Little River Watershed Summary

Muddy Brook and Peckham Brook

WATERSHED DESCRIPTION AND MAPS

The Little River watershed covers an area of approximately 15,646 acres in northeastern Connecticut (Figure 1). There are multiple municipalities located at least partially in the watershed, including Woodstock, Putnam, Pomfret, and Thompson, CT. The northern portion of the watershed extends into Massachusetts.

The Little River watershed includes two segments, Muddy Brook (CT-3708-01_01) and Peckham Brook (CT-3708-08_01), impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. Some segments in the watershed are currently unassessed for recreation as of the writing of this document. This does not mean that there are no potential issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of other waterbodies in the watershed (CT DEEP, 2010).

Muddy Brook (CT3708-01_01) begins in eastern Woodstock at the Route 197 crossing, flows southeast through multiple agricultural areas, and ends at the inlet to Roseland Lake between Roseland Park Road and Senexet Road. This impaired segment is 5.44 miles long and is located entirely within the Town of Woodstock.

Peckham Brook (CT3708-08_01) begins in a wooded area adjacent to large agricultural fields between Hibbard Road and Paine District Road in Woodstock, flows southwest adjacent to agricultural fields, crosses Dugg Hill Road, and ends at the confluence with Muddy Brook. This impaired segment is 0.89 miles long and is located entirely within the Town of Woodstock.

Impaired Segment Facts

Impaired Segments:
Muddy Brook (CT3708-01_01)
Peckham Brook (CT3708-08_01)

Town: Woodstock

Impaired Segment Lengths (miles):
CT3708-01_01 (5.44);
CT3708-08_01 (0.89)

Water Quality Classifications:
Class AA

Designated Use Impairments:
Recreation

Sub-regional Basin Name and Code: Little River, 3708

Regional Basin: Little River

Major Basin: Thames

Watershed Area (acres): 15,646

MS4 Applicable? No

Figure 1: Watershed location in Connecticut

The impaired segments of the Little River watershed have a water quality classification of AA. Designated uses include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. These segments of the river are

impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches on these segments, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT3708-00_01	Little River (Putnam)-01	From mouth at confluence with Quinebaug River (just DS of Route 44 crossing), Putnum, US to drinking water watershed boundary (outlet of marsh, parallel to Peake Brook Road, DS of Shepherds Pond), Woodstock (southeast corner).	2.64	FULL	NOT*	FULL
CT3708-00_02	Little River (Putnam)-02	From drinking water watershed boundary (outlet of marsh, parallel to Peake Brook Road, DS of Shepherds Pond), Woodstock (southeast corner), US to Roseland Lake outlet dam (includes confluence with Peake Brook and Shepherds Pond).	1.79	U	U	FULL
CT3708-01_01	Muddy Brook (Woodstock)-01	From mouth at inlet to Roseland Lake, US to Route 197 crossing, Woodstock.	5.44	U	NOT	FULL
CT3708-01_02	Muddy Brook (Woodstock)-02	From Route 197 crossing, US to confluence with Moss Brook (just DS of Route 169 crossing, Sherman corner area), Woodstock.	1.98	NOT	U	FULL
CT3708-01_03	Muddy Brook (Woodstock)-03	From confluence with Moss Brook (just DS of Route 169 crossing, Sherman corner area), US to Muddy Pond outlet, Woodstock.	1.79	U	U	FULL
CT3708-08_01	Peckham Brook (Woodstock)-01	Mouth at confluence with Muddy Brook just DS of Dugg Hill Road crossing, US to confluence with Coman Brook, just US of Morses Pond outlet stream and parallel to Paine District Road, Woodstock.	0.89	U	NOT	U

Shaded cells indicate impaired segment addressed in this TMDL

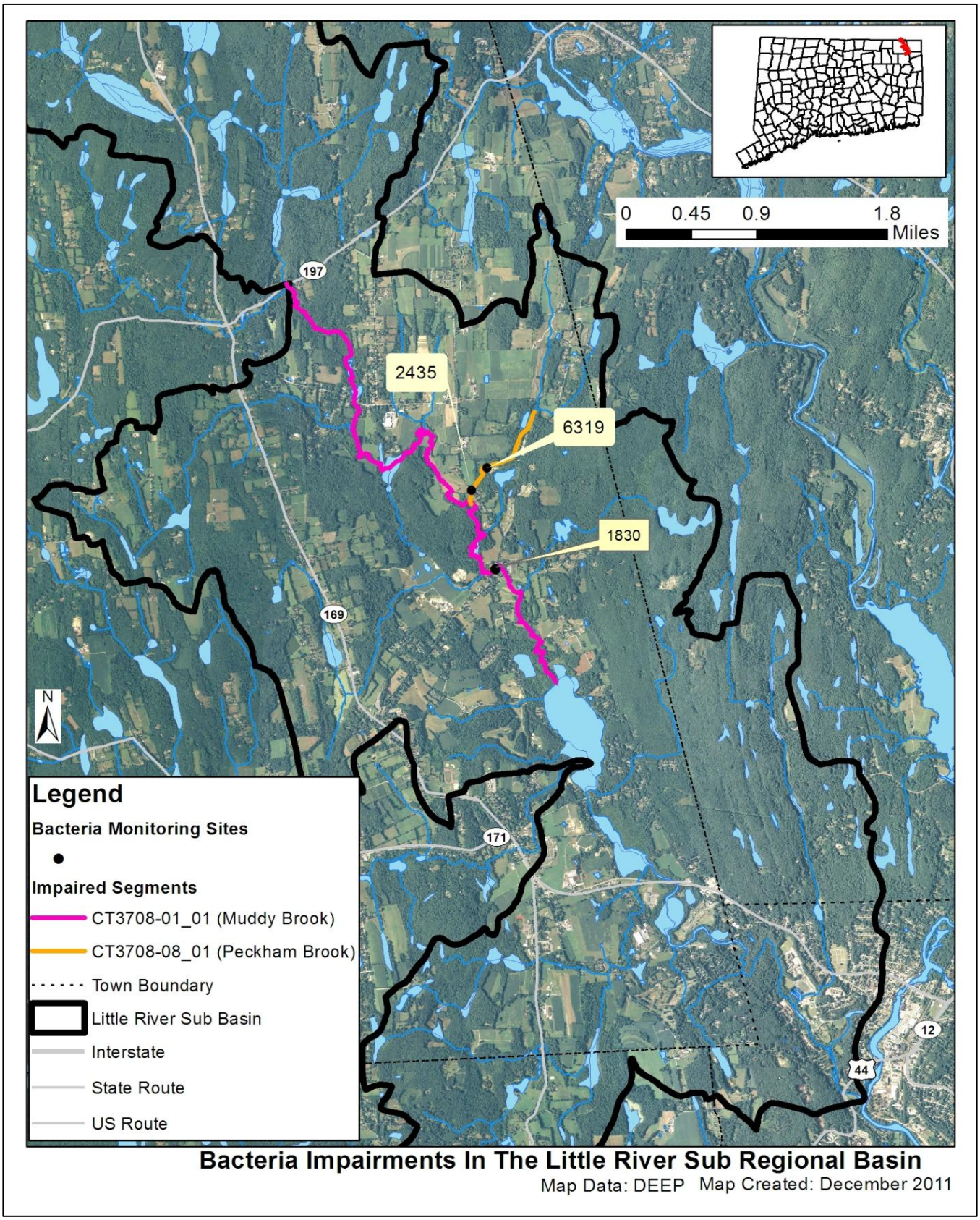
FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

