| B[4] | Non-Stormwater NPDES | 235 | 410 | 576 | | | | 126 | |
| | CSOs | 235 | 410 | 576 | | | | 126 | |
| | SSOs | 0 | 0 | 0 | | | | 0 | |
| | Illicit sewer connection | 0 | 0 | 0 | | | | 0 | |
| | Leaking sewer lines | 0 | 0 | 0 | | | | 0 | |
| | Stormwater (MS4s) | 235[7] | 410[7] | 576[7] | | | | 126[7] | |
| | Stormwater (non-MS4) | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Wildlife direct discharge | | | | 235[7] | 410[7] | 576[7] | | 126[7] |
| | Human or domestic animal direct discharge[5] | | | | 235 | 410 | 576 | | 126 |

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Energy and Environmental Protection and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

**Table 5-2: Bacteria (Enterococcus) TMDLs, WLAs, and LAs for Estuarine and Marine Waters (recreational areas).**

| | | Instantaneous Enterococcus (#/100mL) | | | | Geometric Mean Enterococcus (#/100mL) | |
|---|---|---|---|---|---|---|---|
| **Class** | **Bacteria Source** | **WLA[6]** | | **LA[6]** | | **WLA[6]** | **LA[6]** |
| | **Recreational Use** | **1** | **2** | **1** | **2** | **All** | **All** |
| SA[5] | Illicit sewer connection | 0 | 0 | | | 0 | |
| | Leaking sewer lines | 0 | 0 | | | 0 | |
| | Stormwater (MS4s) | 104[7] | 500[7] | | | 35[7] | |
| | Stormwater (non-MS4) | | | 104[7] | 500[7] | | 35[7] |
| | Wildlife direct discharge | | | 104[7] | 500[7] | | 35[7] |
| | Human or domestic animal direct discharge[3] | | | 104 | 500 | | 35 |
| SB[5] | Non-Stormwater NPDES | 104 | 500 | | | 35 | |
| | CSOs | 104 | 500 | | | 35 | |
| | SSOs | 0 | 0 | | | 0 | |
| | OBDs[4] | 0 | 0 | | | 0 | |
| | Illicit sewer connection | 0 | 0 | | | 0 | |
| | Leaking sewer lines | 0 | 0 | | | 0 | |
| | Stormwater (MS4s) | 104[7] | 500[7] | | | 35[7] | |
| | Stormwater (non-MS4) | | | 104[7] | 500[7] | | 35[7] |
| | Wildlife direct discharge | | | 104[7] | 500[7] | | 35[7] |
| | Human or domestic animal direct discharge[3] | | | 104 | 500 | | 35 |

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **All Other Recreational Uses.**

(3) Human direct discharge = swimmers

(4) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs) from marine vessels with Marine Sanitation Devices.

(5) WLA and LA refer to Enterococcus of human and domestic animal origin

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

**Table 5-3: Bacteria (Fecal Coliform) TMDLs WLAs, and LAs for Shellfish Harvesting Areas.**

| | | Geometric Mean Fecal coliform (#/100mL)[4] | | 90% of samples less than Fecal Coliform (#/100mL)[4] | |
|---|---|---|---|---|---|
| **Class** | **Bacteria Source[1]** | **WLA[5]** | **LA[5]** | **WLA[5]** | **LA[5]** |
| SA Direct Consumption | CSOs | 14 | | 31 | |
| | SSOs | 0 | | 0 | |
| | OBDs[3] | 0 | | 0 | |
| | Illicit sewer connection | 0 | | 0 | |
| | Leaking sewer lines | 0 | | 0 | |
| | Stormwater (MS4s) | 14[6] | | 31[6] | |
| | Stormwater (non-MS4) | | 14[6] | | 31[6] |
| | Wildlife direct discharge | | 14[6] | | 31[6] |
| | Human or domestic animal direct discharge[2] | | 14 | | 31 |
| SB Indirect Consumption | Non-Stormwater NPDES | 88 | | 260 | |
| | CSOs | 88 | | 260 | |
| | SSOs | 0 | | 0 | |
| | OBDs[3] | 0 | | 0 | |
| | Illicit sewer connection | 0 | | 0 | |
| | Leaking sewer lines | 0 | | 0 | |
| | Stormwater (MS4s) | 88[6] | | 260[6] | |
| | Stormwater (non-MS4) | | 88[6] | | 260[6] |
| | Wildlife direct discharge | | 88[6] | | 260[6] |
| | Human or domestic animal direct discharge[2] | | 88 | | 260 |

(1) Criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document *Guide for the Control of Molluscan Shellfish 2009.*

(2) Human direct discharge = swimmers

(3) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs) from marine vessels with Marine Sanitation Devices.

(4) Adverse Condition Allocations apply to areas affected by Point Sources. Adverse Condition or Random Sampling Allocations apply to areas affected by Nonpoint Sources. Adverse condition is defined as "... a State or situation caused by meteorological, hydrological or seasonal events or point source discharges that has historically resulted in elevated [bacteria] levels in the particular growing area." USFDA 2005

(5) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(6) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

**Table 5-4: Bacteria (Total Coliform) TMDLs, WLAs, and LAs for Drinking Water Supply.**

| | | Monthly Moving Average Total Coliform (#/100mL | | Single Sample Maximum Total Coliform (#/100mL) | |
|---|---|---|---|---|---|
| **Class** | **Bacteria Source[1]** | **WLA[3]** | **LA[3]** | **WLA[3]** | **LA[3]** |
| AA, Existing/Proposed | Non-Stormwater NPDES | <100 | | 500 | |
| | CSOs | <100 | | 500 | |
| | SSOs | 0 | | 0 | |
| | OBDs[2] | 0 | | 0 | |
| | Illicit sewer connection | 0 | | 0 | |
| | Leaking sewer lines | 0 | | 0 | |
| | Stormwater (MS4s) | <100[4] | | 500[4] | |
| | Stormwater (non-MS4) | | <100[4] | | 500[4] |
| | Wildlife direct discharge | | <100[4] | | 500[4] |
| | Human or domestic animal direct discharge | | <100 | | 500 |

(1) Criteria applies only at the drinking water supply intake structure.

(2) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs) from marine vessels with Marine Sanitation Devices

(3) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(4) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife input

## 5.3 Seasonal Considerations

Bacteria sources to waters arise from a mixture of continuous and wet-weather driven sources, and there may be no single critical condition that is protective for all other conditions. These bacteria TMDLs have set WLAs and LAs for all allowable known and suspected source categories equal to the water quality criteria or equal to loads which assure water quality criteria are achieved. The bacteria TMDLs apply over the entire seasons that the bacteria criteria apply. Furthermore, any of the recommended measures that are implemented to meet the TMDL targets, will result in reductions of bacteria concentrations and daily loads to water quality criteria levels for all seasons for which the WQS apply. Therefore, the TMDL adequately accounts for seasonal variability.

## 5.4 Future TMDL Applicability

In the future, DEEP may propose that additional bacteria-impaired waters be included in this Statewide Bacteria TMDL. The future submittals will provide detailed information on the impaired waterbodies, similar to the information that is provided in Appendices 2 through 79. At that time, DEEP will provide public notice for review of these additional bacteria TMDLs either alone or as part of the public notice process associated with the biennial review of the State's Section 303(d) List in its Integrated Water Quality Report. If previously unlisted waterbodies are involved, DEEP will clearly state its intent to list the newly assessed waterbodies as impaired, and to apply the appropriate waterbody-specific bacteria TMDLs. Once the EPA approves the TMDL modification as part of the 303(d) list approval, these additional waterbodies would be included as waterbody impairments addressed by this Statewide Bacteria TMDL. A list of the future submittals will be included in Appendix A, which will be updated with each new bacteria-impaired water as new TMDLs are developed by CT DEEP.

## 5.5 NPDES Regulated stormwater discharges

As seen in Tables 5-1 through 5-4, the control of stormwater discharges from regulated sources is a principal means of addressing this TMDL. Regulated stormwater discharges consist of those authorized under the MS4 GP, Industrial GP, Construction GP, and Commercial GP. Each of these general permits requires the preparation and implementation of some type of a stormwater management plan. In order to meet these WLA goals, stormwater discharges regulated by a NPDES permit (issued subsequent to this TMDL) must include in their plan measures to minimize bacteria, to the maximum extent possible, or to eliminate sources of bacteria where feasible.

### 5.5.1 MS4 GP discharges

The Stormwater Management Plan required for municipalities regulated by the MS4 permit reissued on January 9, 2011 includes best management practices (BMPs) grouped into six Minimum Control Measures

(Section 6(a) of the MS4 permit). To address this TMDL, MS4s must implement BMPs to address bacteria sources in runoff from developed areas by focusing on the implementation or improvement of a pet waste ordinance and control program, a nuisance wildlife control program, increased or targeted street sweeping above the basic MS4 GP requirements, a septic system monitoring and enforcement program, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) program that would target bacteria, and other possible sources specific to an area or community. In addition to these measures, MS4s should implement additional structural and non-structural management measures to address bacteria as discussed in Section 6.2. below. The regulated MS4 will need to determine which BMPs are appropriate for their community and are free to develop additional BMPs to address specific sources.

### 5.5.2 Industrial GP discharges

Industrial facilities are required to develop a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include control measures (similar to BMPs) to reduce or eliminate the discharge of pollutants from the site. To address this TMDL, the plan should include the implementation or improvement a nuisance wildlife control program, conducting increased or targeted road/ parking lot sweeping above the basic Industrial GP requirements, and investigating and eliminating any illicit discharge (conveying bacteria) connected to the storm sewer system. In addition to these measures, industrial facilities should implement additional structural and non-structural management measures to address bacteria as discussed in Section 6.2. below. The industrial facility will need to determine which BMPs are appropriate for its site and are free to develop additional BMPs to address specific sources. In cases where additional, site-specific controls are necessary to address this TMDL, DEEP will inform the permittee of the need to install such additional controls. Finally, industrial stormwater discharges must comply with the monitoring requirements for impaired waters with and without a TMDL specified in Section 5(e) of the Industrial GP, as amended.

### 5.5.3 Commercial GP discharges

The Commercial GP regulates commercial sites with impervious surfaces exceeding 5 acres such as malls and "big box" stores. The plan to address the control of stormwater pollutants from these sites is called a Stormwater Management Plan (SMP). While the Commercial GP reissued on May 1, 2001 (current permit) does not discuss or address TMDLs or stormwater discharges to impaired waters, future versions of the permit will include measures similar to the Industrial and MS4 GPs. The current permit does not include a monitoring component. However, future versions may include monitoring. To address bacteria sources, commercial sites should implement or improve a nuisance wildlife control program, conduct increased or targeted road/ parking lot sweeping above the basic Commercial GP requirements, implement and maintain good housekeeping measures, and investigate and eliminate any illicit discharge (conveying bacteria) connected to the storm sewer system. In addition to these measures, commercial sites should implement additional structural and non-structural management measures as discussed in Section 6.2. below. The commercial facility will need to determine which BMPs are appropriate for its site and are free to develop additional BMPs to address specific sources.

### 5.5.4 Construction stormwater discharges

The construction general permit regulates the runoff during construction activities and includes measures to address post-construction stormwater management. The construction control measures in the Construction GP primarily address the control of sediment discharges from a site during construction. Although construction projects are not a significant source of bacteria, bacteria may be bound to sediment conveyed in stormwater runoff. While the Construction GP reissued on April 9, 2010 (current permit) does not address impaired waters or TMDLs, the proposed modified Construction GP, expected to be reissued in 2012, requires controls that would address any bacteria present in runoff. Specifically during construction, erosion and sediment control requirements would minimize the discharge of sediment and therefore, address any potential sources of bacteria to all receiving waters, including to impaired waters with and without a TMDL. For post-construction discharges, the proposed permit includes performance standards that require the retention and/or infiltration of stormwater using LID and runoff reduction methods. Compliance with Construction GP requirements will meet the requirements of this TMDL, unless a permittee is otherwise informed by DEEP to implement additional measures and/ or conduct additional monitoring.

### 5.5.5 Non-regulated MS4 discharges

Approximately one-third of the municipalities in the state do not fall under the MS4 permit (any municipality not listed in Appendix A of the MS4 GP is not regulated by the NPDES program). Therefore, stormwater discharges from these systems are not regulated. These non-MS4 municipalities can follow the BMPs included in the MS4 permit and Section 6.2 of this TMDL to address sources of bacteria.

## 5.6 Monitoring Plans

A comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts and should be designed, at a minimum, to accomplish two major objectives; source detection and tracking water quality improvements. Monitoring is needed to identify specific sources of bacterial loading which will, in turn, direct BMP implementation efforts. As changes are made within the watershed and BMPs applied, additional monitoring is needed to quantify progress in achieving TMDL established goals.

Facilities that are covered by an Industrial GP for stormwater discharges that are affected by this TMDL must continue with monitoring obligations as directed by DEEP. Monitoring must include data collection on the appropriate pollutant (in this case indicator bacteria), as directed in the Industrial GP and the Impaired Waters Monitoring Requirements Table (found at www.ct.gov/deep/stormwater) associated with the Industrial GP, effective October 1, 2011 and as updated in the future. CT DEEP may contact a permittee with requests to do additional or adjusted sampling in the future. After the first year of TMDL sampling, the facility may discontinue sampling for the indicator pollutant if it isn't detected, unless DEEP gives a different directive to continue sampling. If the pollutant is detected, the permittee must continue sampling under the protocols issued by DEEP.

Stormwater discharges from approximately two-thirds of the municipalities in the state are regulated under the MS4 permit. While water quality monitoring can be incorporated into any implementation activity, it is explicitly required under the MS4 GP. Stormwater monitoring is required under Section 6(h)(1)(A) of the MS4 GP which 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.

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 DEEP for an alternative monitoring program as allowed by Section 6(h)(1)(B) of the MS4 GP:

> *"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."*

DEEP 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 track the effectiveness of TMDL pollutant reduction measures. Source detection monitoring will include visual inspection of storm sewer outfalls under dry weather conditions, event sampling of individual storm sewer outfalls, and should be expanded to include 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. When the MS4 permit for a municipality is next reissued, it may also include additional measures for compliance with TMDLs and reduction goals.

Progress in achieving TMDL established goals through BMP implementation may be most effectively gauged through implementing a fixed station ambient monitoring program. DEEP strongly recommends that routine monitoring be performed at the same sites used to generate the data to perform the TMDL calculations. 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 DEEP 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. Sampling should be scheduled at regularly spaced intervals during the recreational season (May 1-Sept 30). 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 DEEP 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)

Beyond the standard MS4 permit requirements, additional monitoring for detergents and MBAS can assist with source tracking efforts. These parameters can be especially useful in determining a connection with impairments sourced to on-site sewage disposal systems.

CT DEEP will continue periodic monitoring of pollutants in impaired segments across the state. These monitoring efforts will primarily be a product of the probabilistic monitoring program and beach monitoring, and to a lesser extent targeted programs and sampling trips.

Any non-governmental entities and watershed associations, as well as academic institutions are welcome to also collect monitoring data for inclusion in DEEP analysis of water quality. Special focus of bacteria monitoring should be focused on source tracking efforts, targeted monitoring during all weather conditions, and ensuring the accessibility of data with documented data collection policies and metadata. DEEP is committed to providing technical assistance in monitoring program design and establishing procedures for electronic data submission.

## 5.7 Reasonable Assurance

The TMDL targets for point sources in this TMDL are not less stringent based on any assumed nonpoint source reductions; therefore, documentation of reasonable assurance in the TMDL is not a requirement. Nevertheless, reasonable assurances that both point and non-point allocations will be achieved include a combination of regulatory and non-regulatory program support in Connecticut, including: regulatory enforcement, availability of financial incentives, and local, State, and federal programs for pollution control. CSOs are regulated under an existing federal and State program. Communities subject to stormwater NPDES permit Phase I and II coverage will address discharges from municipally-owned stormwater drainage systems. Enforcement of regulations controlling non-point source discharges include local implementation of Connecticut's Enhanced State Nonpoint Source Management Program [http://www.ct.gov/dep/lib/dep/water/nps/nps_mgt_program.pdf].

There are only a few categories of sources of bacteria and many of the necessary remedial actions to address these sources are well known. The resources identified in the Implementation Section of this report (Section 6) provide communities with information on effective mitigation of bacteria sources. Section 7 of this report lists potential funds and assistance available for TMDL implementation.

In addition, DEEP continues to work with watershed stakeholders to draft Watershed Based Plans (WBPs) under the CWA 319 program. 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. DEEP 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.

## 5.8 Public Participation

EPA regulations require that calculations to establish TMDLs be subject to public review (40 CFR 130.7 (c) (ii)). Following the presentation and publication of a draft of the Connecticut Statewide TMDL for Bacteria Impaired Waters, the public will have a 30-day period for reviewing and submitting comments on this study and its findings.

All TMDL documents were postedon the CT DEEP website on June 29, 2012 and also printed in several newspapers across Connecticut on the same date. A public information session was held at CT DEEP headquarters in Hartford on July 17, 2012 and approximately 30 members of the general public with an additional 15 CT DEEP staff, attended the session. Public comments were accepted on the draft documents until August 2, 2012.

## 5.9 Response to TMDL goals

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

# 6. Implementation Plans

The Connecticut Bacteria TMDL allocations quantify the concentrations of bacteria required to achieve water quality standards (WQS), and provide general information on how the bacteria reductions might be achieved. Each bacterial contamination represents a unique problem that results from the interaction between watershed conditions and source activity. Substantial time, financial commitment and community drive will be required to attain the goals and load allocations in this TMDL. This implementation plan section provides general guidance for developing more detailed, site-specific implementation plans to address water pollution caused by potentially harmful bacteria in Connecticut’s surface waters.

This TMDL provides a framework to set goals that are needed to address the numerous and diverse sources of bacteria in the State of Connecticut. A comprehensive control strategy to address bacterial pollution requires these basic steps:

- Commitment from community members to fix bacterial contamination;
- Identification of potential sources of contamination, through surveys and monitoring;
- Setting specific bacterial pollution targets goals;
- Developing a plan to control sources using both BMPs and education; and
- Implementing the plan and continuing to monitoring to determine effectiveness.

TMDL implementation should be an iterative process, with realistic goals over a reasonable timeframe and with ongoing adjustments based on monitoring results. A watershed-based approach is recommended for mitigating bacteria impairment; Section 6.1 describes the watershed-based approach and provides examples of watershed management plans in New England and implementation resources.

Stakeholder participation in site-specific plan development and follow-through is critical to the success of restoration efforts and attainment of WQS. Implementation planning and subsequent watershed restoration activities may be conducted by municipalities, conservation districts, watershed groups, and private citizens responsible for, or interested in, mitigating bacterial pollution to surface waters. Municipal personnel include department of public works, water and sewer commission, conservation commissions, boards of health, and harbormasters.

Section 6.2 contains information on implementation measures for various types of potential bacteria sources. These potential sources include developed area stormwater, septic systems, agricultural activities, illicit discharges, combined sewer overflows, pets, wildlife, boats, and marinas. Under each type of source, a brief description of applicable regulations, examples of implementation measures, and useful web links to information resources are provided.

## 6.1 The Implementation and Restoration Process

Using a watershed approach is an effective way to manage water resource quality within specified drainage areas or watersheds and offers a promising approach to protect and restore Connecticut's water resources. The outcomes of the implementation and restoration process are normally documented in a **watershed management plan (WMP).** A WMP serves as a guide to protect and improve water quality in a defined watershed and includes analyses, actions, participants, and resources related to developing and implementing the plan (USEPA, 2008). Figure 6-2 (below) illustrates some of the steps and tools involved in the watershed management and implementation process, including the development of WMPs.

Development of a WMP is a key step in watershed management, leading to restoration of a polluted or otherwise impaired waterbody. It is particularly important to develop and implement WMPs for waters that are impaired in whole or in part by non-point sources of pollution. For these waterbodies, plans should incorporate on-the-ground mitigation measures and practices that will reduce pollutant loads and contribute in measurable ways to reducing impairments and to meeting water quality standards (USEPA, 2008). For Connecticut's bacteria impaired waters, where TMDLs for the affected waters have already been developed, WMPs should be designed to achieve the load reductions called for in the TMDLs.

WMPs developed to implement the Connecticut bacteria TMDLs should also consider other impairments and threats in the watershed. While TMDLs focus on specific waterbody segments and specific pollutant sources, WMPs should be holistic incorporating the pollutant- and site-specific TMDL into the larger context of the watershed, including additional water quality threats, pollutants, and sources (USEPA, 2008).

A WMP should address a watershed area large enough to ensure that implementing the plan will address all the major sources and causes of impairments and threats to the waterbody of interest. Plans that bundle sub-watersheds with similar sets of problems or address a common stressor (e.g., bacteria) across multiple related watersheds can be particularly useful in terms of planning and implementation efficiency and the strategic use of administrative resources (USEPA, 2008). Therefore, it is possible for multiple impaired segments within Connecticut's major watersheds (Figure 4-1) to be addressed in the same WMP.

Although many different components may be included in a WMP, EPA has identified **nine key elements** that are critical for achieving improvements in water quality. It is strongly recommended that these elements be included in all WMPs intended to address water quality impairments. In particular, EPA requires that these nine elements be addressed in watershed plans funded with Clean Water Act section 319 funds. In general, State water quality or natural resource agencies and EPA will review watershed plans that provide the basis for section 319-funded projects. Meeting the nine minimum requirements will help ensure that when work towards plan implementation begins, funding support can be found through the section 319 program.

EPA's nine required elements for WMPs include (USEPA, 2008):

1. ***Identification of causes of impairment and pollutant sources*** or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed management plan.
2. ***An estimate of the load reductions expected*** from management measures.
3. ***A description of the non-point source management measures that will need to be implemented*** to achieve load reductions in number 2, and a description of the critical areas in which those measures will be needed to implement this plan.
4. ***Estimate of the amounts of technical and financial assistance needed***, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

5. ***An information and education component*** used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the non-point source management measures that will be implemented.
6. ***Schedule for implementing the non-point source management measures*** identified in this plan that is reasonably expeditious.
7. ***A description of interim measurable milestones*** for determining whether non-point source management measures or other control actions are being implemented.
8. ***A set of criteria that can be used to determine whether loading reductions are being achieved over time*** and substantial progress is being made toward attaining water quality standards.
9. ***A monitoring component*** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under number 8 immediately above.