*** = Not included in summary because bacteria data showed attainment.**

Figure 2: GIS map featuring general information of the Little River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Little River watershed consists of 57% forest, 15% urban area, 7% water, and 21% agriculture. There are several pockets of urban development near the impaired segments of Muddy Brook and Peckham Brook in eastern Woodstock. Muddy Brook and Peckham Brook are dominated by agricultural and forested land uses.

Figure 3: Land use within the Little River watershed

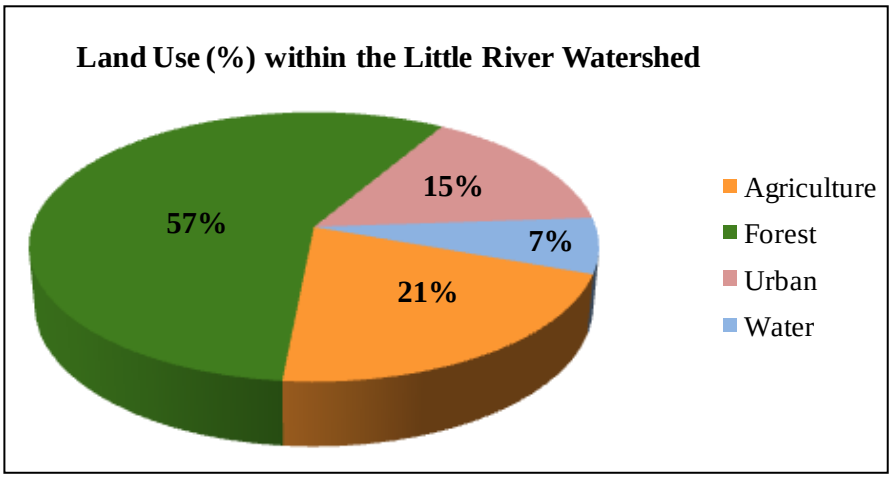
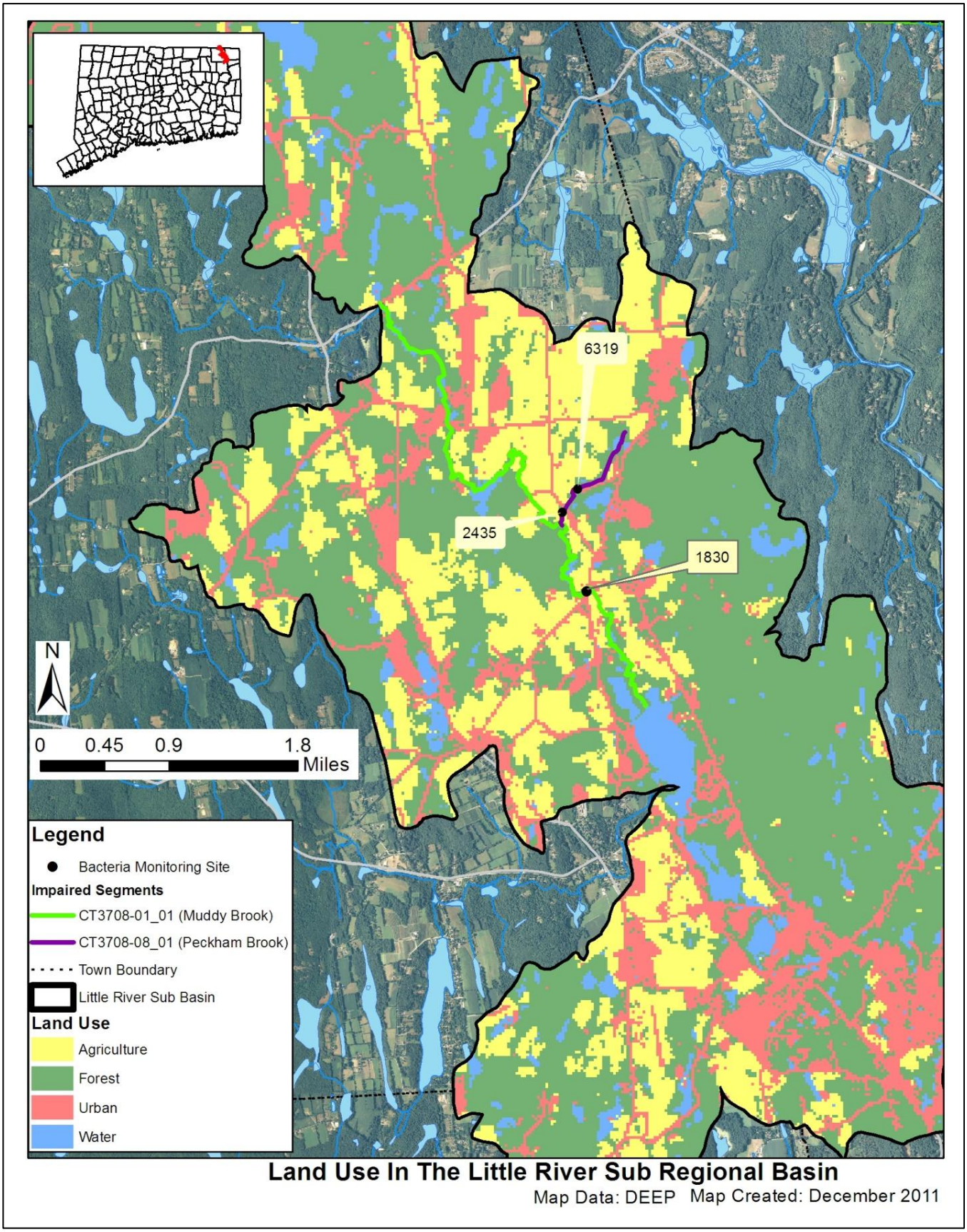


Figure 4: GIS map featuring land use for the Little River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for impaired segments in the Little River watershed

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT3708-01_01	Muddy Brook	1830	Child Hill Road/Roseland Park Rd/Paine District Rd	Woodstock	41.966528	-71.961893
CT3708-08_01	Peckham Brook	2435	Dugg Hill Road	Woodstock	41.97472	-71.965017
		6319	100 Paine District Road	Woodstock	41.97780	-71.962917

Muddy Brook (CT3708-01_01) and Peckham Brook (CT3708-08_01) are Class AA freshwater streams. Their applicable designated uses are existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location on Muddy Brook (Station 1830), and two sampling locations on Peckham Brook (Stations 2435 and 613) (Table 2).

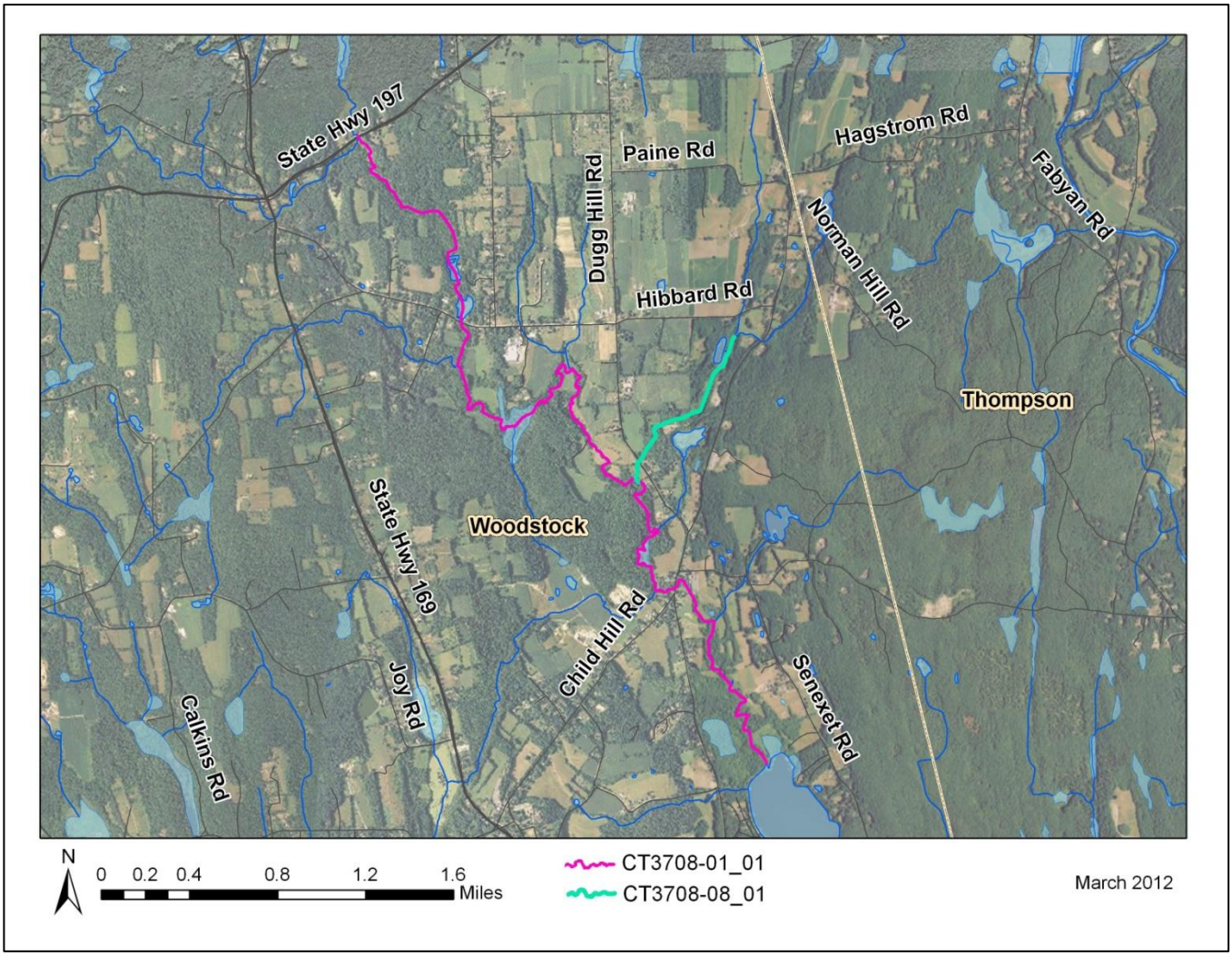
Water quality criteria for *E. coli*, along with bacteria sampling results from 2006-2009, for Muddy Brook are presented in Table 8. Single sample values at Station 1830 exceeded the WQS for *E. coli* several times in all sampling years. The annual geometric mean was calculated for Station 1830 and exceeded the WQS for *E. coli* in all sampling years (Table 8).

Water quality criteria for *E. coli*, along with bacteria sampling results from 2006 and 2011, for Peckham Brook are presented in Table 9. Single sample values exceeded the WQS for *E. coli* several times at Stations 2435 and 6319 in 2011. The annual geometric mean was calculated for Stations 2435 and 6319 and both exceeded the WQS for *E. coli* in 2011 (Table 9).