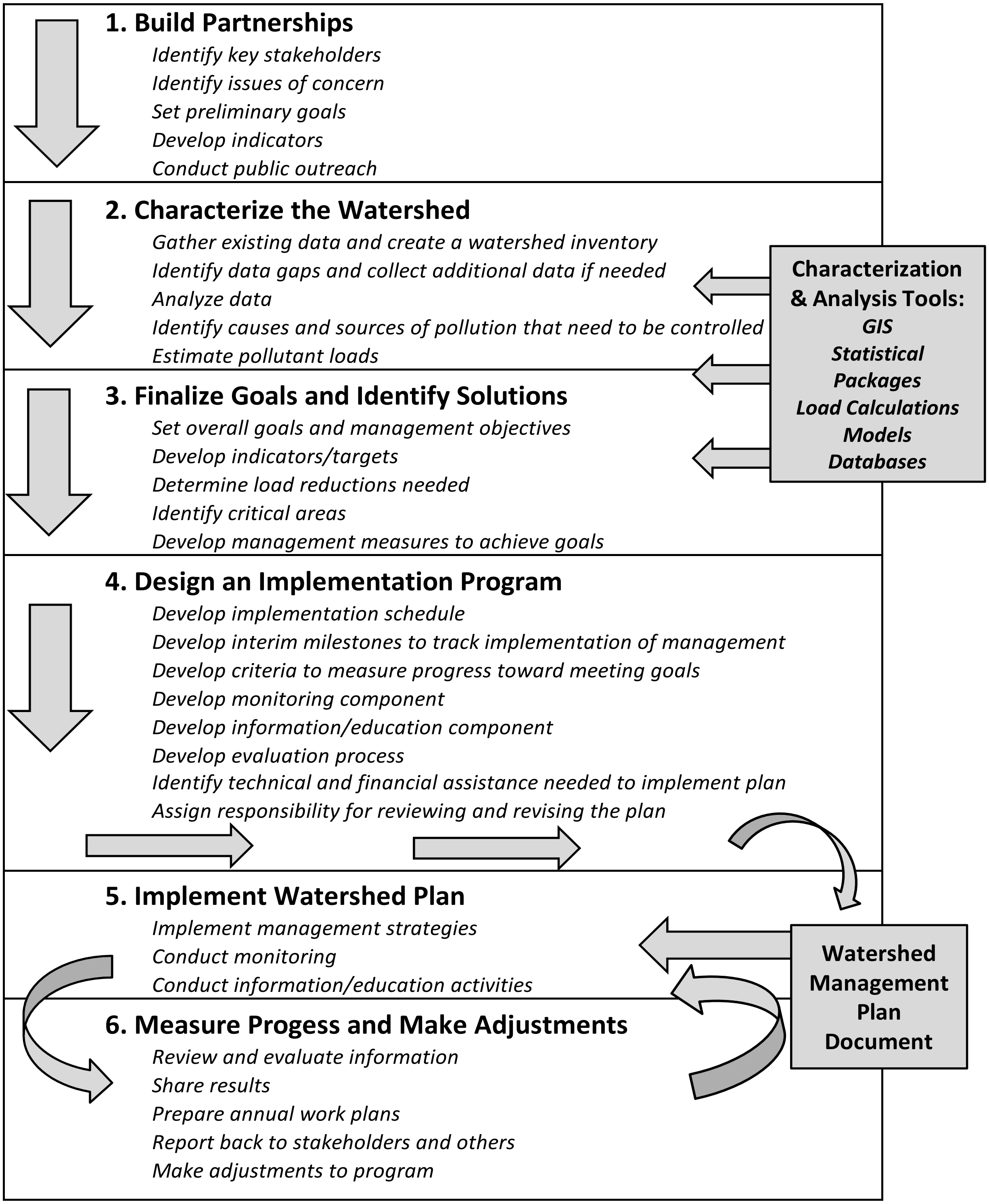


**Figure 6-1: Steps in the Watershed Planning and Implementation Process (USEPA, 2008).**

### 6.1.1 Watershed Management Plan Examples and Resources

Below are examples of watershed plans developed for waterbodies in New England that are comprehensive and have strong technical foundations for setting resources goals and identifying restoration activities. Links to the full documents are provided and may be referred to when developing watershed plans in Connecticut.

- ***Furnace Brook, New Ipswich, NH*** – Furnace Brook is a small stream situated in New Ipswich, New Hampshire and impaired due to excess bacteria. The aquatic habitat of Furnace Brook has been adversely impacted by physical modification and excessive loading of pollutants, and the brook has been found to contain elevated levels of potentially harmful bacteria. Violations of State WQS for *E. coli* bacteria have resulted in Furnace Brook being listed as an "impaired" stream, meaning that it fails to comply with WQS and must be restored. Consequently, a set of analyses and restoration steps are required for Furnace Brook, as part of the TMDL process. A TMDL for Furnace Brook was completed in 2009, a watershed restoration plan was completed in 2010, and a Section 319 restoration implementation project has recently begun.

  The watershed-based restoration plan provides detailed information on the sources of bacteria in the Furnace Brook watershed and recommends actions to achieve the reductions called for in the TMDL. This plan may also serve as an example for other impaired streams, specified in the TMDL report, to follow as an important step toward restoration and water quality compliance.
  *Online:*
  http://des.nh.gov/organization/divisions/water/wmb/was/documents/furnace_brook_wbp.pdf

- ***Spruce Creek, Kittery, ME*** – In 2006, Spruce Creek was classified by the Maine Department of Environmental Protection as impaired, primarily due to bacterial contamination and risks imposed from development. This waterbody has also been identified as one of 17 Nonpoint Source Priority Coastal Watersheds in Maine due to bacterial contamination, low dissolved oxygen, toxic contamination, and a compromised ability to support commercial marine fisheries.

  In 2008, the Spruce Creek Association, working with the Towns of Kittery and Eliot, developed a watershed management plan for Spruce Creek. The WMP serves as a blueprint for restoring and protecting the waterbody. With crucial input from stakeholders, it identifies the most pressing problems and establishes goals, objectives, and actions for resolving them. The WMP also contains strategies for monitoring progress and financing implementation. The plan is a living document that will be reexamined and revised on a regular basis to ensure that the goals, objectives, and specific actions continue to address the most pressing problems in the watershed.
  *Online:* http://www.sprucecreekassociation.org/Spruce_Creek_WBMP_FINAL_08May08.pdf

- ***Cains Brook and Mill Creek, Seabrook, NH*** - The Cains Brook Watershed has experienced significant residential and commercial growth over the past 20 years. This growth and its impacts have led to a degradation of the quality and aquatic habitat of the waters within the brook and the Hampton-Seabrook Estuary.

In 2006 the Seabrook Conservation Commission adopted the original Cains Brook/Mill Creek Watershed Management Plan in effort to better manage the activities and resources within the watershed. Since the adoption of the plan, the Commission has coordinated with the New Hampshire Department of Environmental Services to establish a watershed planning process consistent with EPA's 9 criteria for watershed planning. This plan update reflects the effort of the Commission to incorporate the EPA criteria into the plan as well as to update other activities affecting the watershed, such as NPDES Phase II stormwater management program.
*Online:* http://des.nh.gov/organization/divisions/water/wmb/was/documents/wbp_cains_brook.pdf

Additionally, the following is a list of WMPs plans that address bacterial issues in Connecticut. Links to all plans can be found online at:
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=379296&depNav_GID=1654#nianticriver

As additional WMPs are developed the web site will be updated and so this location should be relied on as the most current and comprehensive listing of WMPs in Connecticut.

- *Barker Cove: Track Down Survey and Abbreviated Watershed Based Plan*, Eastern Connecticut Conservation District, 2011
- *Five Mile River Watershed Based Plan*, AKRF, DRAFT 2011
- *Mashamoquet Brook Abbreviated Watershed Based Plan*, Eastern Connecticut Conservation District, 2011
- *Norwalk River Watershed Based Plan*, Norwalk River Watershed Initiative Committee, HDR, and the South Western Regional Planning Agency, 2011
- *Penquonnock River Watershed Management Plan*, Fuss & O'Neill, DRAFT 2011
- *Mianus River Watershed Based Plan*, AKRF, DRAFT 2011
- *North Branch Park River Watershed Management Plan*, Fuss & O'Neill, 2010
- *Steele Brook Watershed Based Plan*, USDA Natural Resources Conservation Service, 2009
- *Tankerhoosen River Watershed Management Plan*, Fuss & O'Neill, 2009
- *Muddy Brook and Little River Water Quality Improvement Plan*, Eastern Connecticut Conservation District, 2009
- *Coginchaug River Watershed Based Plan*, USDA Natural Resources Conservation Service, July 2008
- *Niantic River Watershed Protection Plan*, CT DEP, 2006
- *Saugatuck River Watershed Based Plan*, The Nature Conservancy's Saugatuck River Watershed Partnership, DRAFT 2006

- *Management Plan for Mattabesset River Watershed,* Mattabesset River Stakeholder Group, 2000
- *The Pawcatuck River Estuary and Little Narragansett Bay: An Interstate Management Plan,* Timothy Dillingham, 1992

**Watershed Planning – Available Resources**

***CT DEEP Watershed Management Program*** - Connecticut DEEP created the Watershed Management Program to more effectively address water resource issues from an integrated watershed perspective. For purposes of water management, the State has been divided into five major watershed basins along natural watershed boundaries. DEEP Watershed Managers work within these five major watershed basins. One of the most important goals of the DEEP Watershed Management Program is to assist in the development of comprehensive watershed management plans, to protect and restore water quality and conserve and manage water resources, by guiding local land use decision making, and enhancing pollution prevention programs.
*Online*: http://www.ct.gov/dep/cwp/view.asp?A=2719&Q=325624

***CT DEEP Clean Water Act Grant Guidance Watershed Based Plan Checklist*** - Connecticut DEEP developed a CT DEEP Clean Water Act Grant Guidance Watershed Based Plan Checklist that is required for grant recipients to receive DEEP Clean Water Act Funding for WMP development. The checklist is also useful for authors of Plans funded in previous years to review and complete to help keep them on track to meet DEEP and EPA's expectations for WMP development.
*Online:* http://www.ct.gov/dep/lib/dep/water/watershed_management/wm_plans/319wbpchecklist.doc

***CT DEEP Nonpoint Source (NPS) Pollution Management Program*** - A significant component of Connecticut DEEP's Nonpoint Source Management Program consists of implementing the EPA Clean Water Section 319 Program. Connecticut DEEP works with watershed stakeholders to draft WBPs under the CWA 319 program.
Online: http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325586

***EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters*** - This handbook is designed for users who are just beginning to develop a WMP, are in the process of developing a plan, or updating an existing plan. EPA has also developed a web-based Watershed Plan Builder which guides planners through developing a customized outline that can be used to develop a WMP.
*Online:* WMP Handbook - http://www.epa.gov/owow/nps/watershed_handbook/
WMP Factsheet - http://www.epa.gov/owow/nps/watershed_handbook/factsheet.htm
WMP Builder - http://iaspub.epa.gov/watershedplan/watershedPlanning.do?pageid=48&navId=35

## 6.2 Best Management Practices

Best Management Practices (BMPs) are effective, practical methods which prevent or reduce the movement of pollutants from the land to surface or ground water. BMPs to reduce pollutant loads, including potentially harmful bacteria, to Connecticut's surface waters are generally either structural or non-structural.

Structural BMPs are generally engineered, constructed systems that can be designed to provide water quality and/or water quantity control benefits. Structural BMPs are used to address both existing watershed impairments and the impacts of new development.

Non-structural BMPs are a broad group of practices designed to prevent pollution through maintenance and management measures. Non-structural measures can be very effective at controlling pollution generation at the source, thereby reducing the need for costly "end-of-pipe" treatment by structural BMPs. Examples of non-structural BMPs include maintenance practices to help reduce pollutant contributions from various land uses and human operations, such as street sweeping, and road and ditch maintenance. In many cases, the most effective approach to mitigating pathogen pollution is through methods such as outreach and education and the enactment of bylaws and ordinances.

Structural and non-structural BMPs are often used together. Effective pollution management is best achieved from a management systems approach, as opposed to an approach that focuses on individual practices. Some individual practices may not be very effective alone, but in combination with others, may be more successful in preventing water pollution.

When determining the appropriate stormwater BMPs to implement at a given site, it is important to consider the water quality of stormwater and how it may affect groundwater, especially if the groundwater is used for drinking water supplies in aquifer protection areas. Maps and information on State aquifer protection areas are available at www.ct.gov/deep/aquiferprotection. Some methods used to reduce stormwater involve direct runoff infiltration through galleries, drywells, or leaching trenches. While appropriate for segregated and clean roof runoff, these methods may not be appropriate for parking lot or road runoff where attenuation of salt or other soluble or volatile compounds is needed. Stormwater from parking lots or roads should be directed to above-ground land treatment areas such as surface swales, depressed grass islands, or detention/retention wet basins. These structures volatilize and attenuate pollutants before stormwater infiltrates the ground.

In most watersheds, pathogen sources are many and diffuse. As a result, appropriate management practices must be selected, designed, and implemented at numerous locations to mitigate adverse impacts and control pathogen impairment. The most appropriate suite of management practices will vary depending on land use and pathogen source. Effective BMP implementation should focus not only on reducing existing pollutant loads, but also on preventing new pollution. Once pollutants are present in a waterbody, it is much more difficult and expensive to restore to an unimpaired condition. Therefore, developing management systems that rely on preventing degradation of receiving waters is recommended.

In the following sections, mitigation measures are organized by the source of pathogens they address. For each source type, relevant BMPs are briefly described and sources for more detailed information (including websites and documents) are provided.

### 6.2.1 Developed Area Stormwater Runoff

In developed areas, large portions of natural landscape cover have been replaced with non-porous, or impervious, surfaces. Developed areas and associated impervious cover result in increased stormwater volume and pollutant loads to receiving waterbodies. Impervious cover refers to surfaces such as roads, driveways, parking lots, and building rooftops that change the natural dynamics of the hydrologic cycle. Impervious surfaces change the character of runoff dramatically by causing water to remain on the land surface. Without slow percolation into the soil, water accumulates and runs off in larger quantities. This faster moving water washes soil from earth surfaces that are not securely held in place by structural means or healthy vegetation. When rain falls in developed areas, it flows quickly off these impervious surfaces, carrying soil, bacteria, nutrients, and other pollutants to nearby waterbodies.

Structural BMPs generally function by reducing and disconnecting these impervious surfaces, and minimizing adverse impacts to receiving waters. Structural stormwater BMPs also collect and treat stormwater runoff before it is discharged. Non-structural BMPs include public education, land use planning, vehicle use reduction, illegal dumping controls, spill prevention, illicit discharge detection programs, and street and storm drain maintenance (NCDENR, 2007).

**Stormwater - Best Management Practices Overview**

Although structural BMPs are generally more costly than non-structural BMPs, an effective maintenance program will extend the life of stormwater controls and BMPs and avert expensive repair costs. Examples of structural stormwater BMPs include: buffers, constructed wetlands, sand filters, infiltration trenches, porous pavements, and rain gardens and other bioretention systems. Several studies examining the bacteria removal performance of stormwater BMPs suggest that flow reduction is the most effective approach to pathogen attenuation in stormwater. In terms of reducing overall bacteria loads to receiving waters, site designs and individual BMPs that reduce runoff volumes should reduce bacteria loading from urban runoff (Wright Water Engineers and Geosyntec Consultants, 2010). BMPs which achieve flow reduction are rain gardens, bioretention cells, and compost amended soils that allow stormwater to infiltrate into the ground. The practices are discussed in more detail below (Low Impact Development Strategies).

While the pollutant removal efficiency of BMPs will vary depending on local site characteristics and specific BMP design, construction, and maintenance considerations, the Center for Watershed Protection (CWP) and the North Carolina Department of Energy and Natural Resources (NCDENR) have reported that sand filters, constructed wetlands, and bioretention areas typically perform well with respect to bacteria removal (CWP, 2007a; NCDENR, 2007). Dense vegetative buffers also facilitate bacteria removal through infiltration into the soil, detention, and filtration by vegetation (Sullivan et al., 2007). Studies have shown variability in pathogen removal by wet (detention) ponds and overall poor performance (57-70% bacteria removal) due to an inability to remove fine clay particles that bacteria tend to adsorb to (Mallin et al., 2002; CWP, 2007b). Stormwater wetlands reduce bacteria loading by 78% (CWP, 2007b), 76% (Birch et al., 2004), 79% (Davies and Bavor, 2000), and 70-99% (Hathaway et al., 2008).

Non-structural BMPs such as preventing overspray onto impervious areas (e.g., sprinklers, hoses, car washes, etc., which send water into driveways and streets), and regular vacuum street sweeping may also help to reduce bacteria loading (Skinner et al., 2010). DEEP has guidance for municipalities on street sweeping and catch basin cleanout, available at: http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/solid_waste/street_sweepings.pdf.

In general, the majority of conventional stormwater BMPs (such as retention ponds, deep sum catch basins, and filter berm swales) do not appear to be effective at reducing fecal indicator bacteria concentrations to primary contact stream standards, which is the ultimate target of TMDLs. Therefore, working to address pathogen impairments in waterbodies should focus first and foremost on source controls. This requires clear identification of the primary sources of fecal indicator bacteria relative to site-specific conditions. Focusing on controllable sources of bacteria, particularly those of human origin, is believed to be the most important first step in protecting human health (Wright Water Engineers and Geosyntec Consultants, 2010).

***Low Impact Development Strategies (LIDS)*** - Low impact development strategies (LIDS) are a set of tools intended to restore or maintain the hydrology of a watershed by reducing runoff rates and volume and increasing groundwater recharge (MADEP, 2011). LID is an alternative way of developing land and managing stormwater that is aimed at minimizing the impacts of urbanization on natural habitats and hydrology. The overall goal of LID is to work with the natural landscape, hydrology, and unique features of a site to avoid unnecessary water pollution, environmental degradation, and flooding. LID accomplishes this by controlling runoff close to the point of generation and retaining more water on the site where it falls, rather than funneling it into pipes that drain into local waterways.

Although LIDS are not primarily designed to reduce pathogen pollution, their mitigation of hydrologic impacts is likely to reduce pathogen loading from stormwater in many situations (MADEP, 2011). As mentioned earlier, one of the primary impacts of increased urbanization is the increase in impervious surface area within the watershed. As a result, runoff volume and velocity increase and lead to the flushing of contaminants, including pathogens, into adjacent surface waters. Therefore, one of the most significant ways to reduce stormwater's contribution to pathogen contamination is to reduce the volume and rate of runoff from a given area. LIDS aim to reduce runoff by increasing infiltration to groundwater and plant uptake. These approaches may be particularly effective if they are targeted at areas known to contribute significantly to pathogen contamination, such as areas with high use by domestic animals or wildlife (MADEP, 2011). As stated earlier, It is important to consider potential impacts to surface water and groundwater from any LIDS implementations. Any LIDS projects should consider existing or future onsite sewage disposal system applications and care should be taken to avoid altering of site hydraulics that may have a negative impact on an existing system. Stormwater runoff from urban areas and roads is often carrying heavy pollutant loads. These pollutants should be allowed to attenuate or volatilize prior to infiltration whenever possible to reduce groundwater loading. Protection of potential future uses for groundwater should be a driver in considering infiltration options and locations. Although LIDS are often intended primarily for new development, many of these practices can be applied as retrofits to existing sites with similar benefits.

Performance evaluation of percent pathogen reduction for BMPs is a fairly new subject of study, and limited data are available. However, links to additional LID resources and information provided at the end of this section should provide the most updated information regarding percent BMP pathogen reductions as new studies are published. The most recent biannual report issued by the University of New Hampshire Stormwater Center (UNHSC) evaluated 22 stormwater treatment systems for flow reduction and pollutant removal efficiencies, and examples of common LID strategies are listed below (MADEP, 2011; UNHSC, 2009). The NCDENR (2007) rated grassed swales, permeable pavement, and green roofs as low for bacteria removal efficiency. It is important to note that no single system will address all pollutant issues at a given site, and therefore, close examination of the source problem will reveal the most appropriate system or combination of systems.

- *Disconnecting Impervious Areas* **-** One of the most effective LIDS is "disconnecting" impervious areas. When runoff from paved surfaces is allowed to flow over pervious or vegetated surfaces before entering a drainage collection system, some or all of the runoff from small rain events will be intercepted and percolated into the ground. This can eliminate stormwater's contribution to pathogen impairment during small storm events. Strategies may include: removing curbs on roads and parking lots; locating catch basins in pervious areas adjacent to parking lots, as opposed to in the paved portion of the lot; and disconnecting roof drains and direct flows to vegetated areas, among others.
- *Sand Filters* - Sand filters are a stormwater treatment practice designed to remove sediment and pollutants from the first flush of runoff from pavement and impervious areas after a rain or storm event. Sand filters have achieved fecal coliform removal rates of 40% in stormwater (Schueler et al 1992). In addition, sand filters reduce sediment, nutrient, and trace metal concentrations. Frequent maintenance of the filter is required to remove accumulated sediments, trash, debris, and leaf litter (Schueler et al 1992).
- *Subsurface Gravel Wetland* - Constructed wetlands offer wildlife habitat, erosion control, surface water storage, flood control, ground water recharge, and pollutant removal. They can be useful in conjunction with other BMPs or they can function independently. Placed appropriately, a constructed wetland can alter hydrologic flow, and allow physical filtration and sedimentation, biological uptake through vegetation and microbial mediation, and chemical sorption of contaminants. Runoff flows through a forebay into vegetated treatment basins where perforated riser

pipes transport water to the subsurface gravel layer for biological treatment or uptake by the root mat. Treatment runoff then exits to the surface via an outlet pipe. According to UNHSC (2009), 87% of the annual average peak flow is reduced and high pollutant removal efficiency is achieved.