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days (Tables 8 and 9). For Muddy Brook, the geometric means exceeded the WQS for *E. coli* at Station 1830 during both wet and dry-weather, and the wet-weather value was more than three times the dry-weather value. For Peckham Brook, the geometric mean exceeded the WQS for *E. coli* at Station 2435 during wet-weather and at Station 6319 during wet and dry-weather.

Due to the elevated bacteria measurements presented in Tables 8 and 9, the impaired segments did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of Muddy Brook and Peckham Brook in the Little River watershed



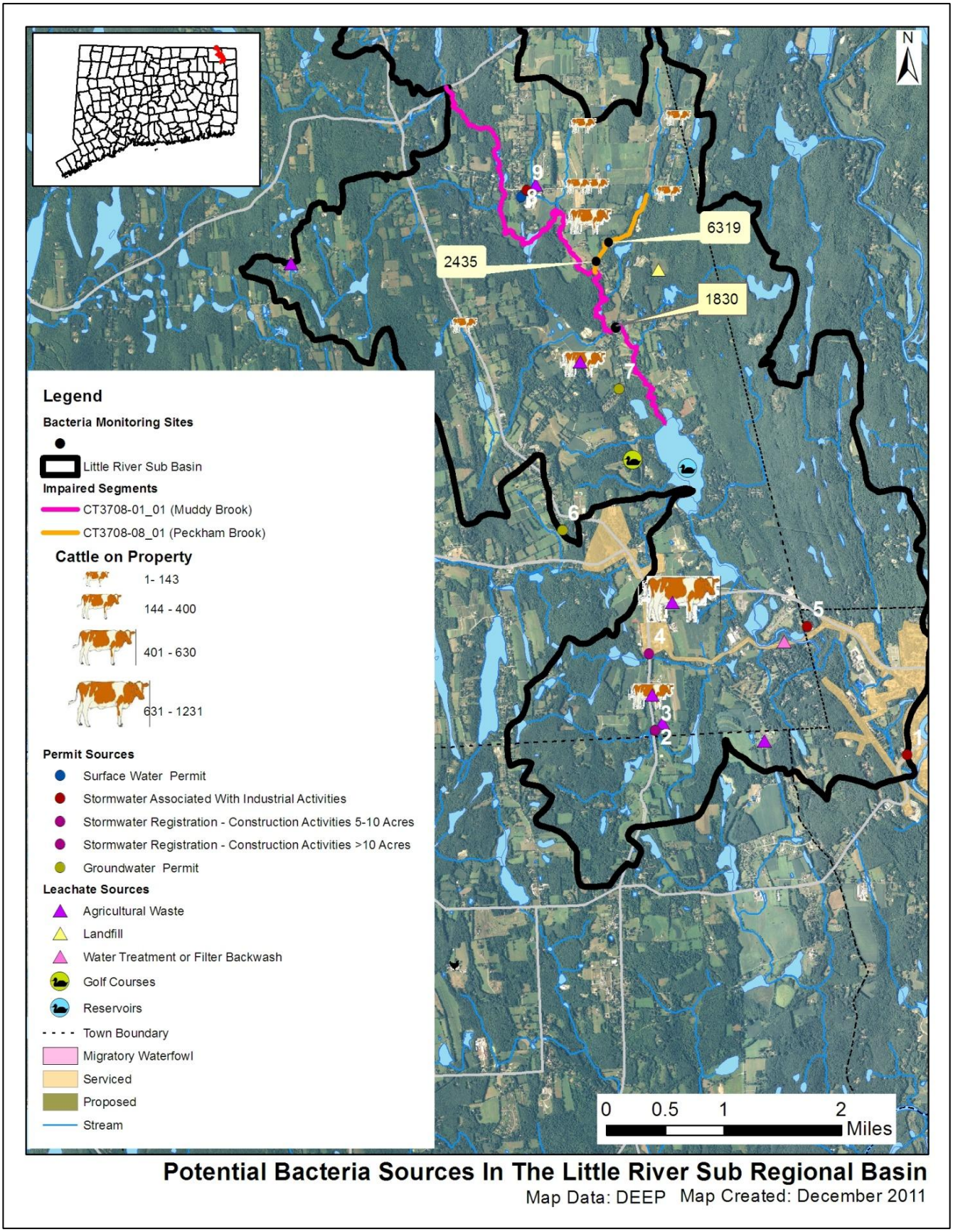
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the Little River watershed based on land use (Figures 3 and 4) and a collection of local information for each of the waterbodies is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional sources. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Little River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/ SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Muddy Brook CT3708-01_01	x			x	x	x	x	
Peckham Brook CT3708-08_01	x			x	x	x	x	

Figure 6: Potential sources in the Little River watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Table 6.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	1
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	3
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	3
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	2

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Little River watershed. Bacteria data from 2001-2003 from one of these industrial permitted facilities are included in Table 6. Although this data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform, one sample taken from Crabtree & Evelyn, Ltd (GSI000731) in Woodstock contained over 7,000 colonies/100 mL and may be a potential source of bacterial contamination to waterbodies in the watershed.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the

Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Little River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Putnam	Town of Putnam	GSM000025	Part B Municipal Stormwater MS4	Putnam, Town of	N/A
Putnam	National Chromium Company, Inc.	GSI000357	Stormwater Associated With Industrial Activities	National Chromium Company, Inc.	5
Putnam	URG Graphics	GSI001781	Stormwater Associated With Industrial Activities	URG Graphics Inc.	1
Woodstock	Inn at Woodstock Hill	UI0000131	Groundwater Permit	Inn at Woodstock Hill	6
Woodstock	Woodstock Meadows Condominium Association, Inc.	UI0000073	Groundwater Permit	Woodstock Meadows Condominium Association, Inc.	7
Woodstock	Rogers Corporation	GSI000879	Stormwater Associated With Industrial Activities	Rogers Corporation HPFD-W	9
Woodstock	Woodstock Academy	GSN002231	Stormwater Registration - Construction Activities >10 Acres	Charles "Bill" Bentley Athletic Complex Expansion	2
Woodstock	Woodstock Academy	GSN002231	Stormwater Registration - Construction Activities >10 Acres	Charles "Bill" Bentley Athletic Complex Expansion	3
Woodstock	Maverick Construction Management Services, Inc.	GSN001703	Stormwater Registration - Construction Activities 5-10 Acres	Woodstock Middle School Building # 7	4
Woodstock	Rogers Corporation	CT0021504	Surface Water Permit	Wstwtr001 Rogers Corporation	8

Table 6: Industrial permits in the Little River watershed and available fecal coliform data (colonies/100 mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Woodstock	Crabtree & Evelyn Ltd.	GSI000731	Little River	Point A	07/17/01	600
Woodstock	Crabtree & Evelyn, Ltd.	GSI000731	Little River	Point A	09/26/02	150
Woodstock	Crabtree & Evelyn, Ltd.	GSI000731	Little River	Point A	07/09/03	7,500

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All

participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program. The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

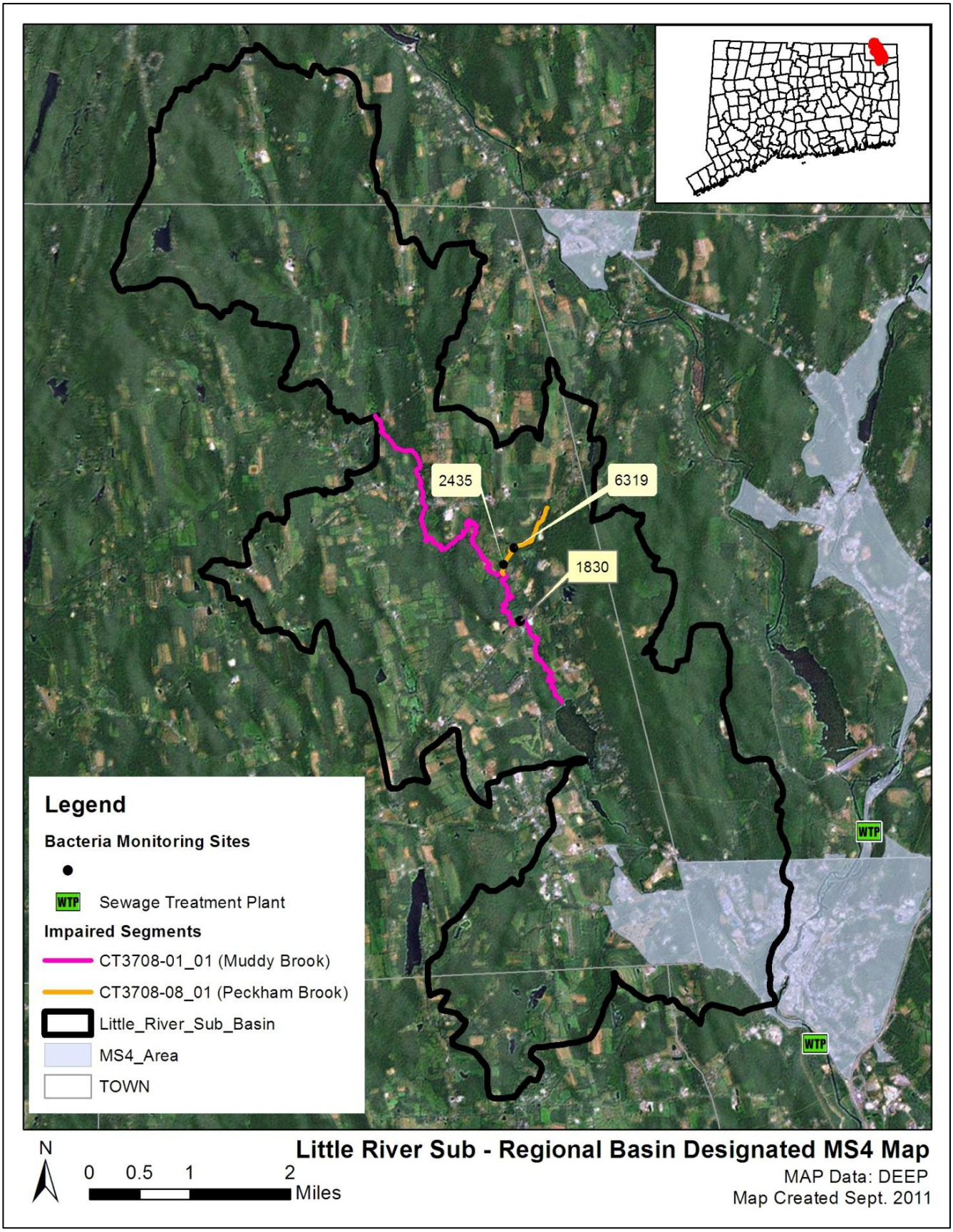
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segments in the Little River watershed are located within the Town of Woodstock. As there are no urban areas as defined by the U.S. Census Bureau around the impaired segment, the town is not an MS4 area and is not required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). Information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Little River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Little River watershed are described below.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of a vegetated buffer along the shoreline. Agricultural land use makes up 21% of the Little River watershed, particularly around the impaired segments (Figure 4). Large agricultural fields are located off Route 197 in eastern Woodstock, Woodstock Road, Hibbard Road, Dugg Hill Road, Child Hill Road, Roseland Park Road, and Senexet Road. As shown in Figure 6, many of these agricultural operations have cattle on the property and multiple agricultural waste sites near the impaired segments. These agricultural areas may carry pollutants such as bacteria to Muddy Brook and Peckham Brook and contribute to the impairment.

Insufficient Septic Systems

As shown in Figure 6, residents and businesses in the Little River watershed near the impaired segments rely solely on onsite wastewater treatment systems, such as septic systems. Water quality data taken at Station 1830 and 6319 were consistently high, especially during dry-weather, which suggests that leaky septic systems may be a source of bacteria to the impaired segments (Tables 8 and 9). Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Woodstock is served by the Northeast District Department of Health (http://www.nddh.org/).