- *Bioretention* – Bioretention uses a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The method combines physical filtering and adsorption with biological processes. These processes are likely to remove sediments and associated pathogens from the water. Also known as bioretention areas, rain gardens are small vegetated depressions that collect, store, and infiltrate stormwater runoff. Their primary utility in reducing pathogen in stormwater relies on the reduction in runoff volume and in the increase infiltration. According to UNHSC (2009), 79% of the annual average peak flow is reduced and high pollutant removal efficiency is achieved. Hathaway et al. (2008) also found that bioretention systems in North Carolina averaged 69% bacteria removal efficiency.

- *Vegetative Buffer Strips or Grassed Swales* - Buffer strips are vegetated sections of land that are essentially flat or have low slopes designed to reduce the runoff volume. A vegetated swale is a broad, shallow, trapezoidal channel with a dense stand of vegetation covering the side slopes and bottom. Swales and buffers can be natural or manmade, and are designed to trap particulate pollutants, promote infiltration, and reduce the flow velocity of storm water runoff. The effectiveness of buffers or grassed swales for reducing bacteria pollution, however, is dependent on the type of vegetation and the width of the buffer or swale. Typically, the wider the buffer or swale, the more pollution reduced. According to UNHSC (2009), 24% of the annual average peak flow is reduced and only modest pollutant removal efficiency is achieved.

- *Green Roofs* - Green roofs help to mitigate the effects of urbanization on water quality by filtering, absorbing, and detaining rainfall. They are constructed of a lightweight soil media, underlain by a drainage layer, and a high quality impermeable membrane that protects the building structure. Green roofs may reduce pathogen loads when roof runoff flows over potentially contaminated surfaces by reducing the volume and frequency of the runoff.

- *Permeable Pavement (Porous Asphalt and Pervious Concrete)* - Permeable pavement, both porous asphalt and pervious concrete, can be installed at parking lots, driveways, and sidewalks. Permeable pavement reduces peak hydrologic flow and allows physical filtration and chemical sorption of contaminants. The porous material allows runoff to filter through a choker course layer and sand filter course layer that remove fine particulates and adsorb to chemical contaminants like heavy metals or phosphorous. The treated runoff can recharge groundwater or be transported in a perforated subdrain to the surface. According to UNHSC (2009), 82% (porous asphalt) and 93% (pervious concrete) of the annual average peak flow is reduced and high pollutant removal efficiency is achieved.

- *Soil Amendment* **-** The aeration and addition of compost amendments to disturbed soils is extremely effective at restoring the hydrologic functions of soils and reducing runoff. Soil amendments increase the spacing between soil particles so that the soil can absorb and hold more moisture. Compared to compacted, un-amended soils, amended soils provide greater infiltration and subsurface storage which reduces a site's overall runoff volume, and helps maintain or restore the predevelopment peak discharge rate and timing. The reduction in runoff, along with the filtering effect of the soil matrix can reduce pathogen loading.

- *Tree Box Filters* – Tree box filters are smaller versions of bioretention systems installed along sidewalks as vegetated catch basins. Runoff flows into the tree box filter and passes through a bioretention soil mix (80% sand, 20% compost) to be treated by the roots and soil microorganisms. Treated runoff is filtered into the groundwater or transported to the storm sewer system. According to UNHSC (2009), tree box filters do not significantly reduce peak flows, but have high pollutant reduction efficiencies.

- *Stormtech Isolator Row* – Stormtech Isolator Row is a manufactured treatment device that uses a series of subsurface chambers over geotextile fabric and crushed stone for filtration of pollutants beneath parking lots or other infrastructure. Over time, an organic filter cake forms between the chamber and geotextile fabric for enhanced chemical sorption. According to the UNHSC (2009), 76% of the annual average peak flow is reduced, and average pollutant removal efficiency is achieved.

***Stormwater Utilities*** - Communities across the nation are increasingly examining the option of stormwater utilities to fund stormwater management. A stormwater utility charges fees to property owners who use the local stormwater management system. The revenue can be used to maintain and upgrade existing storm drain systems, develop drainage plans, construct flood control measures, and cover administrative costs. Stormwater utilities are seen as a fair way of collecting funds for stormwater management. The properties that contribute stormwater runoff and pollutant loads and, therefore, create the need for stormwater management, pay for the program. Stormwater utilities provide a predictable and dependable amount of revenue that is dedicated to the implementation of stormwater management. Over 400 communities in the United States have created stormwater utilities.

Currently no stormwater utility districts operate in Connecticut; however, in 2007, Public Act 7-154, also known as the Municipal Stormwater Authority Pilot Program was signed into law. This law allows for grants for up to four communities interested in examining stormwater utility districts. It also allows for the formation of such districts by participating communities within their municipal boundaries if stormwater utility districts were desired upon completion of the grant studies (Fuss & O'Neill, 2010).

Three communities opted to participate in this program—New Haven, Norwalk, and New London. Each community has considered a utility district to assist with implementation of Phase 2 Stormwater and other stormwater management issues such as flooding and upgrade of aging infrastructure. New Haven is proceeding with additional analysis and stakeholder meetings to identify the best organizational structure and user fee implementation program to address the City's anticipated stormwater management program needs (Fuss & O'Neill, 2010).

**Stormwater – Available Resources**

***Connecticut Stormwater Management Manual*** - The Connecticut Stormwater Management Manual can be downloaded as individual chapters or as a complete manual. The manual provides guidance on protecting the waters of Connecticut from the impacts of post-construction stormwater runoff. This manual should be viewed as a design tool for site planning source control, and stormwater treatment practices.
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325704&depNav_GID=1654

***Watershed Municipal Outreach and Low Impact Development*** - DEEP has compiled LID project examples in Connecticut, and has developed a series of Brochures for Municipalities and homeowners who wish to learn more about implementing innovative stormwater controls:

- 2008 Resident's Guide to Low Impact Development
- 2009 Resident's Guide to Rain Gardens
- 2009 Resident's Guide to Rain Barrels
- 2009 Resident's Guide to Pervious Pavement
- 2010 Resident's Guide to Green Roofs
- 2011 Resident's Guide to Vegetated Riparian Areas

*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2719&q=464958&depNav_GID=1654

***DEEP Low Impact Development Resources Factsheet*** – This document provides links to additional LIDS resources useful to municipalities.
*Online:* http://www.ct.gov/dep/lib/dep/water/watershed_management/wm_plans/lid/lid_resources.pdf

***University of Connecticut NEMO Program*** – The University of Connecticut's Center for Land Use Education and Research established Nonpoint Education for Municipal Officials (NEMO) program in 1991 in order to address the lack of education and assistance to community land use decision makers. NEMO offers a Low Impact Development (LID) Inventory as an online resource to geo-referenced examples of stormwater management practices in Connecticut. NEMO offers site planning concepts for stormwater runoff in conjunction with principles laid out in the State's Stormwater Quality Manual.
*Online:* http://nemo.uconn.edu/

***National Menu of Stormwater BMPs*** – The National Menu of BMPs for Stormwater Phase II was first released in October 2000. An updated version of this original webpage, including the addition of new fact sheets and the revision of existing fact sheets, is available through the EPA website.
*Online:* http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm

***University of New Hampshire Stormwater Center*** – The UNH Stormwater Center runs a facility that provides controlled testing of stormwater management designs and devices. The Center is a technical resource for stormwater practitioners and studies a range of issues for specific stormwater management strategies including design, water quality and quantity, cost, maintenance, and operations. The field research facility serves as a site for testing stormwater treatment processes, for technology demonstrations, and for conducting workshops. The testing results and technology demonstrations are meant to assist resource managers in planning, designing, and implementing effective stormwater management strategies. Detailed descriptions of multiple stormwater BMPs are available through their website and their annual reports.
*Online:* http://www.unh.edu/erg/cstev/

***Forging the Link: Linking the Economic Benefits of Low Impact Development and Community Decisions*** - University of New Hampshire Stormwater Center has published a study that discusses benefits of integrating LID and traditional stormwater management for towns and commercial developers. Through a series of case studies, this project documents the advantages of LID in the economic terms of how municipal land use decisions are commonly made.
*Online:* http://www.unh.edu/unhsc/forgingthelink

***Low Impact Development Appendix to the Connecticut Stormwater Quality Manual*** - CT DEEP conducted a study evaluating possible incorporation of Low Impact Development principles into the Stormwater General Permits program. This document is one of the resulting deliverables of the study and is meant to supplemtn the Connecticut Stormwater Management Manual.
*Online*: http://www.ct.gov/dep/lib/dep/water/nps/swgp/lid_stormwaterfinal.pdf

### 6.2.2 Subsurface Sewage Disposal Systems

In Connecticut, roughly one third of the population uses individual onsite systems to treat wastewater and disperse it back into the environment. The conventional subsurface sewage disposal system, often referred to as a septic system, consists of four major components: the building sewer, the septic tank, distribution piping, and the leaching system.

The building sewer conveys the wastewater from the house plumbing to the septic tank.

The septic tank is a watertight receptacle that serves as the primary physical treatment of the wastewater. Here, the heavier solids are settled out, and the floating scum and greases are kept from escaping into the leaching field. The standard septic tank has a minimum 1,000-gallon minimum liquid capacity and may be made out of concrete or plastic. Newer tanks are equipped with inlet and outlet baffles, an interior compartment wall, and an effluent filter, all which will assist in retaining scum/solids inside the septic tank. A relatively stable biological system within the septic tank helps promote the reduction of complex organic compounds to simpler soluble chemicals and gases.

Distribution piping directs the flow of sewage effluent to the leaching system in a manner that assures full utilization of the system. Sewage effluent can flow through the distribution piping by means of gravity, or with the assistance of a mechanical pump or siphon.

The leaching system disperses the sewage effluent into the surrounding soil, which provides further biological treatment to the sewage. There are many types of leaching systems. The specific type utilized on a property is usually dependant on the soil conditions on that site. Most residential installations utilize stone-filled leaching trenches or hollow structures surrounded by stone. Pathogen reduction is accomplished by requiring a minimum separating distance of at least 18” between the bottom of the leaching system and maximum groundwater level, and 4’ between the bottom of the leaching system and ledge rock. These distances may be increased due to specific site conditions as defined in the Technical Standards.

When properly designed, installed, operated and maintained, subsurface sewage disposal systems can renovate wastewater as well as most conventional sewage treatment plants. However, if a system is going to experience failure, it is most likely to occur in late winter or early spring when groundwater levels are at their highest elevations. It is important to evaluate site conditions during this time period to account for potential worst case scenarios. The following is an additional list of key components for consideration when installing and operating a subsurface sewage disposal system:

- Proper design includes adequate evaluation of soil conditions, seasonal high groundwater or impermeable materials, proximity of sensitive resources (drinking water wells, surface waters, wetlands, etc.);

- Proper installation means that the system is installed in conformance with the approved design;

- Proper operation includes how the property owner uses the system. While such systems excel at treating normal domestic sewage, disposing of some materials, such as toxic chemicals, paints, personal hygiene products, oils and grease in large volumes, and garbage, can adversely affect the function and design life of the system, resulting in treatment failure and potential health threats;

- Proper operation also includes how the property owner protects the system. Allowing vegetation with extensive roots to grow above the system will clog the system. Driving large vehicles over the system may crush or compact piping or leaching structures;

- Proper maintenance means having the septic tank pumped at regular intervals to eliminate accumulations of solids and grease in the tank. It may also mean regular cleaning of effluent filters, if installed.

Regulatory authority (design review, permitting, and enforcement) over subsurface sewage disposal systems varies, depending on the designed flow capacity and the type of treatment and disposal system present on the site. In Connecticut, the local Director of Health has regulatory authority over standard subsurface sewage disposal systems with a design capacity of 2,000 gallons per day(gpd) or less. (For purpose of comparison, the typical 3 bedroom home has a design capacity of 450 gpd.) Systems between 2,000 and 5,000 gpd and employing a conventional subsurface disposal system, are regulated by the CT Department of Public Health. If a site or property has multiple systems in the < 5000 gpd range, the cumulative flow for the entire site must remain below 5,000 gpd or the site is regulated by CT DEEP. Any systems with design flows of greater than 5,000 gpd or any system that utilizes alternative treatment (AT) and all "Community Sewerage Systems" are regulated by the CT DEEP. It is possible for a system to change jurisdiction if any expansions are created to add on more structures to a system or to account for increase in flows over the previous designs. Both of these changes would move jurisdiction of the hypothetical site to DEEP regulatory staff.

**Subsurface sewage disposal systems: Best Management Practices:**

The life and effectiveness of a properly designed and installed subsurface sewage disposal system can be optimized though proper operation and maintenance of the system, including:

- Knowing the location of the building sewer, septic tank, distribution piping and leaching system;
- Keeping deep-rooted trees and shrubs from growing above the leaching system;
- Keeping heavy vehicles from driving on or parking above any component of the subsurface sewage disposal system;
- Installing risers above the inlet and outlet of the septic tank to allow for easy access during inspections and pumping;
- Installing an effluent filter at the outlet of the septic tank to enhance its performance and protect the leaching system from clogging;
- Pumping the tank on a regular basis (typically 3-5 years) to optimize primary treatment and to minimize the potential for solids carry-over into the leaching system (which would result in premature failure of the system);
- Composting kitchen wastes instead of using a garbage disposal;
- Avoiding the dumping of materials down the drains which are likely to inhibit the proper operation of the system, including toxic chemicals, paints, solvents, personal hygiene products, oils and grease in large volumes, and garbage;

- Avoid the disposal of water softener or other water treatment wastewater into the septic system;

- No pet wastes including cat litter should be placed into the septic system;

- Checking all plumbing for leaks on a regular basis. A continually running faucet or toilet could add hundreds of gallons of water a day to the system, possibly resulting in a hydraulic overload and failure of the system.

**Septic Systems – Available Resources**

***CT Department of Public Health*** - The Connecticut Department of Public Health has published a Design Manual for Subsurface Sewage Disposal Systems for Households and Small Commercial Buildings in two parts. Part I identifies general design principles, while Part II discusses specific design considerations. There are also links to Home Buyers Guide, Septic Systems 101: Operation and Maintenance of a Subsurface Sewage Disposal System, and Sewage Backup Fact Sheet. Potential loans and grants can be obtained from Community Development Block Grant and USDA Rural Development Loans and Grants.
*Online*: http://www.ct.gov/dph/subsurfacesewage

***CT General Statutes*** – Connecticut's subsurface sewage disposal system rules are adopted in accordance with Connecticut General Statutes, Chapter 368a and Chapter 446k. The purpose of these rules is to protect public health and the environment by establishing a comprehensive program to regulate the design, construction, replacement, modification, operation, and maintenance of subsurface wastewater systems.
*Online:* www.cga.ct.gov

***National Small Flows Clearinghouse-*** The National Small Flows Clearinghouse was funded by the US EPA to help America's small communities and individuals solve their wastewater problems through objective information about onsite wastewater collection and treatment systems. http://www.nesc.wvu.edu/wastewater.cfm

***Homeowner's Guide to Septic Systems*** – This EPA guide describes how a septic system works and what homeowners can do to help their systems treat wastewater effectively
*Online:* http://www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf

***EPA Septic Website*** – This site offers valuable information and resources to manage onsite wastewater systems in a manner that is protective of public health and the environment and allows communities to grow and prosper.
*Online:* http://cfpub.epa.gov/owm/septic/home.cfm

The following EPA publications are some of the many available on the EPA septic system's guidance, manuals and policies page:

*Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*- Guide that helps states and local communities establish comprehensive management programs to ensure that onsite sewage systems function properly. Proper management of decentralized systems involves implementation of approximately one dozen management components such as public education and participation, planning, operation and maintenance, and financial assistance and funding.

*Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems* – A "how-to guide" for implementing EPA's Voluntary National Guidelines for Managemnet of Onsite and Clustered (Decentralized) Wastewater Treatment Systems. The guide describes a step-by-step approach for the development of a community management program for decentralized wastewater systems. It includes specific community examples, gives an overview of the elements essential for sound management of these systems and provides links to resources.

*Onsite Wastewater Treatment Systems Manual* – This manual was developed to provide supplemental and new information for wastewater treatment professional in the public and private sectors. This manual goes into more focused details about onsite wastewater treatment and onsite system management than the previous manual.

### 6.2.3 Agriculture

Agricultural activities such as dairy farming, the raising of livestock (including hogs, fowl, horses, llamas, alpacas, and other animals), and crop farming can contribute to bacterial impairment of surface waters. Agricultural land uses with the potential to contribute to bacteria pollution include manure storage and application, livestock grazing, and barnyards.

When appropriately applied to soil, animal manure can fertilize crops and restore nutrients to the land. However, when improperly managed, animal wastes can pose a threat to human health and the environment. Pollutants in animal waste and manure can enter surface waters through a number of pathways, including surface runoff and erosion, direct discharges to surface water, spills and other dry-weather discharges, and leaching into soil and groundwater. These discharges of manure pollutants can originate directly from animals accessing surface waters, or indirectly from manure stockpiles and cropland where manure is spread (USEPA, 2003).

Agriculture in Connecticut includes: crop land, livestock, forestry and forest products, the "Green" industry, bees, poultry, Christmas trees, vineyards, maple syrup, aquaculture, and orchards (CTFB, 2009). Connecticut DEEP is the lead agency for nonpoint source management, responsible for administering the annual section 319 grants. Connecticut is able to offer technical and financial support to farm businesses in their farm waste efforts through the "Partnership for Assistance on Agricultural Waste Management Systems". This partnership includes the following agencies: USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency, University of Connecticut Cooperative Extension System, Connecticut Conservation Districts, CT DEEP and the Connecticut Department of Agriculture. Through this partnership, a farm may obtain waste management planning, structure design and qualify for financial assistance as well as help in procuring required permits.

**Agriculture - Best Management Practices Overview**

Manure management BMPs and nutrient management planning are two of the primary tools for controlling bacterial runoff from agricultural areas, particularly horse farms in Connecticut. Agriculture management measures addressed by Connecticut's coastal nonpoint source pollution control program and the Agricultural Permitting Program pertain to nutrient management and confined animal facilities. A confined animal facility is a non-agriculturally productive lot or facility where non-aquatic animals are held and fed for at least 45 days per year. The key measures recommended include:

***1. Confined Animal Facilities***

- Limit discharges by storing wastewater and diverting runoff caused by storms;
- Manage stored runoff and solids through proper use of waste and disposal methods that minimize impacts to surface water and/or groundwater; and
- Collect solids and reduce contaminant concentrations, and reduce runoff to minimize the discharge of contaminants in both facility wastewater and runoff caused by all storms up to and including 25-year, 24-hour frequency storms.

***2. Nutrient Management***

- Develop and implement Comprehensive Nutrient Management Plan (CNMPs), including:
  - Nutrient budgets for crops;
  - Identification of the types and amount of nutrients necessary to produce a crop based on realistic crop yield expectations; and
  - Identification of the environmental hazards of the site.
- Conduct soil tests and other tests to determine crop nutrient needs and proper calibration of nutrient application equipment.

A CNMP is a conservation system for livestock agricultural operations. CNMPs are designed to address, at a minimum, the soil erosion and water quality concerns of agricultural operations. The CNMP encompasses the storage and handling of the manure as well as the utilization and application of the manure nutrients on the land. Manure and nutrient management involves managing the source, rate, form, timing, and placement of nutrients. Writing a CNMP is an ongoing process because it is a working document that changes over time.

The State of Connecticut has the second highest horse density in the nation, which makes proper horse farm management a priority for farm operations in the State. The Horse Environmental Awareness Program

(HEAP) developed the "Good Horse Keeping: Best Practices Manual for Protecting the Environment 2011," which identified the following BMPs for sustainable horse management and environmental protection:

1. Construct adequate manure (permanent or temporary) storage facilities based on the number of horses and divert runoff away from manure piles using roof, gutters, curbs, walls, or land grading.
    a. Earthen channels or diversion should be constructed where clean water may mix with wastewater from paddocks or manure storage areas and diverted to a stable outlet such as a vegetated channel or storm drain.
2. If not using a roll-off dumpster for manure removal, construct an onsite compost pile away from water sources for farm spreading operations.
3. Select an appropriate bedding material (such as pine shavings, pine sawdust, straw, wood pellets, straw pellets, peat moss, etc.) that is absorbent and cost effective at mitigating wastewater runoff to surface and ground waters.
4. Develop a nutrient management plan based on field soil tests to determine the amount, type, and timing of nutrient amendments. Ensure adequate buffers are planted around water sources to reduce erosion and excess nutrient loading.
5. Designate stream crossings to minimize impacts to stream banks using bridges, culverts, and stabilized gravel pads.
6. Rotate pastures to ensure overgrazing does not compact soil and cause erosion.
7. Use alternative water systems (automatic or manual) and proper fencing to restrict horse access to streams.

Connecticut DEEP is developing a ***General Permit for Concentrated Animal Feeding Operations (CAFOs)*** in order to regulate manure management activities currently practiced on Connecticut Animal Feeding Operations (Connecticut AFOs). The General Permit specifically regulates Connecticut AFOs with a larger number of animals, defined by the permit as CAFOs. In a Technical Report on the Impact of General Permit on Concentrated Animal Feeding Operations in Connecticut prepared for the Connecticut DEEP and issued in March 2003, dairy and poultry manures were identified as contributing to a nutrient surplus in Connecticut (Wright-Pierce). Land application is the most common agricultural manure management method for dairy and poultry manure. Due to the present loss of farmland in Connecticut, there is no longer sufficient land available under the control of the farms for agronomic application rates. The proposed General Permit has provisions that will limit land application to agronomic rates and that could limit the amount of manure which is land applied on CAFO farms. In order to maintain current production rates, and thus manure production rates, development of feasible manure management alternatives are essential for the survival of the farms directly affected by the DEEP General Permit. To meet the proposed agronomic application rates for manure application, the surplus nutrients must be economically treated and moved off-farm for utilization in other market sectors (Eastern Connecticut RCDA, 2011).