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Little River watershed represent a potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas including recreational fields, golf courses, and agricultural crop fields. There are numerous agricultural crop fields in close proximity the impaired segments. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

As hotspots for dog and horse owners, residential development surrounds portions of the impaired segments, particularly near Muddy Brook (Figure 4). When not properly disposed, waste from domestic animals such as dogs and horses can enter surface waters directly or through stormwater infrastructure.

Stormwater Runoff from Developed Areas

Approximately 15% of the land use in the watershed is considered urban, and some of that area is concentrated around the impaired segments in the Town of Woodstock along the Dugg Hill Road corridor (Figure 4). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al*., 2000).

Approximately 94% of the Little River watershed is characterized by 0-6% impervious cover, particularly around the impaired segments, 6% is characterized by greater than 16% impervious cover downstream of the impaired segments, and less than 1% is characterized by 7-11% impervious cover, particularly in the upstream portion of Muddy Brook (Figure 8). While impervious surfaces are not prevalent in the watershed as a whole, there are areas near the impaired segments with impervious surfaces, including buildings, parking lots, and roads along Dugg Hill Road. Water quality data taken at Stations 1830, 6319, and 2435 were consistently high, especially during wet-weather, which suggests that stormwater runoff may be a source of bacteria to the impaired segments (Tables 8 and 9). Of particular note, the wet-weather value was approximately three times greater than the dry-weather value at Station 1830 on Muddy Brook.

Figure 8: Range of impervious cover (%) in the Little River watershed

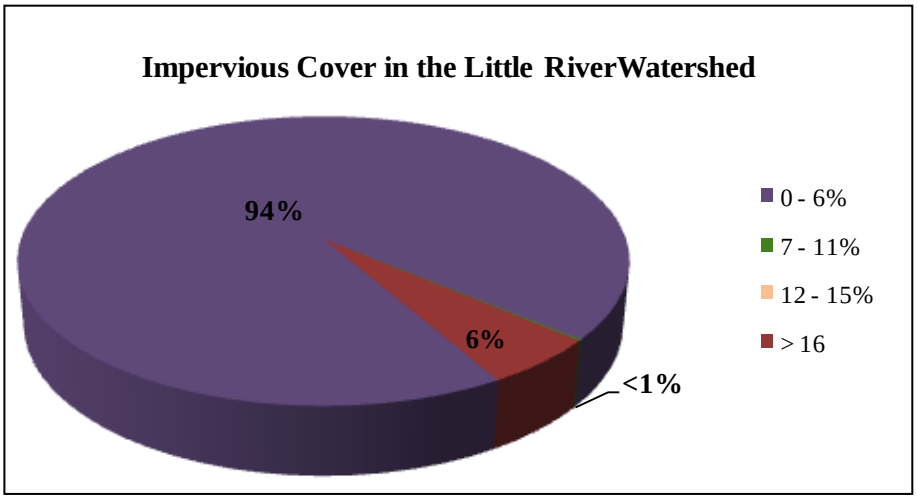
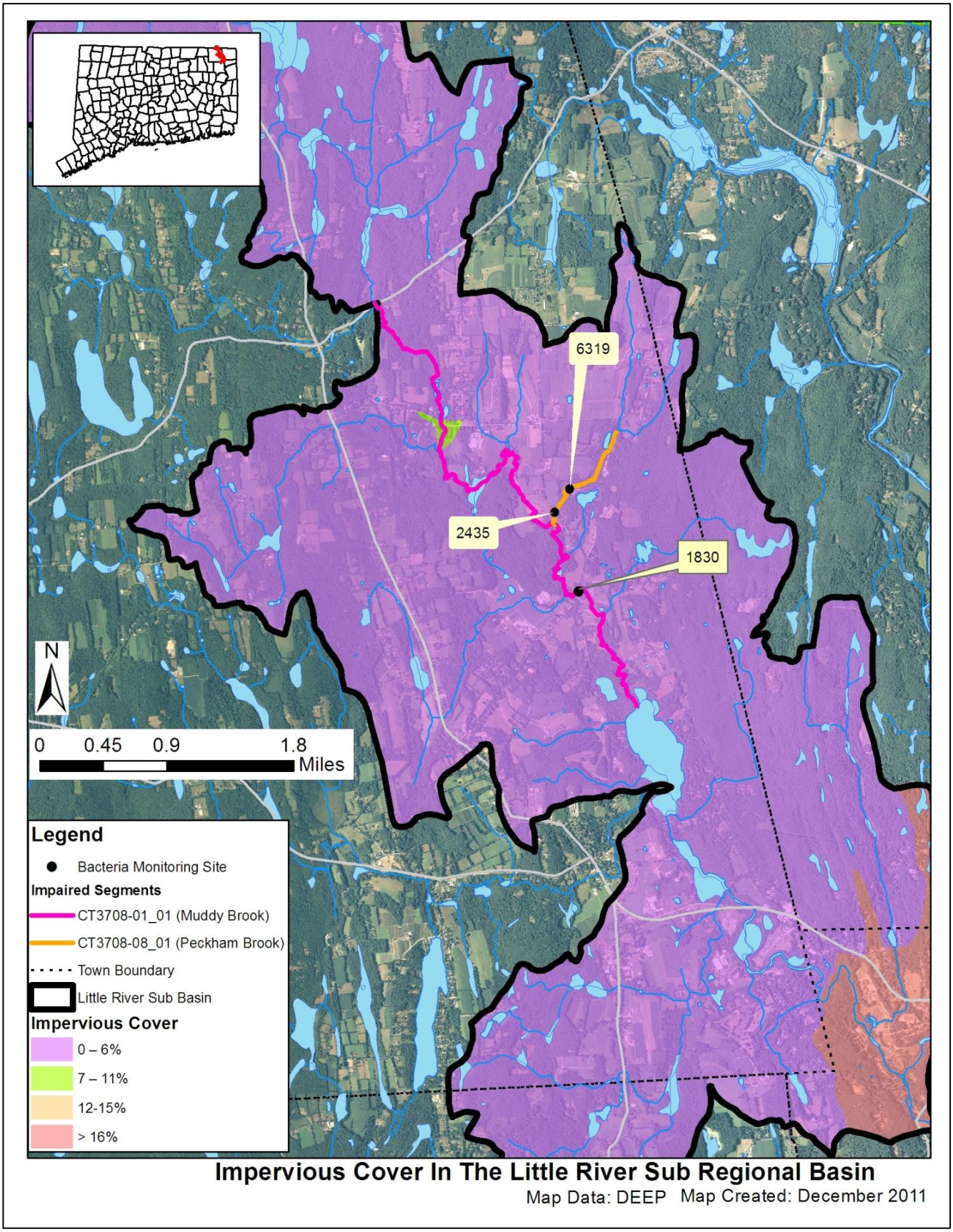


Figure 9: Impervious cover (%) for the Little River sub-regional watershed



Additional Sources

A landfill was identified in Figure 6 south of Peckham Brook and east of Muddy Brook, and may be a concern for water quality. There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Muddy Brook and Peckham Brook. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

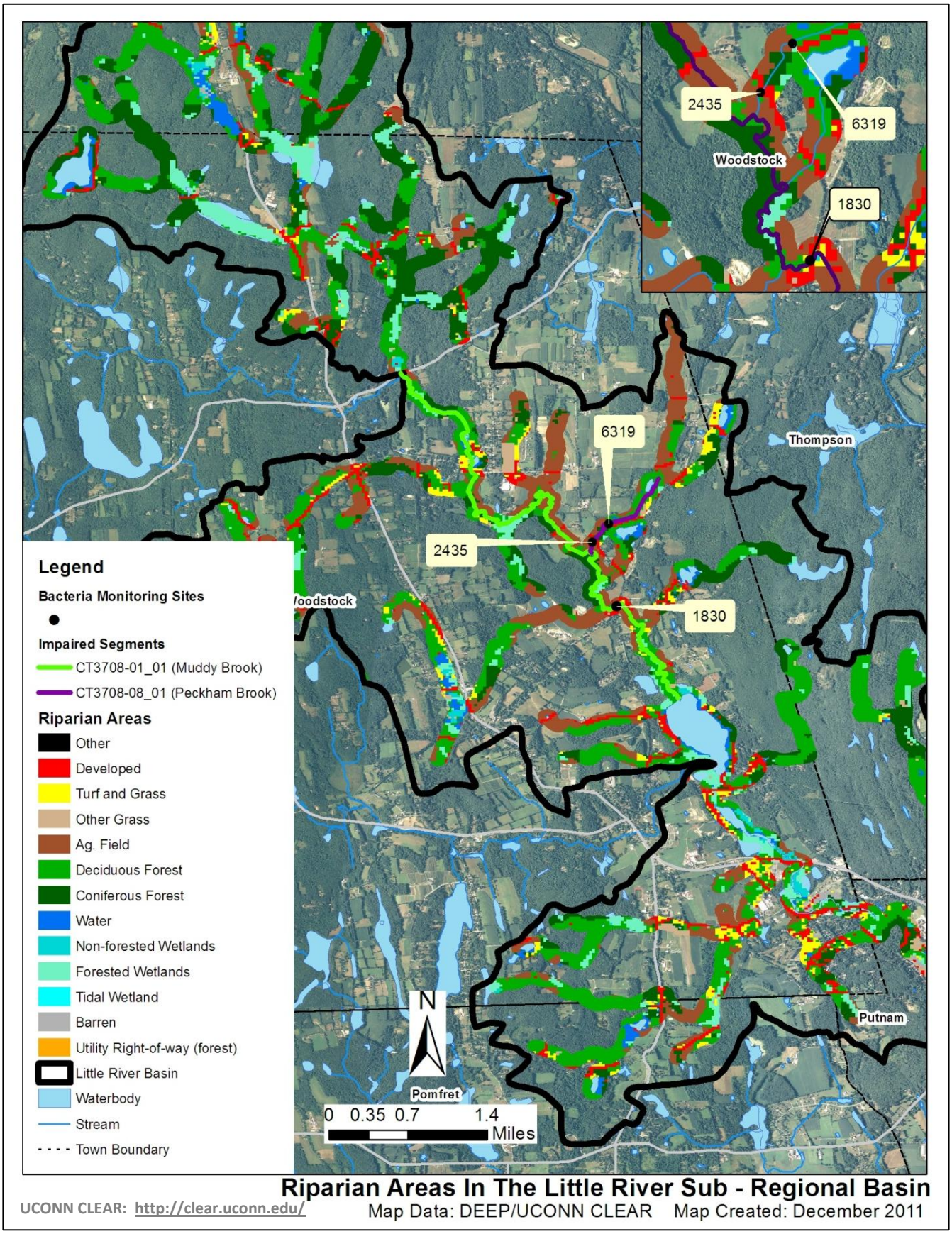
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The riparian zones for Muddy Brook and Peckham Brook are characterized primarily by agricultural land with portions of forested and developed areas (Figure 10). Developed and agricultural areas within the riparian zone likely contribute pollutants such as bacteria to the waterbody since the natural riparian buffer cannot treat stormwater runoff from impervious surfaces and agricultural waste sites.

Figure 10: Riparian buffer zone information for the Little River watershed



CURRENT MANAGEMENT ACTIVITIES

The watershed community has developed and implemented programs to protect water quality from bacterial contamination. In 2009, the Muddy Brook and Little River Water Quality Improvement Plan was developed and is available through the CT DEEP's website: (http://www.ct.gov/dep/lib/dep/water/watershed_management/wm_plans/little_river_final6_29_10.pdf) This document outlines current actions in the watershed and recommends future actions necessary to maintain or improve water quality. The plan examined land use, used extensive field surveys to map storm drain outflows, and surveyed eight dairy operations in the watershed.

CT DEEP's Non-Point Source Pollution Program administers a Non-Point Source Grant Program with funding from EPA under Section 319 of the Clean Water Act (319 grant). Several 319 grants have been awarded in the watershed. In 2005, a 319 grant was awarded to fund water quality monitoring, field observations, and GIS mapping of land use affecting water quality. In 2006, a 319 grant was awarded to introduce new manure spreading equipment that reduces nutrient loading in the Little River watershed. More information on these and other 319 grants is available on CT DEEP's website (http://www.depdata.ct.gov/maps/nps/npsmap.htm).