Examples of successful agricultural management projects can be found at Lake Waramuag http://www.ct.gov/dep/lib/dep/water/nps/success_stories/lkwara.pdf ; Manure Management in Blackberry watershed http://www.ct.gov/dep/lib/dep/water/nps/success_stories/mm_blackberry.pdf

**Agriculture - Available Resources**

***Manual of Best Management Practices for Agriculture: Guidelines for Protecting Connecticut's Water Resources*** – This manual describes a wide range of BMPs designed to reduce the impact of agriculture on ground and surface water quality.
*Online:* http://www.ct.gov/dep/lib/dep/aquifer_protection/bmps_agriculture_1993.pdf

***USDA Natural Resources Conservation Service (NRCS)*** - Agricultural operators can obtain assistance in developing CNMPs and BMPs from the NRCS in Connecticut, which can be accessed through the local county conservation district.
*Online*: http://www.ct.nrcs.usda.gov/

***CT Department of Agriculture*** – Agricultural operators can obtain assistance in nutrient or wastewater management from the Department of Agriculture in Connecticut. Many of the State grants and loans are in collaboration with such agencies as NRCS listed above.
*Online*: http://www.ct.gov/doag/cwp/view.asp?a=1366&q=258948&doagNav=

***EPA National Management Measures to Control Non-Point Source Pollution from Agriculture***
*Online*: http://www.epa.gov/owow/nps/agmn/index.html

***EPA Livestock Manure Storage*** – Software designed to assess the threat to ground and surface water from manure storage facilities.
*Online*: http://www.epa.gov/seahome/manure.html

***EPA Animal Waste Management Software*** – A tool for estimating waste production and storage requirements.
*Online*: http://www.wcc.nrcs.usda.gov/awm/awm.html

***Horse Environmental Awareness Program – Good Horse Keeping: Best Practices Manual for Protecting the Environment 2011*** - a guide that assists equine owners with managing horses and protecting the environment through sustainable BMP practices.
*Online:* http://easternrcd-ct.org/HEAP/GOODHORSEKEEPINGBMP-PROOF3.pdf

### 6.2.4 Illicit Discharges

Illicit discharge refers to any discharge to a municipal separate storm sewer that is not composed entirely of stormwater, except discharges pursuant to a NPDES permit and discharges resulting from fire-fighting activities. Examples of illicit discharges that may be found in Connecticut's urban communities include direct illicit discharges such as sanitary wastewater piping that is directly connected from a home to a storm sewer, and indirect illicit discharges such as an old and damaged sanitary sewer line that is leaking fluids into a cracked storm sewer line (NEIWPCC, 2003).

EPA's Stormwater Phase II Final Rule states that municipalities are required to develop illicit discharge detection and elimination (IDDE) plans as one of the following six minimum measures included in a stormwater management plan (NEIWPCC, 2003):

1. Public education and outreach;
2. Public involvement and participation;
3. Illicit discharge detection and elimination;
4. Construction site stormwater runoff control;
5. Post-construction stormwater management in new development and re-development; and
6. Pollution prevention and good housekeeping in municipal operations.

The implementation of a municipal program to detect and eliminate illicit discharges to the storm sewer system is an EPA and CT DEEP priority due to its effectiveness in addressing water quality impairments. The reissued MS4 permit will contain more prescriptive requirements related to the Illicit Discharge Detection and Elimination (IDDE) program.

Stormwater management programs to address illicit discharges must incorporate the following four elements (NEIWPCC, 2003):

1. ***Developing a Storm Sewer Map****:* If not already completed, a storm sewer system map showing the location of all outfalls and the names and location of all waters that receive discharges from those outfalls must be developed.
2. ***Prohibiting Illicit Discharges****:* A municipal ordinance created to comply with Phase II regulations must include a prohibition of illicit discharges and an enforcement mechanism. It is also essential for the municipality to establish a legal authority to inspect properties suspected of releasing contaminated discharges into the storm sewer system.
3. ***Developing and Implementing a Plan to Detect and Address Illicit Discharges:*** Municipalities must develop and implement a plan to detect and address illicit discharges, including illegal dumping, to the system. It is recommended that the plan include locating priority areas, tracing and removing the source of an illicit discharge, and evaluating and assessing the program**.**

4. ***Outreach to Employees, Businesses, and the General Public****:* Municipalities must also inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.

**Illicit Discharges - Best Management Practices Overview**

A sample list of IDDE BMPs and measurable milestones is presented below. BMPs are listed in bold, followed by the measurable goals for each BMP. This list was excerpted from "*Illicit Discharge Detection and Elimination Manual: a Handbook for Municipalities*" (NEIWPCC, 2003):

1. **Create a storm sewer map**
   - Map a certain percentage of outfalls (adding up to 100% by the end of the permit term) or of the area of the town.
2. **Pass an illicit discharge ordinance**
   - Draft an IDDE ordinance (or stormwater ordinance with IDDE component) or an amendment to existing bylaws.
3. **Prepare an IDDE plan**
   - Complete a final plan and obtain the signature of the person overseeing the plan.
4. **Conduct dry weather field screening of outfalls**
   - Screen a certain percentage of outfalls (adding up to 100% by the end of the permit term).
5. **Trace the source of potential illicit discharges**
   - Trace the source of a certain percentage of continuous flows (adding up to 100% by the end of the permit term); and
   - Trace the source of a certain percentage of intermittent flows and illegal dumping reports.
6. **Eliminate illicit discharges**
   - Eliminate a certain number of discharges and/or a certain volume of flow, or a certain percentage of discharges whose source is identified (adding up to 100% by the end of the permit term).
7. **Implement and publicize a household hazardous waste collection program**
   - Hold a periodic (e.g., annual) hazardous waste collection day; and
   - Mail flyers about the hazardous waste collection program to all town residences.
8. **Create and distribute an informational flyer for homeowners about IDDE**
   - Mail the flyer to town residences; and
   - Print the flyer as a doorknob hanger and have water-meter readers distribute it.
9. **Create and distribute an informational flyer for businesses about IDDE**
   - Mail the flyer to targeted businesses.
10. **Work with community groups to stencil storm drains**

- Stencil a certain percentage of drains.

11. **Create and publicize an illicit discharge reporting hotline**
    - Put the hotline in place;
    - Include an announcement of the hotline in sewer bills; and
    - Follow up on all hotline reports within 48 hours.

**Illicit Discharges – Available Resources**

***Connecticut Illicit Discharge Detection and Elimination Program*** – Section 3 of Connecticut's Stormwater Management Plan requires Connecticut municipalities to develop, implement and enforce plans to detect and eliminate existing illicit discharges and connections.
*Online*: http://www.ct.gov/dot/lib/dot/documents/dpolicy/swmp/sec_3.pdf

***Illicit Discharge Detection and Elimination Manual*** - The New England Interstate Water Pollution Control Commission published a useful manual for communities titled Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities.
*Online*: www.neiwpcc.org.

***Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*** - Center for Watershed Protection's comprehensive manual that outlines practical, low cost, and effective techniques for stormwater program managers and practitioners. The guidelines include details on creating and managing an IDDE program, timelines that estimate how long program implementation will take, information on estimating program costs in terms of capital and personnel expenses, and types of testing used to detect stormwater illicit discharges. This manual provides valuable guidance for communities and others seeking to establish IDDE program.
*Online:* http://cfpub2.epa.gov/npdes/docs.cfm?program_id=6&view=allprog&sort=name#iddemanual

***Illicit Discharge Detection and Elimination*** – The EPA provides additional information pertaining to IDDE programs, including key BMP resources.
*Online:*http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=3

***EPA Model Ordinances*** – The EPA maintains a list of model ordinances designed to protect local resources through the elimination and prevention of illicit discharges. The list includes language to address illicit discharges in general, as well as illicit connections from industrial sites.
*Online*: http://www.epa.gov/nps/ordinance/discharges.htm

***EPA Illicit Discharge Detection and Elimination Program Development BMP Fact Sheet*** – Communities addressing IDDE minimum measure should begin with EPA's IDDE program development BMP fact sheet. The additional BMPs listed below can be used to help implement an IDDE program.

*Online:*http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=11

### 6.2.5 Combined Sewer Overflows (CSOs)

During heavy rains, stormwater can enter municipal combined sewer systems which can cause the system to surcharge and overflow; this is known as a Combined Sewer Overflow (CSO). When this happens, sewage and stormwater may be discharged to surface waters without being treated. CSOs can be a major source of pathogens.

In 1994, under the National Pollutant Discharge Elimination System (NPDES) permitting program, EPA developed a Combined Sewer Overflow Control Policy which acts as a national framework for control of CSOs. The policy provides guidance to municipalities and State and Federal permitting authorities on how to cost-effectively meet the Clean Water Act's pollution control goals (USEPA, 1999a).

The policy contains four fundamental principles to ensure that CSO controls are cost-effective and meet local environmental objectives (USEPA, 1999a):

1. Establish clear levels of control to meet health and environmental objectives;
2. Provide flexibility to consider the site-specific nature of CSOs and find the most cost-effective way to control them;
3. Use phased implementation of CSO controls to accommodate a community's financial capability; and
4. Review and revise water quality standards during the development of CSO control plans to reflect the site-specific wet weather impacts of CSOs.

Connecticut DEEP and EPA Region 1 work with permittees to incorporate these principles into NPDES permits. Communities with combined sewer systems are expected to develop long-term CSO control plans that will ultimately provide for full compliance with the Clean Water Act, including attainment of water quality standards.

**CSO - Best Management Practices Overview**

Mitigation measures to address CSOs include:

***CSO Prevention Practices*** **-** CSO prevention practices are aimed at both minimizing the volume of pollutants entering a combined sewer system and reducing the frequency of CSOs. Stormwater management measures that reduce the volume and rates of runoff can also reduce the frequency of CSO events. Additionally, management measures that reduce pathogen sources to stormwater will reduce the pathogen concentrations in CSO discharges ( MADEP, 2011).

As of 1997, all CSO communities are responsible for implementing EPA's 9 minimum technology-based controls. The nine minimum controls are measures that can reduce the prevalence and impacts of CSOs without significant engineering or construction (USEPA, 1999a). These controls include ( MADEP, 2011):

1. Proper operation and maintenance of the collection system;
2. Maximum use of the collection system for storage;
3. Review of pretreatment programs to minimize CSO-related impacts;
4. Maximum flow to the treatment plant;
5. Prohibit dry-weather overflows;
6. Control of solid and floatable materials;
7. Pollution prevention;
8. Public notification; and
9. Monitoring to characterize CSO improvements and remaining CSO impacts.

***Combined Sewer Separation*** - Sewer separation is the practice of separating the combined, single pipe system into separate sewers for sanitary and stormwater flows. In a separate system, stormwater is conveyed to a stormwater outfall for discharge directly into the receiving water. Based on a comprehensive review of a community's sewer system, separating part or all of its combined systems into distinct storm and sanitary sewer systems may be feasible. Communities that elect for partial separation typically use other CSO controls in the areas that are not separated (USEPA, 1999b).

**CSO – Available Resources**

***CT DEEP Clean Water Fund*** **-** The Clean Water Fund (CWF) provides funding and loans to municipalities along Long Island Sound for various projects, including combined sewer overflows.
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654

***Guidance: Coordinating Combined Sewer Overflow (CSO) Long-Term Planning with Water Quality Standards Reviews*** - Addresses impediments to implementing the water quality-based provisions in the CSO Policy, and actions that State and Interstate Water Pollution Control Directors and CSO communities should take to overcome these impediments.
*Online:* http://www.epa.gov/npdes/pubs/cover-cso.pdf

***Combined Sewer Overflows Guidance for Nine Minimum Control Measures*** -
Provides information on nine minimum technology-based controls that communities are expected to use to address CSO problems, without extensive engineering studies or significant construction costs, before long-term measures are taken.
*Online:* http://www.epa.gov/npdes/pubs/owm0272.pdf

***Combined Sewer Overflow Management Fact Sheet: Sewer Separation*** – Describes the basic information regarding the separation of CSOs for combined sewer systems.
*Online:* http://www.epa.gov/OWM//mtb/sepa.pdf

### 6.2.6 Pets

In residential and urban areas, pet fecal matter can be a significant contributor of pathogens in stormwater. Each dog is estimated to produce 200 grams of feces per day, and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (CWP, 1999). If the waste is not disposed of properly, these bacteria can wash into storm drains or directly into waterbodies and contribute to bacteria impairment.

**Pets- Best Management Practices Overview**

Animal waste collection as a pollution source control involves using a combination of educational outreach and enforcement to encourage residents to clean up after their pets. It is recommended that residents do not put dog and cat feces in a compost pile because it may contain parasites, bacteria, pathogens and viruses that are harmful to humans. These may or may not be destroyed by composting. Put dog and cat feces in a plastic bag and set it out with the trash.

***Education and Outreach Campaigns*** - Public education programs can be used to reduce pet waste. These programs are often incorporated into a larger message of reducing non-point source pollution to improve water quality. Signs, posters, brochures, and newsletters describing the proper techniques to dispose of pet waste can also be used to educate the public about this problem and to create a cause-and-effect link between pet waste and water quality (USEPA, 2001b).

Designated dog parks are becoming more common and can be used as a technique to reduce pet waste near surface waters. These parks often include signs about the importance of removing pet waste as well as bags and trashcans in which to dispose of the waste. Other techniques can be incorporated into the design of the park. “Doggy Loos,” pet waste disposal units placed in the ground and operated by foot-activated lids, “Pooch Patches,” a pole surrounded by sand that dogs are encouraged to go to defecate, and “Long Grass Areas,” an area where grass is left un-mowed to allow pet waste to disintegrate naturally have been used in existing dog parks. Other practices, such as creating a vegetated buffer around the park would reduce impacts of this type of developed area runoff to nearby surface waters by encouraging infiltration into soils (USEPA, 2001b).

Individual pet owners can also take steps to reduce their pet’s impact on water quality. Adopting simple habits such as carrying a plastic bag on walks and properly disposing of pet waste in dumpsters or other refuse containers, can make a difference.

***Town Ordinances and Enforcement*** - “Pooper-scooper” ordinances are often used to regulate pet waste disposal. These ordinances generally require the removal of pet waste from public areas, other people’s properties, and occasionally from personal property, before leaving the area. Fines are typically the enforcement method used to encourage compliance with these ordinances.

**Pets– Available Resources**

The following resources discuss the heath and water quality risks associated with pet waste:

***Give a Bark for a Clean State Park (CT DEEP)(CT River Coastal Conservation District)***
*Online:* http://www.conservect.org/ctrivercoastal/PetWaste/tabid/317/Default.aspx

***Non-Point Source Pollution Education: Managing Pet Waste (MA DEP)***

*Online:* http://www.mass.gov/dep/water/resources/petwaste.htm

***What's the Scoop on Pet Waste and Water Quality? (TAPP-Think About Personal Pollution)***
*Online:* http://www.tappwater.org/what-pet.aspx?a=viewPost&PostID=2242

***EPA Source Water Protection Practices Bulletin*** – Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water.
*Online:* http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf

### 6.2.7 Wildlife

Wildlife such as deer, rodents, beaver, geese, and other birds are commonly associated with bacterial contamination of waterbodies. While important, these sources are diffuse and difficult to measure. Large numbers of geese, gulls, and ducks, however, are of particular concern because they often deposit their waste directly into surface waters, contributing bacteria directly to lakes and ponds (CWP, 1999).

**Wildlife - Best Management Practices Overview**

Reducing the impact of wildlife on bacteria concentrations in waterbodies generally requires either reducing the concentration of wildlife in an area or reducing their proximity to a waterbody. In areas where wildlife is observed to be a large source of bacterial contamination, a program of repelling wildlife from surface waters (also called harassment programs) may be implemented. These programs often involve the use of scarecrows, kites, a daily human presence, or modification of habitat to reduce attractiveness of an at-risk area.

Human development has altered the natural habitat of many wildlife species, which may lead to greater access to surface waters by wildlife. Restricting the availability of food sources to wildlife from humans will discourage wildlife from frequenting these sensitive surface waters. Providing closed trash cans near waterbodies, as well as discouraging wildlife from entering surface waters by installing fences, pruning trees, or making other changes to landscaping may reduce impacts to water quality.

Canada geese are an increasing urban nuisance in office parks, recreation areas, residential areas, and golf courses. Studies have correlated the amount of developed land to the number of geese, particularly land use defined as turf grass or lawns at open fields and parks. The goal of goose management is to reduce goose populations to a migratory presence (with minimal resident time) and protect property, water quality, and aesthetics. The CT DEEP Wildlife Division identifies two primary methods of goose management that municipalities can adopt, and include non-lethal and lethal forms of control.

1. ***Non-lethal Goose Population Controls***
   a. Promote widespread education of goose management to public, and recommend that residents do not feed waterfowl.
   b. Develop a hazing program that discourages waterfowl from certain areas and forces waterfowl to areas with greater predation. Techniques include the use of chemical repellents, dogs, fencing, reflective tape, balloons, and noisemakers. A survey of municipalities with a goose management program indicated that dog services were the most effective at hazing geese.
2. ***Lethal Goose Population Controls***
   a. Regulate sport hunting during non-migratory season.
   b. Conduct egg addling whereby fertilized embryos are removed from goose eggs and replaced in nests.
   c. Register citizens to destroy Canada goose nests from March – June.
   d. Trap and cull or euthanize geese (most controversial control mechanism).

**Wildlife – Available Resources**

***CT DEEP Wildlife Division*** – The Wildlife Division offers links to wildlife publications related to fisheries, endangered species, and mosquito management.
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2723&q=325726&depNav_GID=1655

#### 6.2.8 Boats and Marinas

Recreational water uses can contribute to bacteria loads. Marinas and areas frequented by boats may be impacted by sources of potentially harmful bacteria specific to these areas including sewage from boats and marinas.

Boats have the potential to discharge bacteria in sewage from installed toilets and gray water (including drainage from sinks, showers, and laundry). Sewage and gray water discharged from boats can contain pathogens (including harmful bacteria, viruses, and protozoans), nutrients, and chemical products which can lead to water quality violations.

Under the federal Clean Water Act, it is illegal to discharge untreated (raw) sewage from a vessel within three miles of shore of the United States, Great Lakes, and navigable rivers. The Clean Vessel Act was established in 1992 by the Federal Government and was signed into law to protect our waters and associated recreational opportunities from damaging vessel sewage discharges. In Connecticut, the Clean Vessel Act is administered by CT DEEP. The impact of dumping even a small amount of raw sewage into open waters can significantly impact the local ecosystem, causing algal blooms and a degradation in water quality. Boaters are now prohibited from discharging sewage into Connecticut's coastal waters from the Rhode Island State boundary in the Pawcatuck River to the New York State Boundary in the Byram River and extending from shore out to the New York State boundary (CTDEEP, 2011c). These waters are considered “No Discharge Areas”.

Under U.S. Coast Guard regulations, if your boat has an installed toilet, you are required to have a certified Marine Sanitation Device (MSD). Type I or II MSD’s treat sewage chemically and discharge it into the water. Type III MSD's include holding tanks that retain and discharge human body waste. It is illegal to discharge any untreated waste into Long Island Sound or any of Connecticut’s waters. Type III MSD's must be emptied at pumpout facilities or may be directly discharged three nautical miles past the southern shore of Long Island. For boats that have a portable toilet, sewage must be disposed of at a pumpout facility or dump station.

Thiry-one communities along Connecticut’s shoreline have marinas with a pumpout station for recreational boaters. It is important for marinas to offer pumpout services for two reasons; to provide a convenient service to boaters and to maintain a clean aquatic marina environment. This additional service results in a more attractive marina to prospective boaters.

In addition to discharges from boats, there are a number of other potential bacteria sources in marinas. Bacteria from shore side restrooms, uncontrolled pet waste, and fecal matter from wildlife attracted to fish cleaning waste can contaminate waters near marinas. Shore side sanitary facilities should be functioning properly to protect public health and the environment. Waste from pets, especially dogs, is a major source of complaints from barefoot boaters and has the potential to substantially affect bacteria levels at nearby beaches.

**Boats and Marinas - Best Management Practices Overview**

***Boats***

- Target outreach to marina owners, boat dealers, and their consumers regarding the State and EPA requirements for No Discharge Areas; and
- Encourage marina owners to provide clean and safe onshore restrooms and pumpout facilities.

***Marinas***

- Provide an appropriate location for boat washing;
- Provide an appropriate pump out station that is accessible to staff and customers;
- Do not allow waste from the pump out stations to drain directly into receiving waters;

- Consider alternatives to asphalt for parking lots and vessel storage areas such as dirt, gravel, or permeable pavement;
- Install infiltration trenches at the leading edge of a boat ramp to catch pollutants in an oil absorbent barrier or crushed stone before discharge;
- Install vegetated buffers between surface waters and upland areas; and
- Protect storm drains with filters or oil-grit separators. Stencil words (such as "Drains to the River") on storm drains to alert customers and visitors that storm drains lead directly to waterbodies without treatment. Contact the municipal public works department before stenciling any drain.

**Boats and Marinas – Available Resources**

***Connecticut's Clean Vessel Act Program*** **-** The CT Clean Vessel Act Program works to secure a healthy aquatic environment by preventing improper sewage disposal by recreational boats. Many recreational activities are sustained by our water resources, and improper sewage disposal could threaten this use.
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323750&depNav_GID=1711%20

***Connecticut's Pump-out Services Directory***- Several coastal Towns in Connecticut offer pumpout facilities or even boats that target specific geographic areas. Pumpout services are free to utilize by boat owners.

*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323708&depNav_GID=1711

## 7. Funding and Community Resources

Funding assistance for bacteria mitigation and other watershed management projects is available from various governmental and private sources. This section provides an overview and contact information for financial assistance programs offered by the State of Connecticut. Information here is subject to change, so please contact the appropriate agency to learn more about the programs. Grant funding information for water quality, infrastructure, and agricultural improvements is provided below.

**Water Quality Improvement Grants**

***Section 319 Non-Point Source Management Grants***

Congress enacted Section 319 of the Clean Water Act in 1987 establishing a national program to abate non-point sources of water pollution. These grants, known as Section 319 Grants, are made possible by the federal funds provided to CT DEEP by the USEPA, and are available to assist in the implementation of projects to promote restoration of water quality by reducing and managing non-point source pollution in Connecticut waters.

*Eligible applicants:* Municipalities, other governmental agencies and non-profit organizations, schools, and universities
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325588&depNav_GID=1654
*Contact:* MaryAnn Nusom-Haverstock, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3730

***604(b) Water Quality Planning Grants to Regional Planning Commissions***

CT DEEP was allocated $485,000 annually under the federal Clean Water Act Section 604(b) to enable regional comprehensive planning organizations to conduct a variety of water-related planning activities. These activities include water quality standard revisions, TMDL developments, water quality assessments and watershed restoration plans.

*Eligible applicants:* Connecticut's regional planning agencies
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2688&Q=458026&depNav_GID=1511
*Contact:* Terri Schnoor, 604(b) Program Coordinator, CT DEEP, 79 Elm Street, Hartford, CT 06106

***CT DEEP Lakes Grant Program***

The Lakes Grant Program provides matching grants for lake restoration studies and projects at lakes with public access. Lake restoration studies are used to mitigate lake eutrophication using a variety of restoration techniques, including dredging, algae control, stormwater infrastructure improvements, and aquatic weed control.

*Eligible applicants:* Municipalities, Lake Associations in taxing districts, and Lake Authorities

*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2687&q=322344&depNav_GID=1511
*Contact:* Charles Lee, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3716

***Long Island Sound Research Grant Program***

The Long Island Sound Research Grant offers support for scientific pursuit that will increase understanding of ecological processes of Long Island Sound. The information obtained through funded research must be directly applicable to managing Long Island Sound natural resources.

*Eligible applicants:* any in-State academic institution
*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2687&q=322344&depNav_GID=1511
*Contact:* Harry Yamalis, Office of Long Island Sound Programs, 79 Elm Street, Hartford, CT 06106, (860) 424-3034

***CT DEEP Long Island Sound License Plate Program***

Proceeds from the sale of Long Island Sound license plates are distributed by the CT DEEP for projects that will benefit Long Island Sound. Projects include the protection and restoration of water quality, fish and wildlife habitat, public outreach and education about watershed resources, and the monitoring of water quality.

*Eligible applicants:* Municipalities, schools, environmental groups, non-profit organizations
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323782&depNav_GID=1635
*Contact:* Kate Brown, Office of Long Island Sound Programs, 79 Elm Street, Hartford, CT 06106, (860) 424-3034.

***Connecticut's Landowner Incentive Program***

The Landowner Incentive Program (LIP) provides technical advice and funding to private landowners for habitat management that results in the protection or restoration of at-risk fish and wildlife habitats. Grants are given to this program by the U.S. Fish and Wildlife Service.

*Eligible applicants:* private landowners or partnering organizations
*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2723&q=325734&depNav_GID=1655
*Contact:* Judy Wilson, Private Lands Program Coordinator, CT DEEP Eastern District Headquarters, 209 Hebron Rd, Marlborough, CT 06447, (860) 295-9523

***CT DEEP Coastal Habitat Restoration Program***

This program funds restoration projects around tidal wetlands, coves and embayments, riverine migratory corridors, and coastal barrier beaches.

*Eligible applicants:* any individual, agency or private organization

*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323538&depNav_GID=1635
*Contact:* Office of Long Island Sound Programs, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3034

***NFWF Long Island Sound Futures Fund***

The Long Island Sound Futures Fund supports projects that restore and protect the health and living resources of Long Island Sound and its coastal watersheds. Projects should focus on habitat restoration, water quality improvement, watershed management plan development and public awareness of water resource issues. Funding is provided by EPA, U.S. Fish and Wildlife Service and the National Fish and Wildlife Foundation (NFWF).

*Eligible applicants:* State and local governments, non-profit organizations, for-profit entities, educational institutions, and interstate entities or regional water pollution control agencies
*Online*: http://longislandsoundstudy.net/about/grants/lis-futures-fund/
*Contact:* Lynn Dwyer, NFWF, Eastern Partnership Office, 1133 Fifteenth St., N.W., Ste 1100, Washington, D.C., 20005, (631) 627-3488

***NRCS Wildlife Habitat Incentive Program (WHIP)***

WHIP offers funding for development and improvement of fish and wildlife habitat on private land. NRCS provides technical assistance and up to 75% of the cost-share assistance.

*Eligible Applicants:* private landowners
*Online*: http://www.ct.nrcs.usda.gov/programs/whip/whip.html
*Contact:* Joyce Purcell, Assistant State Conservationist, (860) 871-4028

***Rivers Alliance of CT Watershed Assistance Small Grants Program***

Using funding from CT DEEP, the Rivers Alliance of CT offers assistance for development of new river-watershed organizations that will address water quality impairments. Grants range from $500 to $5,000.

*Eligible Applicants:* non-profit river watershed organizations and environmental groups with strong watershed management focus
*Online:* http://www.riversalliance.org/watershedassistancegrantrfp.cfm
*Contact:* Rivers Alliance of CT, P.O. Box 1797 Litchfield, CT 06759, (860) 361-9349

***Connecticut Corporate Wetlands Restoration Partnership (CWRP)***

The CT CWRP supports projects for wetland restoration through a public-private partnership with various corporations that donate through monetary contributions or in-kind services.

*Eligible Applicants:* any individual, agency or private organization
*Online:* http://www.cwrp.org/connecticut.html

*Contact:* Christie Bradway, CT CWRP State Lead, bradwcl@nu.com

***NU Environmental Community Grant Program***

Northern Utilities' Environmental Community Grant Program offers funding to environmental projects that are often overlooked by larger grant programs. Funding goes toward projects that raise awareness of environmental issues to adults and children, improve access to outdoor areas, improve local wildlife habitat through clean-ups, invasive species removal, etc.

*Eligible Applicants:* any organization served by the Connecticut Light and Power (CL&P), Yankee Gas (YG), Western Massachusetts Electric Company (WMECO), or Public Service of NH (PSNH).
*Online:* www.nu.com/environmental/grant.asp
*Contact:* Patricia Baxa, Northeast Utilities, PO Box 270, BMN2, Hartford, CT 06141, baxapl@nu.com

***CT DEEP Recreation and Natural Heritage Trust Program***

This is the CT DEEP primary program for acquiring land to expand the State's system of parks, forests, wildlife, and other natural open spaces. The program focuses on land in CT that represents the ecological and cultural diversity of the State, including rivers, mountains, rare natural communities, scenic qualities, historic significance, connections to other protected land, and access to water.

*Eligible Applicants:* land owners willing to sell their land now or for a future sale or donation of the property
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2706&q=323840&depNav_GID=1642
*Contact:* Jackie Albert, DEEP Division of Land Acquisitions and Management, 79 Elm Street, Hartford, CT 06106, (860) 424-3016

***CT DEEP Section 6217 Coastal Non Point Pollution***

Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 requires the State of Connecticut to implement specific management measures to control NPS pollution in coastal waters. Management measures are economically achievable measures that reflect the best available technology for reducing nonpoint source pollution.

*Eligible Applicants:* Connecticut municipalities in coastal nonpoint program management areas
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323566
*Contact:* Department of Energy and Environmental Protection, 79 Elm Street, Hartford, CT 06106, (860) 424-3000

***CT DEEP Open Space and Watershed Land Acquisition Grant Program***

This program offers funding to towns or organizations for the purchase of land that is valuable for recreation, forestry, fishing, and conservation of wildlife and natural resources.
*Eligible applicants:* municipalities, non-profit land conservation organizations, and Water Companies

*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2687&q=322338&depNav_GID=1511
*Contact:* David Stygar, DEEP Division of Land Acquisitions and Management, 79 Elm Street, Hartford, CT 06106, (860) 424-3016

**Infrastructure Improvement Grants and Loans**

***National Recreational Trails Program***

The Recreational Trails Program is administered by the CT DEEP for the U.S. Department of Transportation's Federal Highway Administration. This fund supports construction of new trails, maintenance and restoration of existing trails, disability access to trails, purchase of trail construction equipment, and purchase of land for trails.

*Eligibility:* non-profit organizations, municipalities, State departments
*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2707&q=323866
*Contact:* Laurie Giannotti, Department of Energy and Environmental Protection, 79 Elm Street, Hartford, CT 06106, (860) 424-3578

***CT DEEP Clean Water Fund***

The Clean Water Fund (CWF) provides funding and loans to municipalities along Long Island Sound for projects aimed at water pollution control, sewage treatment plant construction and upgrades, nutrient removal projects, non-point source pollution control, river restoration and drinking water treatment plant upgrades.

*Eligible applicants:* Municipalities
*Online*: http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654
*Contact:* Susan Hawkins, Clean Water Fund Management Office, Bureau of Financial and Support Services, (860) 424-3325

***CT OPM Small Town Economic Assistance Program (STEAP)***

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action (CGS Section 4-66c) bonds. This program covers development projects involving economic and community development, transportation, environmental protection, public safety, children and families and social service programs.

*Eligible applicants:* municipalities that are not designated as a distressed municipality or public investment community, and the State Plan of Conservation Development does not show them as having a regional center
*Online*: http://www.ct.gov/opm/cwp/view.asp?a=2965&q=382970&opmNav_GID=179

*Contact:* Barbara Rua, Office of Policy and Management, CT DEP, 79 Elm Street, Hartford, CT 06106, (860) 418-6303

### *Drinking Water State Revolving Loan Fund*

This loan program provides funds to repair or improve existing privately-owned drinking water systems. Connecticut's Department of Public Health approves loans to obtain requisite permits, design, plan, construct, repair, or improve eligible water systems to comply with federal and State standards.

*Eligible applicants:* Privately-owned community water systems and privately-owned non-profit, non-community public water systems.
*Online:* http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387340
*Contact:* Department of Public Health, Regulatory Services Branch, Drinking Water Section, 410 Capitol Avenue, MS #51 WAT, PO Box 340308, Hartford, CT 06134, (860) 509-7333

### *Water Source Protection Loans*

This loan program, funded by the EPA, provides funds for municipalities for purchasing land or conservation easements in order to protect the health of public water sources.

*Eligible applicants:* Municipalities.
*Online:* http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387338
*Contact:* Department of Public Health, Regulatory Services Branch, Drinking Water Section, 410 Capitol Avenue, MS #51 WAT, PO Box 340308, Hartford, CT 06134, (860) 509-7333

### *Connecticut Community Development Program Block Grants*

The Connecticut Community Development Block Grant Program, also known as the Small Cities Program, is funded through the Department of Housing and Urban Development as part of the federal Community Development Block Grant program. It provides grants for a wide range of assistance projects for low and moderate income communities with populations of less than 50,000. These projects include improvements to water, sewer, and roads serving economic development and housing.

*Eligible applicants:* Any Connecticut town, city, or incorporated village chartered to function as a general purpose unit of local government. The majority of projects are a coordinated effort between the municipalities, community groups, and local or State non-profit organizations.
*Online:* http://www.ct.gov/ecd/cwp/view.asp?a=3414&Q=249736
*Contact:* Veronica Hunter, Department of Economic and Community Development, 505 Hudson St, Hartford, CT 06106, (860) 270-8236.

### *USDA Rural Development Water and Waste Disposal Loans and Grants*

The USDA Rural Development Water and Waste Disposal Loans and Grants program supports community development projects in communities of less than 10,000 people. Eligible projects include water improvements (source, storage, distribution, treatment), sanitary sewer (collection, treatment, combine sewer separation, storm sewers), solid waste disposal (transfer station, incinerator), new systems, renovations, expansions, purchase of an existing system, or "buy-in" fees to existing systems.

*Eligible applicants:* An eligible applicant can be a public body (town, village, special purpose district) or a non-profit association serving a community with a population of less than 10,000 people. Applicants must also show that they are unable to afford commercial credit.
*Online*: http://www.rurdev.usda.gov/Home.html
*Contact:* Mary Grasso, Area Director, 100 Northfield Dr, Fl 4, Windsor, CT 06095, (860) 688-7725, x 4

## Agricultural Grants

### *Connecticut Conservation Stewardship Program*

NRCS in Connecticut provides funding for landowners with agricultural land and forest land to address natural resource conservation and management activities on their properties.

*Eligible applicants:* private landowners of agricultural land and non-industrial private forest land
*Online*: http://www.ct.nrcs.usda.gov/programs/csp/cstp.html
*Contact:* Joyce Purcell, Assistant State Conservationist, (860) 871-4028 or local NRCS field office

### *Farms, Forest and Open Space Property Tax Benefits*

Under Connecticut Public Act 490, all farm, forest and open space land can apply for a use value assessment that may lower property taxes for the landowner.

*Eligible applicants:* landowners with farm, forest or open space land must apply at their local tax assessor's office. Landowners with designated forest land must have an area totaling 25 acres or more in parcels no smaller than 10 acres
*Online:* http://www.privatelandownernetwork.org/yellowpages/resource.aspx?id=10320
*Contact:* local tax assessor's office

### *Department of Agriculture NRCS Environmental Quality Incentives Program (EQIP)*

This program is a voluntary conservation grant program designed to promote and stimulate innovative approaches to environmental enhancement and protection, while improving agricultural production. Through EQIP, farmers and forestland managers may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural and forest land. EQIP provides for additional funding specifically to promote ground and surface water conservation activities to improve irrigation systems; to convert to the production of less water intensive agricultural commodities;

to improve water storage through measures such as water banking and groundwater recharge; or to institute other measures that improve groundwater and surface water conservation. EQIP payment rates may cover up to 75 percent of the costs of installing certain conservation practices.

*Eligible applicants:* Any person engaged in livestock, agricultural production, aquaculture, or forestry on eligible land.
*Online:* http://www.ct.nrcs.usda.gov/programs/eqip/eqip.html
*Contact:* Joyce Purcell, Assistant State Conservationist, (860) 871-4028

**Boating Grants**

***Clean Vessel Act Grants***

The Clean Vessel Act was established in 1992 by the Federal Government and was signed into law to protect our waters and associated recreational opportunities from damaging vessel sewage discharges. Projects proposed for the construction, renovation, operation, or maintenance of pumpout stations, pumpout boats, and dump stations used by boaters are all eligible to receive federal funding. This money can also be used to pay for projects that hold and transport boater sewage to sewage treatment plants, such as holding tanks, piping, or hauling and disposal fees. Approved projects are given funding for up to 75 percent of the total cost of the project.

*Eligible applicants:* Any public/private marina, boatyard, shipyard, or State/county/municipal organization wishing to install OR significantly upgrade their pumpout station and make it available to all boaters is eligible for grant funding.
*Online:* http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323750&depNav_GID=1711%20
*Contact:* Kate Hughes Brown, Office of Long Island Sound Program, 79 Elm Street, Hartford, CT 06106, (860) 424-3652

**Additional Resources**

***U.S. Environmental Protection Agency (EPA)***

The EPA recognizes that committed watershed organizations and State and local governments need adequate resources to achieve the goals of the Clean Water Act and improve our nation’s water quality. To this end, the EPA has created the following website to provide tools, databases, and information about sources of funding to practitioners and funders that serve to protect watersheds:

*Online:* http://www.epa.gov/owow/funding.html

***U.S. Department of Agriculture (USDA)***

The USDA offers several potential sources of funding for the protection, restoration and stewardship of our water resources, including the Watershed and Clean Water and the Forestry Innovation Program, and the Water Resources Program.

*Online*: http://www.na.fs.fed.us/watershed/gp_innovation.shtm; and http://www.nrcs.usda.gov/wps/portal/nrcs/main/?ss=16&navtype=BROWSEBYSUBJECT&cid=null&navid=100000000000000&pnavid=null&position=BROWSEBYSUBJECT&ttype=main&pname=Programs%20&%20Services%20-%20NRCS

***National Oceanic and Atmospheric Administration (NOAA)***

NOAA's Office of Ocean and Coastal Resource Management offers several options in protecting coastal resources.

*Online:* http://coastalmanagement.noaa.gov/funding/welcome.html

## 8. Connecticut's Drainage Basins and Bacteria-Impaired Segments

Connecticut DEEP has established eight major basins that include all of Connecticut and some hydrologically-connected parts of Massachusetts, New York, New Hampshire, and Vermont. These major basins are further divided into regional and sub-regional basins, while saltwater segments tend to follow municipal borders. Figure 8-1 provides a map of Connecticut with major basins indicated. The figure also illustrates the locations of bacteria impaired segments addressed in this TMDL report. The saltwater impaired segments are located in Long Island Sound, which is divided into Western, Central and Eastern portions. Further division is made from inner estuary (1), shoreline (2), mid shore (3) and offshore (4) segments. Table 8-3 provides a compilation of impaired segments by major basin (freshwater segments) and Long Island Sound division (saltwater segments). As shown in Table 8-1, the freshwater impaired segments are spread among 7 of the 8 major basins, with the most impaired segments in the Connecticut River Basin (Basin 4). 134 impaired segments are freshwater, while 46 impaired segments are saltwater. As additional bacteria-impaired segments are discovered and analyzed in the future, they will be listed and described by CT DEEP through the process outlined in Section 5.4 of this report.

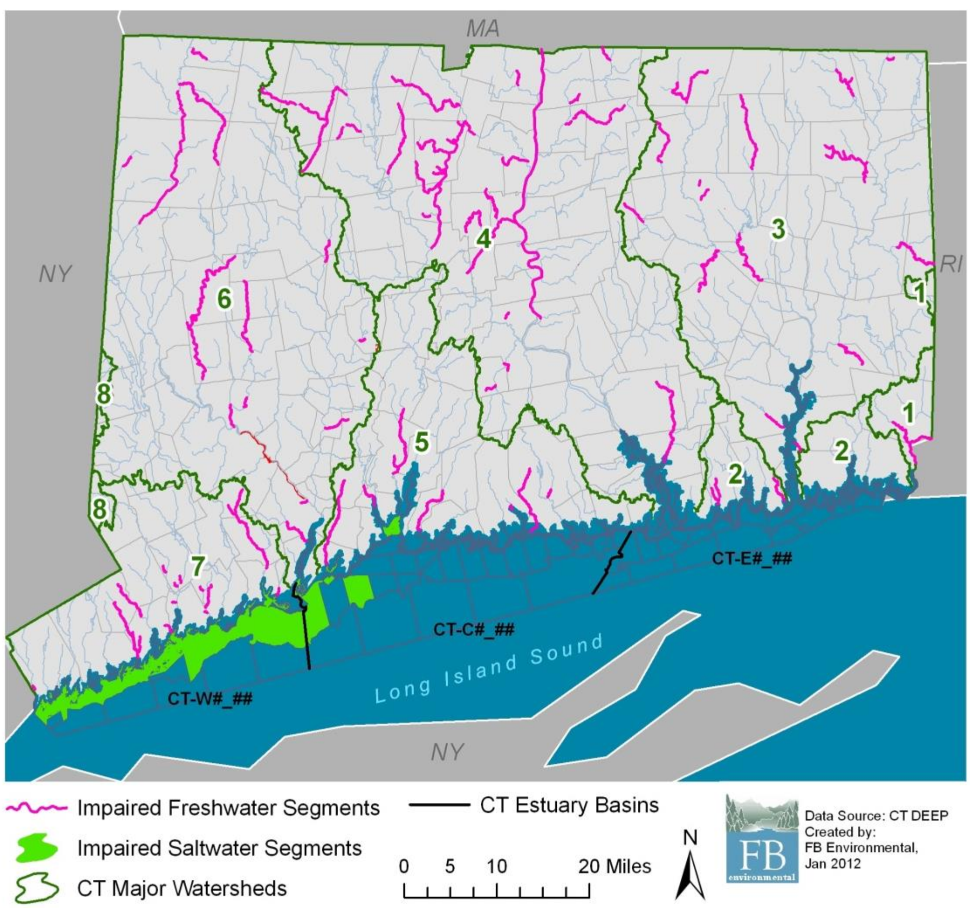


**Figure 8-1: Bacteria-Impaired Waters in Connecticut, by Major Watershed and Long Island Sound Division.**

**Table 8-1: Connecticut Major Watersheds and Long Island Sound Divisions with Number of Bacteria-Impaired Segments Indicated.**

| Freshwater Segments | | |
|---|---|---|
| **Basin No.** | **Basin Name** | **# of Freshwater Impaired Segments** |
| 1 | Pawcatuck River | 1 |
| 2 | Southeast Coast | 4 |
| 3 | Thames River | 28 |
| 4 | Connecticut River | 45 |
| 5 | South Central Coast | 15 |
| 6 | Housatonic River | 16 |
| 7 | Southwest Coast | 25 |
| 8 | Hudson River | 0 |
| **Saltwater Segments** | | |
| **Division** | **Division Name** | **# of Saltwater Impaired Segments** |
| W | Western | 39 |
| C | Central | 7 |
| E | Eastern | 0 |
| | ***Total*** | ***180*** |

## 8.1 Watershed-Specific Bacteria Data Summaries

Appendices 2 through 79 provide bacteria data and information for the 180 impaired segments. Additional bacteria-impaired segments discovered and analyzed in the future will be listed and described by CT DEEP through the process outlined in Section 5.4 of this report. The numbered appendices are organized by sub-regional basin. Each appendix contains segment-specific summaries for the bacteria impaired segments in a particular sub-regional basin. For example, the Shunock River appendix (Appendix 2) contains one segment-specific summary and the Farmington River appendix (Appendix 27) contains five summaries.

Each segment-specific summary provides the following information:

- A description of the watershed for each impaired segment (size, location, and major features) and an overview of available information related to bacteria;
- A series of watershed maps showing the locations of impaired segments and the land area draining to the impaired segment, land use, potential bacteria sources, MS4 areas, the amount of impervious cover, and the land use in the riparian buffer zones in the watershed;
- Data tables with information about permitted facilities within the watershed; and
- Data tables with recent bacteria data for each impaired segment with geometric mean and reductions required to meet TMDL requirements as described in Sections 8.1.2 and 8.1.2.

The appendices are listed below by major basin and sub-regional basin. The number of impaired segments in each appendix is indicated in parentheses.

An initial list of the bacteria impaired segments included in this Statewide TMDL is provided at the end of this section in Table 8-2. The table provides the waterbody name, ID, town(s), and specific indicator bacteria for each impaired segment. Information related to the estimated percent reduction needed to meet the TMDL is described in Section 8.1.2 below, for informational purposes only. Additional bacteria-impaired segments will be listed and described in more detail by CT DEEP in Appendix A.

**Freshwater Segments**

**Major Basin 1: Pawcatuck**

Appendix 2: Sub-Regional Basin CT1004: Shunock River (1)

**Major Basin 2: Southeast Coast**

Appendix 3: Sub-Regional Basin CT2000: Southeast Shoreline (1)
Appendix 4: Sub-Regional Basin CT2206: Bride Brook (3)

**Major Basin 3: Thames**

Appendix 5: Sub-Regional Basin CT3000: Thames River (1)
Appendix 6: Sub-Regional Basin CT3004: Oxoboxo Brook (1)
Appendix 7: Sub-Regional Basin CT3100: Willimantic River (3)
Appendix 8: Sub-Regional Basin CT3102: Middle River (2)
Appendix 9: Sub-Regional Basin CT3103: Furnace Brook (2)
Appendix 10: Sub-Regional Basin CT3106: Skungamaug River (2)
Appendix 11: Sub-Regional Basin CT3108: Hop River (1)
Appendix 12: Sub-Regional Basin CT3110: Tenmile River (1)
Appendix 13: Sub-Regional Basin CT3200: Natchaug River (1)
Appendix 14: Sub-Regional Basin CT3206: Mount Hope River (1)
Appendix 15: Sub-Regional Basin CT3207: Fenton River (1)
Appendix 16: Sub-Regional Basin CT3300: French River (1)
Appendix 17: Sub-Regional Basin CT3500: Moosup River (1)
Appendix 18: Sub-Regional Basin CT3708: Little River (2)
Appendix 19: Sub-Regional Basin CT3710: Mashamoquet Brook (5)
Appendix 20: Sub-Regional Basin CT3716: Broad Brook (1)
Appendix 21: Sub-Regional Basin CT3800: Shetucket River (2)

**Major Basin 4: Connecticut**

Appendix 22: Sub-Regional Basin CT4000: Connecticut River (2)
Appendix 23: Sub-Regional Basin CT4009: Roaring Brook (1)
Appendix 24: Sub-Regional Basin CT4101: Muddy Brook (1)
Appendix 25: Sub-Regional Basin CT4205: Buckhorn Brook (1)
Appendix 26: Sub-Regional Basin CT4206: Broad Brook (2)
Appendix 27: Sub-Regional Basin CT4300: Farmington River (5)
Appendix 28: Sub-Regional Basin CT4302: Mad River (3)
Appendix 29: Sub-Regional Basin CT4303: Still River (3)
Appendix 30: Sub-Regional Basin CT4304: Sandy Brook (1)
Appendix 31: Sub-Regional Basin CT4305: Morgan Brook (3)
Appendix 32: Sub-Regional Basin CT4309: Cherry Brook (2)

**Saltwater Segments**

**Major Basin: Western**

Appendix 73: Estuary 1: Norwalk (6)
Appendix 74: Estuary 2: Greenwich/Stamford (12)
Appendix 75: Estuary 3: Darien (5)
Appendix 76: Estuary 4: Westport/Fairfield (9)
Appendix 77: Estuary 5: Milford (6)

**Major Basin: Central**

Appendix 78: Estuary 6: New Haven (1)
Appendix 79: Estuary 7: Bridgeport (7)

### 8.1.1 Wet/Dry Weather Analysis Methodology

Wet or dry weather status (i.e., whether or not it has rained recently) concurrent with sampling events has been found to be a useful data characteristic. This analysis enables investigators to evaluate whether or not bacteria violations occur during wet or dry weather conditions, supporting the identification and prioritization of bacteria pollutant sources for mitigation. Since most of the bacteria data presented in the watershed-specific appendices were collected without noting the weather conditions, the rainfall status for each of the waterbody segments covered by this TMDL had to be calculated using the method described below.

***Analytical Procedure – Wet and Dry Weather Events:***

Precipitation data is reviewed and each sampling date is designated as a "dry" or "wet" sampling event. For this TMDL, "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. The rainfall amounts are added together from each of the measured time periods (24, 48 and 96 hours) and the cumulative amount is compared against these wet/dry guidelines.

In watersheds that have point source discharges, the WLA component of the TMDL is based on the geometric mean of all bacteria data that are designated as "wet" using the above rainfall calculations. The LA component of the TMDL is based on the geometric mean all bacteria data designated as "dry" using the above rainfall calculations.

In watersheds that do not have point source discharges, the geometric mean of all bacteria data that are designated "wet" are utilized for the wet weather LA, and the geometric mean of all bacteria data that are designated as "dry" are utilized for the dry weather LA.

### 8.1.2 Estimated Bacteria Reduction Calculation Methodologies

For information purposes, estimated reduction goals to meet the TMDL targets were calculated using sets of bacteria data. These methods are consistent with CTDEEP water quality standards and EPA guidelines for statistical analysis of bacteria data. As described in Section 2, Connecticut uses the geometric mean and single sample maximum components from populations of *E.coli* bacteria data to assess freshwater recreation uses and Enterococci bacteria data for saltwater recreation uses to determine compliance with water quality standards. For shellfishing uses, the geometric mean and 90% of samples less than values of fecal coliform are used to determine compliance. The methodology used for fecal coliform based on the criteria listed in the CT WQS and the selection of these values is from the NSSP-MO Guide for Control of Molluscan Shellfish (USFDA 2009). For total coliform, the monthly moving average and single sample maximum are used to determine compliance with freshwater drinking water standards.

Geometric means of bacteria data sets were calculated for all sampling stations in all impaired segments. Geometric means are often used to evaluate data spanning several orders of magnitude to remove the influence of any one particularly high or low data point. By definition, the geometric mean is the average of the logarithmic values, converted back to a base 10 number. Geometric means are calculated using the following equation:

$$\textbf{Geometric Mean} = n^{th} \textbf{ root of } (x_1)(x_2)....(x_n)$$

where, $x_1$, $x_2$, etc. represent individual data points and n is the total number of data points used in the calculation (Costa, 2011).

For segments impaired for fecal coliform, the 90% of samples less than values were calculated for each sampling station by sampling year. A 90% of samples less than concentration indicates that 90 percent of the values in a dataset are less than the appropriate criteria from the CT WQS. The 90% less than values were calculated by determining how many sample values (n) were in a given dataset and dividing that value into 100%.  This gave the (P)% of each data value. Then this (P)% was multiplied by the total number of values that exceeded criteria(E) which results in % of samples exceeding.  The % samples was then reduced by 10 and the difference was included as the reduction goal (RG)needed for the dataset.

$$100/n = P\%$$

$$(P\%) * E = S$$

$$S - 10 = (RG)$$

For these TMDLs, the geometric mean values were calculated using the GEOMEAN function in Microsoft Excel, while the 90% values were calculated using pencil and paper.

In each impaired segment, the sampling station with the highest geometric mean and/or 90% less than/single sample maximum statistical value in relation to the applicable criterion was then used to calculate a percent reduction for bacteria for each segment. These reductions provide a rough estimation of the pollution abatement action needed for each segment to meet water quality standards. The percent reduction is calculated based on the difference between measured ambient bacteria data and the applicable water quality criteria for bacteria, which are also the TMDL target concentrations.

For example, the highest geometric mean from Beaver Brook, a Class A segment impaired for *E. coli*, was 200 colonies/100 mL. The geometric mean WQS is 126 colonies/100 mL. The percent reduction needed to meet the geometric mean criteria is calculated as follows:

**Percent reduction = [(200 – 126)/200] x 100 = 37% reduction**

The highest single sample value for Beaver Brook was 3000 colonies/100 mL. The single sample WQS is 410 colonies/100 mL. The percent reduction needed to meet the single sample criteria is calculated as follows:

**Percent reduction = [(3000 – 410)/3000] x 100 = 86% reduction**

The results of this analysis for each sampling station and each impaired segment are provided in the appendices. The sampling stations with the highest geometric mean or 90% less than values and the associated required reductions are provided in Table 8-2 by impaired segment. Table 8-2 details the appropriate wasteload allocations that are established by this TMDL study for use as water quality targets for permittees as permits are renewed and updated. These targets will not be used as NPDES permit limits except for WLA for non-stormwater NPDES discharges or as otherwise specified in regulatory or statutory requirements.

**Table 8-2: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Single Sample | Geometric Mean | Single Sample | Geometric Mean |
| **Major Basin 1: Pawcatuck** | | | | | | | | |
| 2 | CT1004-00_01 | Shunock River | A | North Stonington | 410 | 126 | 86 | NA |
| **Major Basin 2: Southeast Coast** | | | | | | | | |
| 3 | CT2000-30_01 | Southeast Shoreline / Fenger Brook | A | New London | 410 | 126 | 62 | 7 |
| 4 | CT2206-00_01 | Bride Brook | A | East Lyme | 410 | 126 | 7 | NA |
| 4 | CT2206-00_02 | Bride Brook | A | East Lyme | 410 | 126 | 98 | 81 |
| 4 | CT2206-03_01 | Bride Brook | A | East Lyme | 410 | 126 | 94 | 71 |
| **Major Basin 3: Thames** | | | | | | | | |
| 5 | CT3000-08_01 | Thames River / Flat Brook | A | Ledyard | 410 | 126 | 97 | 81 |
| 6 | CT3004-00_01 | Oxoboxo Brook | B | Montville | 410 | 126 | 94 | 43 |
| 7 | CT3100-00_06 | Willimantic River | B | Stafford | 410 | 126 | 89 | 84 |
| 7 | CT3100-17_03 | Willimantic River / Cedar Swamp Brook | A | Mansfield | 410 | 126 | 66 | 15 |
| 7 | CT3100-19_02 | Willimantic River / Eagleville Brook | A | Mansfield | 410 | 126 | 96 | 91 |
| 8 | CT3102-00_01 | Middle River | B | Stafford | 410 | 126 | 96 | 86 |
| 8 | CT3102-00_02 | Middle River | A | Stafford | 410 | 126 | 68 | 13 |
| 9 | CT3103-00_01 | Furnace Brook | B | Stafford | 410 | 126 | 78 | 80 |
| 9 | CT3103-00_02 | Furnace Brook | B | Stafford | 410 | 126 | 96 | 82 |
| 10 | CT3106-00_01b | Skungamaug River | A | Tolland | 410 | 126 | 90 | 67 |
| 10 | CT3106-06-1-L2_01 | Skungamaug River / Crandall Pond | A | Tolland | 235 | 126 | 88 | NA |
| 11 | CT3108-00_01b | Hop River | A | Andover, Coventry, Bolton | 410 | 126 | 29 | 32 |
| 12 | CT3110-00_01 | Tenmile River | A | Lebanon | 410 | 126 | 80 | 39 |
| 13 | CT3200-00_01 | Natchaug River / Lauter Park Beach | A | Windham, Chaplin, Eastford | 235 | 126 | 24 | NA |
| 14 | CT3206-00_02 | Mount Hope River | AA | Ashford, Mansfield | 410 | 126 | 84 | 38 |
| 15 | CT3207-16-1-L1_01 | Fenton River / Bicentennial Pond | A | Mansfield | 235 | 126 | 79 | NA |
| 16 | CT3300-02_01 | French River / Long Branch Brook | A | Thompson | 410 | 126 | 59 | 12 |

**Table 8-2, cont'd: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 17 | CT3500-00_03 | Moosup River | B | Plainfield, Sterling | 410 | 126 | 63 | 11 |
| 18 | CT3708-01_01 | Little River / Muddy Brook | AA | Woodstock | 410 | 126 | 92 | 74 |
| 18 | CT3708-08_01 | Little River / Peckham Brook | AA | Woodstock | 410 | 126 | 91 | 50 |
| 19 | CT3710-00_02 | Mashamoquet Brook | A | Pomfret | 410 | 126 | 80 | 60 |
| 19 | CT3710-00_01 | Mashamoquet Brook | A | Pomfret | 410 | 126 | 94 | 65 |
| 19 | CT3710-11_01 | Mashamoquet Brook / Abington Brook | A | Pomfret | 410 | 126 | 84 | 72 |
| 19 | CT3710-13_01 | Mashamoquet Brook / Sap Tree Run | A | Pomfret | 410 | 126 | 94 | 59 |
| 19 | CT3710-18_01 | Mashamoquet Brook / White Brook | A | Pomfret, Brooklyn | 410 | 126 | 96 | 76 |
| 20 | CT3716-00_01 | Broad Brook | A | Preston | 410 | 126 | 98 | 71 |
| 21 | CT3800-00_05 | Shetucket River | B | Norwich, Scotland, Sprague, Windham | 410 | 126 | 83 | NA |
| 21 | CT3800-02_01 | Shetucket River / Obwebetuck Brook | A | Windham, Lebanon | 410 | 126 | 82 | 39 |
| **Major Basin 4: Connecticut** | | | | | | | | |
| 22 | CT4000-00_01 | Connecticut River | B | Middletown, Portland, Haddam, East Hampton, East Haddam, Chester | 410 | 126 | 67 | 74 |
| 22 | CT4000-00_03 | Connecticut River | B | Enfield, Suffield, Windsor, Eat Windsor, Windsor Locks, South Windsor Glastonbury, Wethersfield, East Hartford, Rocky Hill, Cromwell, Hartford | 410 | 126 | 98 | 81 |
| 23 | CT4009-00-2-L4_01 | Roaring Brook / Angus Park Pond | A | Glastonbury | 235 | 126 | 88 | 7 |
| 24 | CT4101-00_01 | Muddy Brook | A | Suffield | 410 | 126 | 78 | 66 |
| 25 | CT4205-00_01 | Buckhorn Brook | A | Enfield | 410 | 126 | 98 | 95 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 26 | CT4206-00_01 | Broad Brook | A | East Windsor, Ellington | 410 | 126 | 98 | 92 |
| 26 | CT4206-00_02 | Broad Brook | A | East Windsor, Ellington | 410 | 126 | 98 | 89 |
| 27 | CT4300-00_02 | Farmington River | B | East Granby, Simsbury, Avon, Farmington | 410 | 126 | NA | NA |
| 27 | CT4300-32_01 | Farmington River / Minister Brook | A | Simsbury | 410 | 126 | 96 | 84 |
| 27 | CT4300-33_01 | Farmington River / Russell Brook | A | Simsbury | 410 | 126 | 97 | 71 |
| 27 | CT4300-39_01 | Farmington River / Owens Brook | A | Simsbury | 410 | 126 | 98 | 85 |
| 27 | CT4300-44_01 | Farmington River / Munnisunk Brook | A | Simsbury, Granby | 410 | 126 | 97 | 96 |
| 28 | CT4302-00_01 | Mad River | B | Winchester, Norfolk | 410 | 126 | 89 | 52 |
| 28 | CT4302-00_02a | Mad River | A | Winchester, Norfolk | 410 | 126 | 86 | 61 |
| 28 | CT4302-00_03 | Mad River | AA | Winchester, Norfolk | 410 | 126 | 59 | NA |
| 29 | CT4303-00_02 | Still River | B | Winchester, Colebrook, Torrington | 410 | 126 | 58 | 20 |
| 29 | CT4303-00_03 | Still River | B | Winchester, Colebrook, Torrington | 410 | 126 | NA | 67 |
| 29 | CT4303-00_04 | Still River | A | Winchester, Colebrook, Torrington | 410 | 126 | 87 | 42 |
| 30 | CT4304-00_01a | Sandy Brook | B | Colebrook, Norfolk | 410 | 126 | 85 | 48 |
| 31 | CT4305-00_01 | Morgan Brook | A | Barkhamsted | 410 | 126 | 59 | 35 |
| 31 | CT4305-00_02 | Morgan Brook | A | Barkhamsted | 410 | 126 | 55 | 47 |
| 31 | CT4305-00_04 | Morgan Brook | A | Barkhamsted | 410 | 126 | 43 | NA |
| 32 | CT4309-00_01 | Cherry Brook | A | Canton | 410 | 126 | 89 | 38 |
| 32 | CT4309-00_02 | Cherry Brook | A | Canton | 410 | 126 | 98 | 79 |
| 33 | CT4316-00_02 | Thompson Brook | A | Avon | 410 | 126 | 62 | 57 |
| 34 | CT4317-00_01 | Nod brook | A | Avon, Simsbury | 410 | 126 | 89 | 65 |
| 35 | CT4318-00_01 | Hop Brook | A | Simsbury | 410 | 126 | 87 | 62 |
| 36 | CT4319-00_01a | West Branch Salmon Brook | A | Granby, Hartland | 410 | 126 | 79 | 65 |
| 36 | CT4319-00_01b | West Branch Salmon Brook | A | Granby, Hartland | 410 | 126 | 60 | 28 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 37 | CT4321-00_01 | Mill Brook | A | Windsor, Bloomfield | 410 | 126 | 26 | 63 |
| 38 | CT4400-00_01 | Park River | B | Hartford | 410 | 126 | 98 | 91 |
| 38 | CT4400-01_01 | S Branch Park River | B | Hartford | 410 | 126 | 98 | 91 |
| 38 | CT4400-01_02 | S Branch Park River | B | Hartford | 410 | 126 | 98 | 91 |
| 39 | CT4402-00_01 | Piper Brook | B | West Hartford | 410 | 126 | 98 | 76 |
| 39 | CT4402-00_02 | Piper Brook | B | West Hartford, New Britain, Newington | 410 | 126 | 97 | 81 |
| 40 | CT4403-00_01 | Trout Brook | A | West Hartford | 410 | 126 | 98 | 86 |
| 40 | CT4403-00_02 | Trout Brook | A | West Hartford | 410 | 126 | 98 | 92 |
| 40 | CT4403-00_03 | Trout Brook | A | West Hartford | 410 | 126 | 98 | 78 |
| 41 | CT4404-00_01 | N Branch Park River | A | Hartford | 410 | 126 | 98 | 92 |
| 41 | CT4404-00_02 | N Branch Park River | A | Bloomfield, Hartford, West Hartford | 410 | 126 | 98 | 92 |
| 42 | CT4600-27_trib_01 | Mattabesset River / Willow Brook East Branch | A | Cromwell | 410 | 126 | 93 | 95 |
| 43 | CT4607-00-UL_pond_01 | Coginchaug River / Wadsworth Falls SP pond | A | Middletown, Middlefield | 235 | 126 | 88 | NA |
| 43 | CT4607-08_01 | Coginchaug River / Lyman Meadows Brook | A | Middletown, Middlefield | 410 | 126 | 98 | 97 |
| 43 | CT4607-13_01 | Coginchaug River / Laurel Brook | A | Middletown, Middlefield | 410 | 126 | 93 | 69 |
| 44 | CT4800-00_01 | Eightmile River | A | Lyme, East Haddam | 410 | 126 | 85 | 32 |
| **Major Basin 5: South Central Coast** | | | | | | | | |
| 45 | CT5105-00_01 | Chatfield Hollow Brook | A | Killingworth | 410 | 126 | 37 | NA |
| 46 | CT5107-00_01 | Neck River | A | Madison | 410 | 126 | 92 | 40 |
| 47 | CT5108-00_01 | East River | A | Guilford | 410 | 126 | 88 | 79 |
| 48 | CT5112-00_01 | Farm River | A | East Haven, North Branford | 410 | 126 | 98 | 91 |
| 48 | CT5112-00_02 | Farm River | AA | East Haven, North Branford | 410 | 126 | 75 | 91 |
| 49 | CT5202-00-1-L3_01 | Tenmile River / Mixville Pond | A | Cheshire | 235 | 126 | 88 | 20 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 50 | CT5302-00_02 | Mill River | AA | Hamden, Cheshire, North Haven | 410 | 126 | 94 | 77 |
| 50 | CT5302-06_01 | Mill River / Shepard Brook | AA | Hamden, Cheshire, North Haven | 410 | 126 | 71 | 77 |
| 51 | CT5305-00_01 | West River | A | New Haven | 410 | 126 | 88 | 86 |
| 51 | CT5305-00-3-L1_01 | West River / Edgewood Park Pond | A | New Haven | 410 | 126 | 94 | 62 |
| 52 | CT5307-00_01 | Wepawaug River | A | Milford, Orange, Woodbridge | 410 | 126 | 97 | 73 |
| 52 | CT5307-00_02 | Wepawaug River | A | Milford, Orange, Woodbridge | 410 | 126 | 74 | 88 |
| 52 | CT5307-00_03 | Wepawaug River | A | Milford, Orange, Woodbridge | 410 | 126 | 90 | 68 |
| 52 | CT5307-00_04 | Wepawaug River | AA | Milford, Orange, Woodbridge | 235 | 126 | 94 | 70 |
| 52 | CT5307-00_05 | Wepawaug River | AA | Milford, Orange, Woodbridge | 235 | 126 | 94 | 90 |
| **Major Basin 6: Housatonic** | | | | | | | | |
| 53 | CT6000-00_06 | Housatonic River | B | Cornwall, Kent, Salisbury | 410 | 126 | 89 | 61 |
| 53 | CT6000-00-5+L2_01 | Housatonic River / Lake Zoar | B | Southbury | 235 | 126 | 93 | NA |
| 53 | CT6000-00-5+L4_01 | Housatonic River / Lake Housatonic | B | Shelton | 235 | 126 | 88 | NA |
| 53 | CT6000-73_01 | Housatonic River / Curtiss Brook | AA | Shelton | 410 | 126 | 18 | 29 |
| 54 | CT6025-00_02 | Far Mill River | B | Stratford, Shelton | 410 | 126 | 98 | 59 |
| 55 | CT6100-00_02a | Blackberry River | B | North Canaan, Norfolk | 410 | 126 | 98 | 87 |
| 56 | CT6200-00_01 | Hollenbeck River | A | Canaan | 410 | 126 | 90 | 39 |
| 57 | CT6302-00_02 | Mill Brook | A | Sharon | 410 | 126 | 71 | NA |
| 58 | CT6700-20_01 | Shepaug River / Walker Brook | AA | Washington, Roxbury, New Milford | 410 | 126 | 98 | 90 |
| 59 | CT6705-00_01 | Bantam River | AA | Morris, Litchfield | 410 | 126 | 95 | 4 |
| 60 | CT6800-00_03 | Pomperaug River | B | Southbury, Woodbury | 410 | 126 | 92 | 75 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 60 | CT6800-00_01 | Pomperaug River | B | Southbury, Woodbury | 410 | 126 | 90 | 65 |
| 61 | CT6804-00_01 | Weekeepeemee River | A | Woodbury, Bethlehem | 410 | 126 | 98 | 48 |
| 62 | CT6900-28_01 | Naugatuck River / Hockanum Brook | A | Beacon Falls | 410 | 126 | 73 | 55 |
| 63 | CT6914-06-1-L1_01 | Mad River / Hitchcock Lake | A | Waterbury, Wolcott | 235 | 126 | 72 | NA |
| 63 | 6914-06_01 | Lilly Brook | A | Wolcott | 410 | 126 | 97 | 84 |
| **Major Basin 7: South West Coast** | | | | | | | | |
| 64 | CT7000-22_01 | South West Shoreline / Indian River | A | Westport | 410 | 126 | 96 | 67 |
| 64 | CT7000-22_02 | South West Shoreline / Indian River | A | Westport | 410 | 126 | 92 | 34 |
| 65 | CT7102-00_02 | Bruce Brook | B | Stratford, Bridgeport | 410 | 126 | 98 | NA |
| 66 | CT7105-00_05 | Pequonnock River | A | Bridgeport, Trumbull | 410 | 126 | 15 | 31 |
| 66 | CT7105-00_02 | Pequonnock River | A | Bridgeport, Trumbull | 410 | 126 | 98 | 82 |
| 66 | CT7105-00_03 | Pequonnock River | A | Bridgeport, Trumbull | 410 | 126 | 49 | 50 |
| 66 | CT7105-00_04 | Pequonnock River | A | Bridgeport, Trumbull | 410 | 126 | 85 | 11 |
| 66 | CT7105-01_01 | West Branch Pequonnock River | A | Bridgeport, Trumbull | 410 | 126 | 38 | 46 |
| 67 | CT7109-00-trib_01 | Sasco Brook / Great Brook | A | Fairfield | 410 | 126 | 99 | 85 |
| 67 | CT7109-06_01 | Sasco Brook / Great Brook | A | Fairfield | 410 | 126 | 89 | 61 |
| 67 | CT7109-02_01 | Sasco Brook / Unnamed Tributary | A | Fairfield | 410 | 126 | 92 | 14 |
| 67 | CT7109-06_02 | Sasco Brook / Great Brook | A | Fairfield | 410 | 126 | 94 | 53 |
| 68 | CT7200-22_01 | Saugatuck River / Beaver Brook | A | Weston | 410 | 126 | 86 | 37 |
| 68 | CT7200-24_01 | Saugatuck River / Kettle Creek | A | Weston | 410 | 126 | 74 | 5 |
| 68 | CT7200-26_01 | Saugatuck River / Poplar Plain Brook | A | Westport | 410 | 126 | 86 | 36 |
| 69 | CT7203-04_01 | West Branch Saugatuck River / Cobbs Mill Brook | A | Weston | 410 | 126 | 46 | 7 |
| 70 | CT7302-00_02 | Silvermine River | A | Norwalk | 410 | 126 | 96 | 86 |
| 71 | CT7401-00_02 | Fivemile River | B | New Canaan | 410 | 126 | 98 | 77 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (*E. coli*) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| 71 | CT7401-00_01 | Fivemile River | B | New Canaan | 410 | 126 | 98 | 88 |
| 71 | CT7401-00_03 | Fivemile River | A | New Canaan | 410 | 126 | 73 | 56 |
| 71 | CT7401-02_01 | Fivemile River / Unnamed Tributary | A | New Canaan | 410 | 126 | 77 | 50 |
| 71 | CT7401-05_01 | Fivemile River / Holy Ghost Father's Brook | A | Norwalk | 410 | 126 | 89 | 52 |
| 71 | CT7401-06_01 | Fivemile River / Keelers Brook | A | Norwalk | 410 | 126 | 96 | 80 |
| 71 | CT7401-07_01 | Fivemile River / Unnamed Tributary to Keelers Brook | A | Norwalk | 410 | 126 | 98 | 98 |
| 72 | CT7411-00_01 | Byram River | B | Greenwich | 410 | 126 | 98 | 88 |

**Table 8-2, cont'd: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (Fecal Coliform) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Geometric Mean | 90% less than | Geometric Mean | 90% less than |
| **Estuary 1: Norwalk** | | | | | | | | |
| 73 | CT-W2_011 | LIS WB Shore - Canfield Island | SA | Westport | 14 | 31 | NA | 23 |
| 73 | CT-W2_012 | LIS WB Shore - Outer Norwalk Harbor(East) | SA | Norwalk | 14 | 31 | 53 | 56 |
| 73 | CT-W2_013 | LIS WB Shore - Outer Norwalk Harbor(West) | SA | Norwalk | 14 | 31 | 48 | 40 |
| 73 | CT-W2_014 | LIS WB Shore - Wilson Cove, Farm Creek | SA | Norwalk | 14 | 31 | NA | 40 |
| 73 | CT-W3_008-I | LIS WB Midshore - Norwalk Islands | SA | Westport, Norwalk | 14 | 31 | 50 | 40 |
| **Estuary 2: Greenwich/Stamford** | | | | | | | | |
| 74 | CT-W1_022-SB | LIS WB Inner - Byram River | SB | Greenwich | 88 | 260 | 70 | 56 |
| 74 | CT-W2_018 | LIS WB Shore - Westcott Cove | SA | Stamford | 14 | 31 | NA | 40 |
| 74 | CT-W2_019 | LIS WB Shore - Stamford Harbor | SA | Stamford | 14 | 31 | 30 | 15 |

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (Fecal Coliform) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Geometric Mean | 90% less than | Geometric Mean | 90% less than |
| 74 | CT-W2_020 | LIS WB Shore - Stamford Harbor (West) | SA | Stamford | 14 | 31 | 53 | 40 |
| 74 | CT-W2_021 | LIS WB Shore - Greenwich Cove | SA | Greenwich | 14 | 31 | NA | 26 |
| 74 | CT-W2_022 | LIS WB Shore - Cos Cob Harbor | SA | Greenwich | 14 | 31 | 18 | 29 |
| 74 | CT-W2_024 | LIS WB Shore - Byram Harbor | SA | Greenwich | 14 | 31 | NA | 14 |
| 74 | CT-W2_025 | LIS WB Shore - Byram Harbor (West) | SA | Greenwich | 14 | 31 | NA | 4 |
| 74 | CT-W3_011 | LIS WB Midshore - Outer Westcott Cove | SA | Stamford | 14 | 31 | 50 | 40 |
| 74 | CT-W3_012 | LIS WB Midshore - Outer Stamford Harbor | SA | Stamford, Greenwich | 14 | 31 | 66 | 40 |
| 74 | CT-W3_013 | LIS WB Midshore - Outer Cos Cob Harbor | SA | Greenwich | 14 | 31 | NA | 11 |
| 74 | CT-W3_015-I | LIS WB Midshore - Captain Harbor | SA | Greenwich | 14 | 31 | 7 | 40 |
| **Estuary 3: Darien** | | | | | | | | |
| 75 | CT-W2_015 | LIS WB Shore - Fivemile River Estuary | SA | Norwalk, Darien | 14 | 31 | NA | 40 |
| 75 | CT-W2_016 | LIS WB Shore - Scott Cove | SA | Darien | 14 | 31 | 26 | 23 |
| 75 | CT-W2_017 | LIS WB Shore - Darien Cove | SA | Darien, Stamford | 14 | 31 | 75 | 73 |
| 75 | CT-W3_009 | LIS WB Midshore - Outer Fivemile River Estuary | SA | Norwalk, Darien | 14 | 31 | 7 | 40 |
| 75 | CT-W3_010 | LIS WB Midshore - Outer Cove Harbor | SA | Darien, Stamford | 14 | 31 | 30 | 40 |

**Table 8-2, cont'd: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (Fecal Coliform) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Geometric Mean | 90% less than | Geometric Mean | 90% less than |
| **Estuary 4: Westport/Fairfield** | | | | | | | | |
| 76 | CT-W1_005 | LIS WB Inner - Southport Harbor | SA | Fairfield | 14 | 31 | 98 | 90 |
| 76 | CT-W1_008 | LIS WB Inner - Sherwood Millpond | SA | Westport | 14 | 31 | 95 | 65 |
| 76 | CT-W1_010-SB | LIS WB Inner - Saugatuck River (Mouth) | SB | Westport | 88 | 260 | NA | 40 |
| 76 | CT-W2_006 | LIS WB Shore - Southport Harbor (East) | SA | Fairfield | 14 | 31 | 44 | 26 |
| 76 | CT-W2_007 | LIS WB Shore - Southport Harbor (West) | SA | Fairfield | 14 | 31 | 67 | 83 |
| 76 | CT-W2_009 | LIS WB Shore - Compo Cove, SISP | SA | Westport | 14 | 31 | 52 | 57 |
| 76 | CT-W2_010 | LIS WB Shore - Compo Beach, Cedar Point | SA | Westport | 14 | 31 | 22 | 50 |
| 76 | CT-W3_005 | LIS WB Midshore - Southport Harbor | SA | Fairfield, Westport | 14 | 31 | 68 | 65 |
| 76 | CT-W3_006 | LIS WB Midshore - Sherwood Point | SA | Westport | 14 | 31 | 0 | 40 |
| **Estuary 5: Milford** | | | | | | | | |
| 77 | CT-C1_018-SB | LIS CB Inner - Milford Harbor & Gulf Pond | SB | Milford | 88 | 260 | 20 | 23 |
| 77 | CT-C1_019-SB | LIS CB Inner - Housatonic River (Mouth) | SB | Milford | 88 | 260 | 36 | NA |
| 77 | CT-C2_023 | LIS CB Shore - Walnut Beach | SA | Milford | 14 | 31 | NA | 10 |
| 77 | CT-C3_017 | LIS CB Midshore - Milford | SA | Milford, West Haven | 14 | 31 | NA | 17 |
| 77 | CT-C3_019-I | LIS CB Midshore - Outer Silver Sand Beach | SA | Milford | 14 | 31 | 33 | 50 |

**Table 8-2, cont'd: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (Fecal Coliform) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Geometric Mean | 90% less than | Geometric Mean | 90% less than |
| 77 | CT-C3_020 | LIS CB Midshore - Milford Point | SA | Milford | 14 | 31 | 76 | 70 |
| **Estuary 6: New Haven** | | | | | | | | |
| 78 | CT-C1_013-SB | LIS CB Inner - New Haven Harbor | SB | New Haven | 88 | 260 | NA | 10 |
| **Estuary 7: Bridgeport** | | | | | | | | |
| 79 | CT-W1_001-SB | LIS WB Inner - Bridgeport Harbor | SB | Bridgeport | 88 | 260 | NA | 40 |
| 79 | CT-W1_002-SB | LIS WB Inner - Black Rock Harbor | SB | Bridgeport | 88 | 260 | NA | 10 |
| 79 | CT-W2_004 | LIS WB Shore - Outer Bridgeport Harbor | SA | Fairfield | 14 | 31 | 89 | 90 |
| 79 | CT-W3_001 | LIS WB Midshore - Lordship | SA | Stratford | 14 | 31 | 18 | 50 |
| 79 | CT-W3_002 | LIS WB Midshore - Bridgeport Harbor (East) | SA | Stratford, Bridgeport | 14 | 31 | 56 | 65 |
| 79 | CT-W3_003 | LIS WB Midshore - Bridgeport Harbor (West) | SA | Bridgeport | 14 | 31 | 30 | 57 |
| 79 | CT-W3_004 | LIS WB Midshore - Shoal Point | SA | Bridgeport, Fairfield | 14 | 31 | 60 | 50 |

**Table 8-2, cont'd: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies.**

| Appendix # | Waterbody ID | Waterbody Name | WQ Class | Towns | End Point Target (Enterococci) (cols/100mls) | | % Reduction to meet TMDL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Single Sample | Geometric Mean | Single Sample | Geometric Mean |
| **Estuary 1: Norwalk** | | | | | | | | |
| 73 | CT-W1_013-SB | LIS WB Inner - Norwalk Harbor | SB | Norwalk | 35 | 104 | 34 | 99 |
| **Estuary 2: Greenwich/Stamford** | | | | | | | | |
| 74 | CT-W1_022-SB | LIS WB Inner - Byram River | SB | Greenwich | 35 | 500 | 98 | 2 |
| 74 | CT-W2_024 | LIS WB Shore - Byram Harbor | SA | Greenwich | 35 | 104 | 10 | 95 |
| **Estuary 7: Bridgeport** | | | | | | | | |
| 77 | CT-W1_002-SB | LIS WB Inner - Black Rock Harbor | SB | Bridgeport | 35 | 500 | 97 | NA |

NA in any of the % reduction columns refers to the fact that the segment iscurrently meeting water quality standards and no reduction is necessary for bacteria

## 9. References

Birch et al. (2004). Efficiency of a constructed wetland in removing contaminants from stormwater. *Wetlands*. 24(2): 459-466.

Costa, Joe (2011). Calculating Geometric Means. Buzzards Bay National Estuary Program. http://www.buzzardsbay.org/geomean.htm

CTDEP (1993). Manual of Best Management Practices for Agriculture: Guidelines for Protecting Connecticut's Water Resources. CT Dept. of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT. http://www.ct.gov/dep/lib/dep/aquifer_protection/bmps_agriculture_1993.pdf

CTDEP (2002). Water Quality Standards. CT Dept. of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT. http://www.dep.state.ct.us/wtr/wq/wqs.pdf

CTDEP (2006). 2006 Impaired Waters List (CT Waterbodies Not Meeting Water Quality Standards). CT Dept. of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT. http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/2006appendixc303d.pdf

CTDEEP (2011a). Water Quality Standards. CT Dept. of Energy & Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT. http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf

CTDEEP (2011b). 2010 State of Connecticut Integrated Water Quality Report. CT Dept. of Energy & Environmental Protection, Bureau of Water Protection and Land Reuse, Hartford, CT. Final- May 31, 2011. http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/ctiwqr10final.pdf

CTDEEP (2011c). CT Dept. of Energy & Environmental Protection. Connecticut's No Discharge Area Program. Updated July 26, 2011. http://www.ct.gov/dep/cwp/view.asp?A=2705&Q=323816

CTDEEP (2011d). CT Dept. of Energy & Environmental Protection, Bureau of Water Protection and Land Reuse, Clean Water Fund Management Office. Connecticut's Clean Water Fund. http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654

CTDEEP (2011e). CT Dept. of Energy & Environmental Protection. Stormwater Management Program. Updated October 2011. http://www.ct.gov/dep/cwp/view.asp?A=2721&Q=325702

CTDEEP (2011f). CT Dept. of Energy & Environmental Protection. Subsurface Sewage Treatment and Disposal Systems (Septic Systems). Updated March 12, 2008. http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325706&depNav_GID=1654

CTDPH (ND). CT Dept. of Public Health. Septic Systems 101: Operation and Maintenance of a Subsurface Sewage Disposal System.

http://www.ct.gov/dph/lib/dph/environmental_health/environmental_engineering/pdf/Septic_Systems_101.pdf

CTFB (2009). Connecticut Farm Bureau. The Changing Face of Connecticut Agriculture – Classroom Presentation. http://www.ct.gov/dep/lib/dep/water_inland/wetlands/seg3_2009changingface_jn.pdf

CWP (2007a). National Pollutant Removal Performance Database: Version 3. Ellicott City, MD. Online: http://www.stormwaterok.net/CWP%20Documents/CWP-07%20Natl%20Pollutant%20Removal%20Perform%20Database.pdf

CWP (2007b).Urban Stormwater Retrofit Practices. Center for Watershed Protection. http://www.cwp.org/Store/usrm.htm

CWP (1999). Watershed Protection Techniques. Center for Watershed Protection. Vol.3, No.1.

Davies, C.M., and H.J. Bavor. (2000). The fate of stormwater-associated bacteria in constructed wetland and water pollution control pond systems. *Journal of Applied Microbiology*. 89: 349-360.

Eastern Connecticut RCDA (2011). Eastern Connecticut Resource Conservation and Development Area, Inc. Nutrient Management. http://easternrcd-ct.org/NutrientManagement/CTNMIndex.html

Fuss and O'Neill (2010). Technical Memorandum 2 Evaluating the Role of Stormwater Utility Districts in the Implementation of Low Impact Development. Partners for the Connecticut Low Impact Development and Stormwater General Permit Evaluation, Connecticut. August 2010.

Garzio-Hadzick, A.M., Shelton, D.R., Hill, R., Pachepsky, Y.A., Guber, A.K., Rowland, R.A. (2010). Survival of manure-borne E. coli in streambed sediment: effects of temperature and sediment properties. Water Research. 44:2753-2762

Hathaway, J.M., W.F. Hunt, J.D. Wright, and S.J. Jadlocki. (2008). Pathogen removal performance of best management practices in Charlotte and Wilmington, North Carolina. *World Environmental and Water Resources Congress.* Online: http://lshs.tamu.edu/docs/lshs/end-notes/pathogen%20removal%20performance%20of%20best%20management%20practices%20in-2347948826/pathogen%20removal%20performance%20of%20best%20management%20practices%20in.pdf

MADEP (2011). Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts. Massachusetts Department of Environmental Protection. http://www.mass.gov/dep/water/resources/tmdls.htm

MADEP (2007). Final Pathogen TMDL for the Charles River Watershed. January, 2007. Massachusetts Department of Environmental Protection, Division of Watershed Management. CN 0156.0.

Mallin, M.A., K.E. Williams, E.C. Esham, and R.P. Lowe. (2000). Effect of human development on bacteriological water quality in coastal watersheds. *Ecological Applications.* 10(4): 1047-1056.

NEIWPCC (2003). Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities. January 2003. New England Interstate Water Pollution Control Commission. Online: http://www.neiwpcc.org/neiwpcc_docs/iddmanual.pdf

North Carolina Department of Energy and Natural Resources (NCDENR). (2007). *Stormwater Best Management Practices Manual.* Online: http://www.ncsu.edu/ehs/environ/DWQ_StormwaterBMPmanual_001%5B1%5D.pdf

Perry, Ann ( 2011). E. coli: Alive and Well, Probably in a Streambed Near You. Agricultural Research.

Schueler, T.R., P.A. Kumble, and M. Heraty (1992). A Current Assessment of Urban Best Management Practices Techniques for Reducing Non-Point Source Pollution in the Coastal Zone. Metropolitan Washington Council of Governments. Washington, DC.

Sullivan, T.J., J.A. Moore, D.R. Thomas, E. Mallery, K.U. Snyder, M. Wustenberg, J. Wustenberg, S.D. Mackey, D.L. Moore (2007). Efficacy of Vegetated Buffers in Preventing Transport of Fecal Coliform Bacteria from Pasturelands. Environmental Management. 40:958–965.

UNHSC (2009). 2009 Biannual Report. Online: http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/2009_unhsc_report.pdf

URI (2010). Septic System Information for Rhode Islanders: Maintaining your Septic System. University of Rhode Island Cooperative Extension Wastewater Training Center.

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

USEPA (1999a). National Pollutant Discharge Elimination System (NPDES) Combined Sewer Overflows Control Policy. United States Environmental Protection Agency. Online: http://cfpub.epa.gov/npdes/cso/cpolicy.cfm?program_id=5.

USEPA (1999b). Combined Sewer Overflow Management Fact Sheet – Sewer Separation. September, 1999. United States Environmental Protection Agency. EPA 832-F-99-04.

USEPA (2001a). Protocol for Developing Pathogen TMDLs. January 2001. United States Environmental Protection Agency. EPA 841-R-00-002.

USEPA (2001b). Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. Online: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf.

USEPA (2003). National Management Measures to control Non-point Source Pollution from Agriculture. United States Environmental Protection Agency. EPA 841-B-03-004. Online: http://www.epa.gov/owow/nps/agmm/index.html

USEPA (2006). National Pollutant Discharge Elimination System: Preventing Septic System Failure. United States Environmental Protection Agency.

http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutto n=detail&bmp=25

USEPA (2008). Handbook for Developing Watershed Plans to Restore and Protect Our Waters. March, 2008. United States Environmental Protection Agency. EPA 841-B-08-002. http://www.epa.gov/owow/nps/watershed_handbook

USEPA (2010). No Discharge Areas in Connecticut. United States Environmental Protection Agency. http://www.epa.gov/region1/eco/nodiscrg/vt.html.

USFDA (2009). NSSP 2009 Section II Chap IV. Shellstock Growing Areas National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish. United States Food and Drug Administration. http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FederalStatePrograms/NationalShellfishSanitationProgram/ucm046988.htm

USFDA (2009). NSSP 2009 Section IV Chap II.14 Calculating the 90th Percentile. National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish. United States Food and Drug Administration. http://www.fda.gov/Food/FoodSafety/ProductSpecificInformation/Seafood/FederalStatePrograms/NationalShellfishSanitationProgram/UCM061379

Wright-Pierce (2003). Technical Report on Impact of General Permit on Concentrated Animal Feeding Operations in Connecticut. Prepared for CT Dept. of Environmental Protection, Hartford, CT. March 2003.

Wright Water Engineers and Geosyntec Consultants (2010). International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary: Fecal Indicator Bacteria. December 2010. http://www.bmpdatabase.org

# APPENDIX 1:
# TMDLS EXPRESSED AS DAILY LOAD

As explained in Section 5.2, Connecticut expresses bacteria TMDLs as concentrations (counts of bacteria/100mL). However, in accordance with federal guidance, bacteria TMDLs are also expressed as daily loads in terms of mass per unit time (i.e., number of bacteria per day as a function of flow for rivers and streams; and daily replacement volume of water for lakes, ponds and coastal embayments.) Graphs and tables are provided below for *E. coli* and Enterococci geometric means.

In contrast to the concentration-based bacteria TMDLs, the margin of safety (MOS) in mass per unit time TMDLs is explicit where a discrete portion of the loading capacity is reserved to ensure that water quality standards will be attained. In the example mass per unit time bacteria TMDLs provided below, 5% of the loading capacity is reserved as the MOS, leaving 95% of the TMDL available for allocation among existing and future sources. The MOS is implicit in the concentration based TMDLs.

Mass per unit time TMDLs for rivers are calculated by multiplying river or stream flow at a given point in time by the allowable bacteria concentration. If stream-flow data are not available, a range of flows can be assumed based on drainage area. Flows within the assumed range are multiplied by the water quality standard (geometric mean) to obtain the loading capacity or TMDL for the stream segment or watershed. For lakes and ponds or estuarine and marine segments, the daily replacement volume of the waterbody is multiplied by the WQS concentration. The daily replacement volume is the flushing rate (the number of times per year that the volume of the waterbody is completely exchanged), divided by 365, and then multiplied by the volume of the waterbody. Formulas to calculate mass per unit time can be found on the following pages.

The following figures contain TMDL calculations for bacteria-impaired rivers and streams, lakes and ponds, and coastal embayments. These figures are intended to provide the necessary formulas, tables, and graphs required for calculating bacteria TMDLs for any bacteria-impaired waterbody, and for any flow and/or volume.

Daily load (mass per unit time) bacteria TMDLs are presented for:

- ***Freshwater River & Stream Recreational Waters*** **–** Figure 1 and Table 1 show allowable loads for these waters based on the geometric mean criterion for primary contact recreation of 126 *E. coli* per 100 mL for non-designated bathing beach waters. This is a flow-based, daily load calculation for freshwater rivers and streams. The process would be similar when calculating loads using any of the applicable concentration-based bacteria water quality criteria. Designated beach TMDL's would be calculated using a criterion of 126 *E. coli* per 100mL as well.

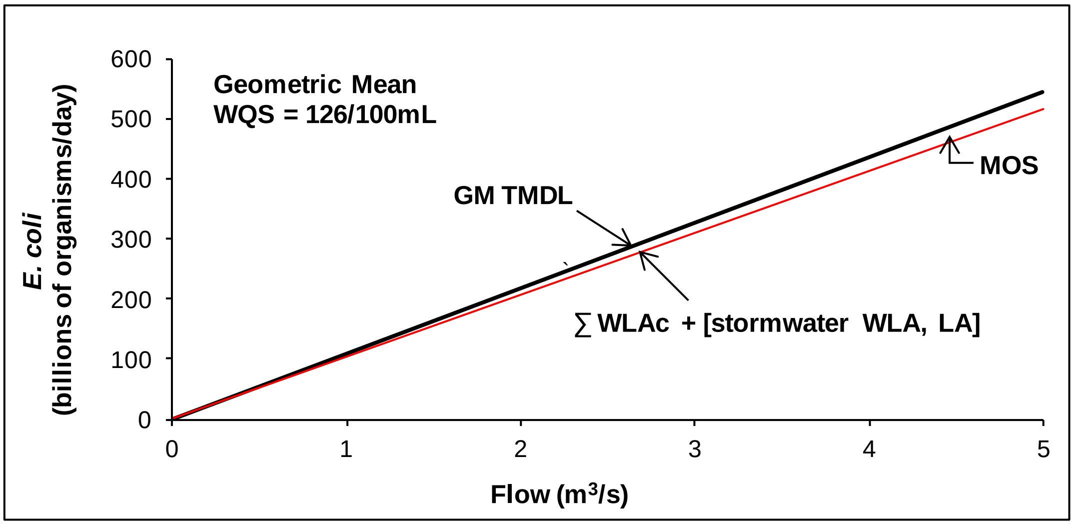


**Figure 1: Freshwater rivers and streams daily load based on *E. coli* geometric mean water quality standard (GM WQS).**

**Table 1: *E. coli* freshwater rivers and streams daily loads.**

| Flow ($m^3$ / sec) | Geometric Mean WQS (count / 100 mL) | TMDL ($10^9$ count / day) | MOS ($10^9$ count / day) | LA and WLA ($10^9$ count / day) |
|---|---|---|---|---|
| 0.005 | 126 | 0.544 | 0.0272 | 0.517 |
| 0.01 | 126 | 1.089 | 0.0544 | 1.034 |
| 0.025 | 126 | 2.722 | 0.1361 | 2.59 |
| 0.05 | 126 | 5.443 | 0.272 | 5.17 |
| 0.075 | 126 | 8.165 | 0.408 | 7.76 |
| 0.1 | 126 | 10.886 | 0.544 | 10.34 |
| 0.25 | 126 | 27.216 | 1.361 | 25.9 |
| 0.5 | 126 | 54.432 | 2.72 | 51.7 |
| 0.75 | 126 | 81.648 | 4.08 | 77.6 |
| 1 | 126 | 108.864 | 5.44 | 103.4 |
| 5 | 126 | 544.320 | 27.2 | 517 |

Formula:

TMDL ($10^9$ organisms / day) = Water Quality Standard (count / 100 mL) x Flow ($m^3$ / sec) x 86,400 (sec / day) x 10 (100 mL / L) x 1000 (L / $m^3$) x $1/10^9$

Where: WQS = 126 / 100mL *E. coli*

Daily Replacement volume = (Annual flushing rate/365) x Waterbody Volume ($m^3$)

Annual Flushing Rate = number of times per year the waterbody's volume is exchanged

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety, set equal to 5% of GM WQS.

mL = milliliter; L = Liter, $m^3$ = cubic meter

- ***Freshwater Lake & Pond Recreational Waters*** **–** Figure 2 and Table 2 show the TMDL for these waters based on the geometric mean criteria for primary contact recreation of 126 *E. coli* per 100mL. These daily load calculations for Class A and B freshwater lakes and ponds are based on the daily replacement volume, which is the volume of the waterbody that is exchanged each day upon a flushing time of one day. The process would be similar when calculating loads using any of the applicable concentration-based bacteria water quality criteria, including when calculating the fecal coliform standards for the terminal reservoir in a drinking water supply.

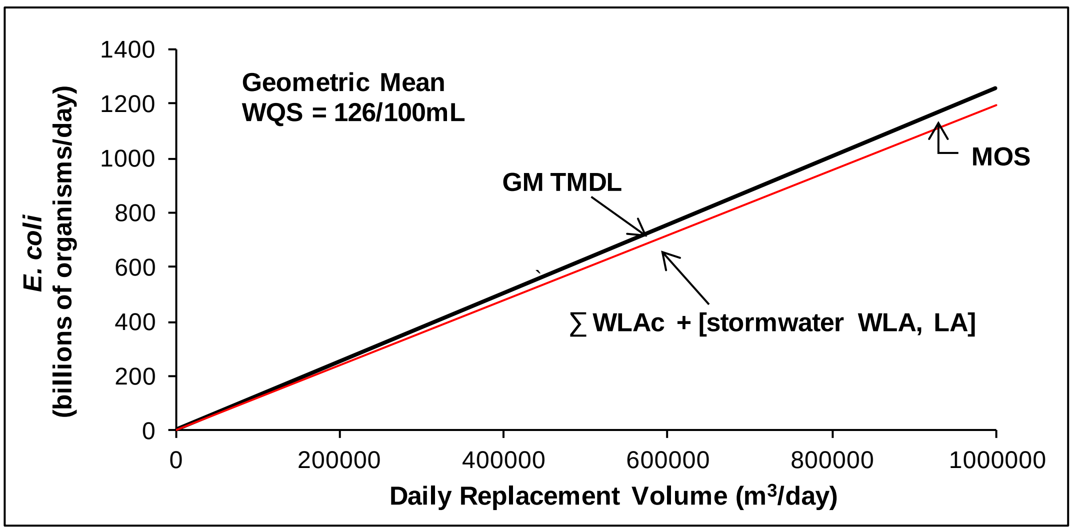


**Figure 2: Freshwater lakes and ponds daily loads based on *E. coli* geometric mean water quality standards (GM WQS).**

**Table 2: *E. coli* freshwater lakes and ponds daily loads.**

| Daily Replacement Volume ($m^3$ / day) | Geometric Mean WQS (count / 100 mL) | GM TMDL ($10^9$ count / day) | MOS ($10^9$ count / day) | LA and WLA ($10^9$ count / day) |
|---|---|---|---|---|
| 1000 | 126 | 1.26 | 0.1 | 1 |
| 5000 | 126 | 6.3 | 0 | 6 |
| 10000 | 126 | 12.6 | 1 | 12 |
| 50000 | 126 | 63 | 3 | 60 |
| 100000 | 126 | 126 | 6 | 120 |
| 500000 | 126 | 630 | 32 | 599 |
| 1000000 | 126 | 1260 | 63 | 1197 |

Formula:

TMDL ($10^9$ organisms / day) = Water Quality Standard (count / 100 mL) x Daily Replacement Volume ($m^3$ / day) x 10 (100 mL / L) x 1000 (L / $m^3$) x $1/10^9$

Where: WQS = 126 count / 100mL *E. coli*

Daily Replacement volume = (Annual flushing rate/365) x Waterbody Volume ($m^3$)

Annual Flushing Rate = number of times per year the waterbody's volume is exchanged

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety – set equal to 5% of GM WQS.

mL = milliliter; L = Liter, $m^3$ = cubic meter

- ***Estuarine and Marine Recreational Waters -*** Figure and Table 3 show TMDLs for these waters based on the geometric mean criterion for primary contact recreation of 35 Enterococci per 100mL. These daily load calculations for Class B coastal embayments are based on the daily replacement volume, which is the volume of the waterbody that is exchanged each day. The process would be similar when calculating loads using any of the applicable concentration-based bacteria water quality criteria, including when calculating the fecal coliform shellfishing salt water standards.

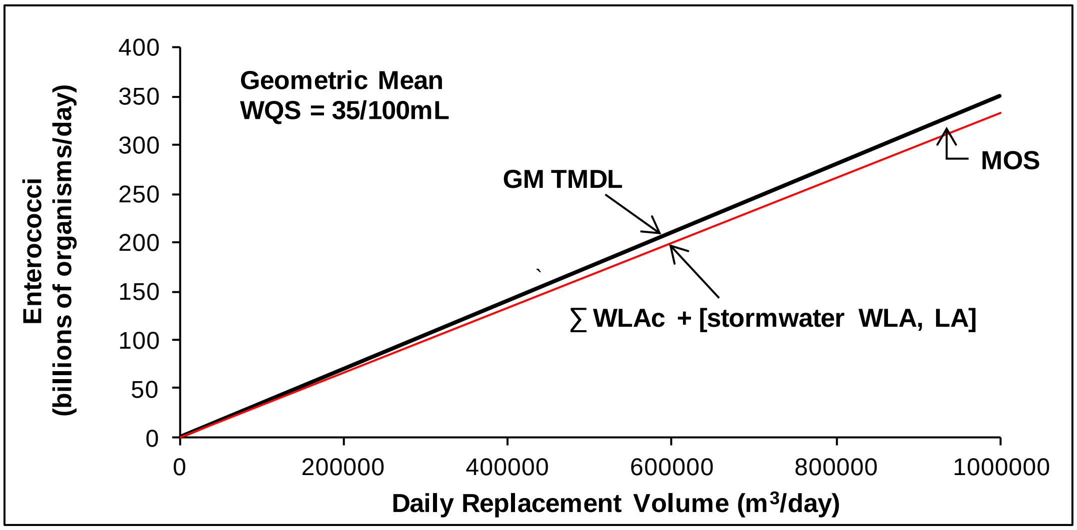


**Figure 3: Estuarine and marine daily loads based on Enterococci salt water geometric mean water quality standards (GM WQS).**

**Table 3: Enterococci estuarine and marine daily loads based on geometric mean water quality standards (GM WQS).**

| Daily Replacement Volume ($m^3$ / day) | Geometric Mean WQS (count / 100 mL) | TMDL ($10^9$ count / day) | MOS ($10^9$ count / day) | LA and WLA ($10^9$ count / day) |
|---|---|---|---|---|
| 1000 | 35 | 0.35 | 0.018 | 0.33 |
| 5000 | 35 | 1.75 | 0.088 | 2 |
| 10000 | 35 | 3.5 | 0.18 | 3 |
| 50000 | 35 | 17.5 | 0.88 | 17 |
| 100000 | 35 | 35 | 1.75 | 33 |
| 500000 | 35 | 175 | 8.75 | 166 |
| 1000000 | 35 | 350 | 17.50 | 333 |

Formula:

TMDL ($10^9$ organisms / day) = Water Quality Standard (count / 100 mL) x Daily Replacement Volume ($m^3$ / day) x 10 (100 mL / L) x 1000 (L / $m^3$) x $1/10^9$

Where: WQS = 35 count / 100mL Enterococci

Daily Replacement volume = (Annual flushing rate/365) x Waterbody Volume ($m^3$)

Annual Flushing Rate = number of times per year the waterbody's volume is exchanged

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety – set equal to 5% of GM WQS.

mL = milliliter; L = Liter, $m^3$ = cubic meter

***Estuarine and Marine Shellfishing Waters -*** Figure and Table 4 show TMDLs for these waters based on the geometric mean criterion for direct consumption of shellfish of 14 fecal coliform units per 100mL. These daily load calculations for Class A coastal waters are based on the daily replacement volume, which is the volume of the waterbody that is exchanged each day.

**Figure 4: Estuarine and marine daily loads based on Fecal coliform salt water geometric mean water quality standards (GM WQS) for direct consumption of shellfish.**

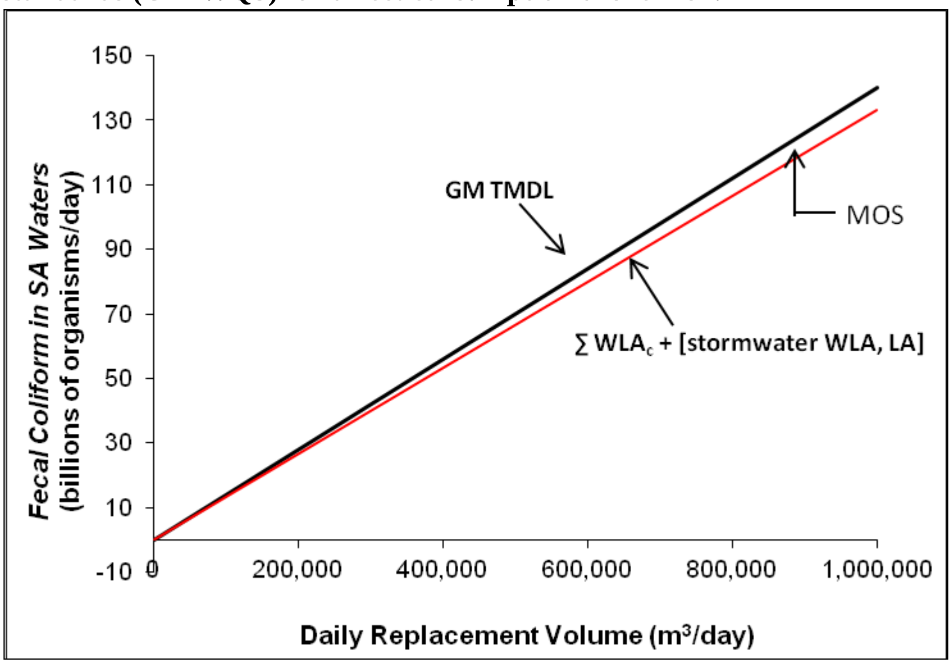


**Table 4: Fecal coliform estuarine and marine daily loads based on geometric mean water quality standards (GM WQS) for direct consumption of shellfish.**

| Daily Replacement Volume ($m^3$ / day) | Geometric Mean WQS (count / 100 mL) | TMDL ($10^9$ count / day) | MOS ($10^9$ count / day) | LA and WLA ($10^9$ count / day) |
|---|---|---|---|---|
| 1000 | 14 | 0.14 | 0.007 | 0.13 |
| 5000 | 14 | 0.70 | 0.035 | 1 |
| 10000 | 14 | 1.4 | 0.07 | 1 |
| 50000 | 14 | 7 | 0.35 | 7 |
| 100000 | 14 | 14 | 0.70 | 13 |
| 500000 | 14 | 70 | 3.50 | 67 |
| 1000000 | 14 | 140 | 7.00 | 133 |

Formula:

TMDL ($10^9$ organisms / day) = Water Quality Standard (count / 100 mL) x Daily Replacement Volume ($m^3$ / day) x 10 (100 mL / L) x 1000 (L / $m^3$) x $1/10^9$

Where: WQS = 14 count / 100mL Fecal coliform

Daily Replacement volume = (Annual flushing rate/365) x Waterbody Volume ($m^3$)

Annual Flushing Rate = number of times per year the waterbody's volume is exchanged

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety – set equal to 5% of GM WQS.

mL = milliliter; L = Liter, $m^3$ = cubic meter

Figure and Table 5 show TMDLs for these waters based on the geometric mean criterion for indirect consumption of shellfish of 88 fecal coliform units per 100mL. These daily load calculations for Class SB coastal waters are based on the daily replacement volume, which is the volume of the waterbody that is exchanged each day.

**Figure 5: Estuarine and marine daily loads based on Fecal coliform salt water geometric mean water quality standards (GM WQS) for indirect consumption of shellfish.**

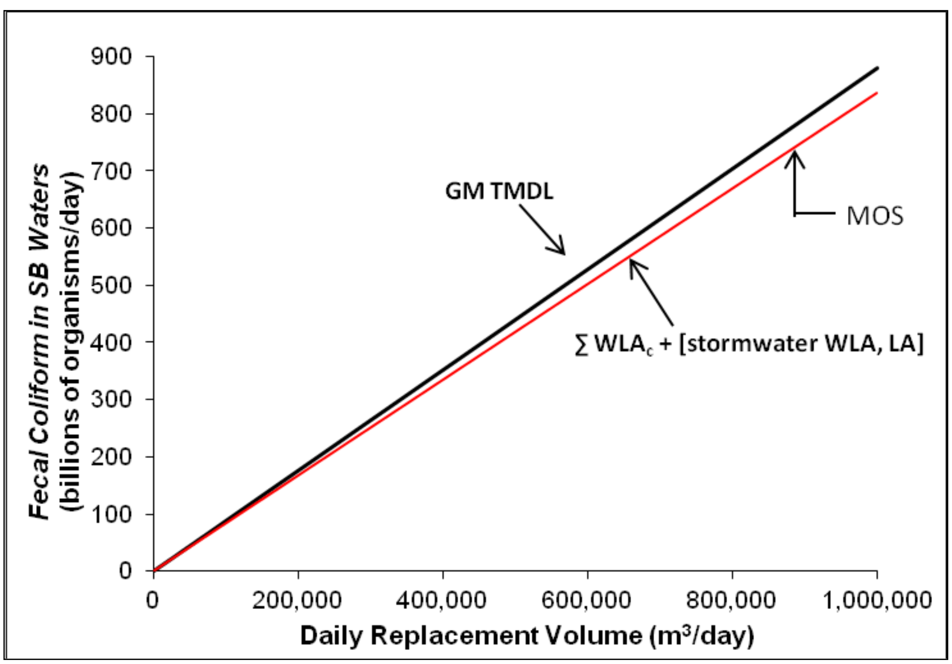

**Table 5: Fecal coliform estuarine and marine daily loads based on geometric mean water quality standards (GM WQS) for indirect consumption of shellfish.**

| Daily Replacement Volume ($m^3$ / day) | Geometric Mean WQS (count / 100 mL) | TMDL ($10^9$ count / day) | MOS ($10^9$ count / day) | LA and WLA ($10^9$ count / day) |
|---|---|---|---|---|
| 1000 | 88 | 0.88 | 0.044 | 0.84 |
| 5000 | 88 | 4.40 | 0.22 | 4.2 |
| 10000 | 88 | 8.8 | 0.44 | 8.4 |
| 50000 | 88 | 44 | 2 | 42 |
| 100000 | 88 | 88 | 4 | 84 |
| 500000 | 88 | 440 | 22 | 418 |
| 1000000 | 88 | 880 | 44 | 836 |

Formula:

TMDL ($10^9$ organisms / day) = Water Quality Standard (count / 100 mL) x Daily Replacement Volume ($m^3$ / day) x 10 (100 mL / L) x 1000 (L / $m^3$) x $1/10^9$

Where: WQS = 88 count / 100mL Fecal coliform

Daily Replacement volume = (Annual flushing rate/365) x Waterbody Volume ($m^3$)

Annual Flushing Rate = number of times per year the waterbody's volume is exchanged

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety – set equal to 5% of GM WQS.

mL = milliliter; L = Liter, $m^3$ = cubic meter

# APPENDIX A:

# ADDITIONAL BACTERIA IMPAIRED SEGMENTS

(THIS APPENDIX IS THE LOCATION FOR FUTURE BACTERIA IMPAIRMENT TMDLS TO BE APPENDED TO THE MAIN CORE DOCUMENT IT IS PRIMARILY USED FOR TRACKING PURPOSES IN CT DEEP)