RECOMMENDED NEXT STEPS

The watershed community has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Little River watershed, including Muddy Brook and Peckham Brook, and have been prioritized below.

1) Ensure there are sufficient buffers and BMPs installed on agricultural lands along Muddy Brook and Peckham Brook.

Agricultural land use represents 21% of the Little River watershed, and is a definite concern for water quality in the impaired segments, particularly with multiple cattle farms identified throughout the watershed (Figure 6). The Muddy Brook and Little River Water Quality Improvement Plan (Muddy Brook and Little River WQI Plan, 2009) made specific recommendations for agricultural operations in the Little River Watershed, including:

- Support programs for small farms that:
    - Enhance vegetative buffers
    - Stockpile manure
    - Restrict stream access through fencing
    - Prevent open steep slopes
- Educate owners of small livestock operations on agricultural NPS pollution, and implement manure management BMPs on their farms.
- Ensure manure storage facilities are found at all applicable farms in the watershed.
- Ensure that runoff from milk houses, silage, and AFO areas are captured on all farms to prevent discharge to waterbodies.

If not already in place, agricultural producers should also work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict access to livestock and horses from streams and wetlands, and that animal waste handling, disposal, and other appropriate BMPs are in place. Particular attention should be paid to those agricultural operations located within the riparian buffer zone of the impaired segments (Figure 10).

2) Develop a system to monitor septic systems.

The majority of residents within the Little River Watershed, particularly near the impaired segments, rely on onsite wastewater systems, such as septic systems. If not already in place, the town should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

3) Identify areas in the developed portions of Muddy Brook and Peckham Brook to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 15% of the Little River watershed is considered urban. As such, stormwater runoff is likely contributing bacteria to Muddy Brook and Peckham Brook. To identify areas that are contributing

bacteria to the impaired segments, the town should conduct wet-weather sampling and prioritize sampling stations with high bacteria concentrations for BMP installation (Table 6). To treat stormwater runoff, the town should identify areas along the impaired segments to install BMPs that encourage stormwater to infiltrate the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

Below are specific recommendations made in the Muddy Brook and Little River WQI Plan (2009) that address pollution from stormwater runoff:

- Complete storm drain outlet mapping in accordance with MS4 general permit requirements.
- Establish and prioritize stormwater outlet retrofits.
- Conduct periodic monitoring of stormwater structures and establish appropriate frequency of street sweeping and catch basin cleaning.

4) Evaluate municipal education and outreach programs regarding animal waste.

Any education and outreach programs in the Little River watershed should highlight the importance of not feeding waterfowl and wildlife, managing horse and livestock waste, and picking up after dogs and other pets. Municipalities and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the Little River and its tributaries that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Little River watershed and can harm human health and the environment. Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-use areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

Below are specific recommendations made in the Muddy Brook and Little River WQI Plan (2009) that address nuisance wildlife, specifically Canadian geese, and domestic animal waste:

- Encourage cooperation between farmers, the CT DEEP Migratory Gamebird Program, and the NRCS to ensure proper goose management program is established.
- Partner with the 4-H Club to provide education on manure management for horses and other farm animals.

5) Continue monitoring of permitted sources.

As shown in Figure 6, there are multiple permitted discharges within the Little River watershed near the impaired segments. Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

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

Table 7 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Little River watershed.

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.

Table 7. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		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

(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) **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.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 8: Muddy Brook Bacteria Data

Waterbody ID: CT3708-01_01

Characteristics: Freshwater, Class AA, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **74%**

Single Sample: **92%**

Data: 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from Station 1830 on Muddy Brook with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1830	Upstream of Child Hill Road[1]	6/27/2006	240	wet	**482* (74%)**
1830	Upstream of Child Hill Road[1]	7/6/2006	1900	wet**	
1830	Upstream of Child Hill Road[1]	7/11/2006	260	wet**	
1830	Upstream of Child Hill Road[1]	7/18/2006	680	wet**	
1830	Upstream of Child Hill Road[1]	7/25/2006	260	dry**	
1830	Upstream of Child Hill Road[1]	8/1/2006	1000	dry**	
1830	Upstream of Child Hill Road[1]	8/8/2006	600	dry	
1830	Upstream of Child Hill Road[1]	8/15/2006	530	wet	
1830	Upstream of Child Hill Road[1]	8/22/2006	300	wet	
1830	Upstream of Child Hill Road[1]	8/29/2006	340	wet	

Single sample *E. coli* (colonies/100 mL) data from Station 1830 on Muddy Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1830	Upstream of Child Hill Road[1]	5/30/2007	150	dry	208
1830	Upstream of Child Hill Road[1]	6/5/2007	640	wet	
1830	Upstream of Child Hill Road[1]	6/12/2007	235†	dry	
1830	Upstream of Child Hill Road[1]	6/19/2007	230	dry	
1830	Upstream of Child Hill Road[1]	6/26/2007	115†	dry	
1830	Upstream of Child Hill Road[1]	7/3/2007	107†	dry	
1830	Upstream of Child Hill Road[1]	7/10/2007	270	dry	
1830	Upstream of Child Hill Road[1]	7/17/2007	135†	dry	
1830	Upstream of Child Hill Road[1]	7/24/2007	195†	wet	
1830	Upstream of Child Hill Road[1]	7/31/2007	3100†	wet	
1830	Upstream of Child Hill Road[1]	8/7/2007	63	wet	
1830	Upstream of Child Hill Road[1]	8/14/2007	2100	wet	
1830	Upstream of Child Hill Road[1]	8/21/2007	74†	dry	
1830	Upstream of Child Hill Road[1]	8/28/2007	20	dry	
1830	Upstream of Child Hill Road[1]	6/3/2008	190	dry	155
1830	Upstream of Child Hill Road[1]	6/10/2008	575†	dry	
1830	Upstream of Child Hill Road[1]	6/17/2008	**5000* (92%)**	wet	
1830	Upstream of Child Hill Road[1]	6/24/2008	820	wet	
1830	Upstream of Child Hill Road[1]	7/1/2008	380†	dry	
1830	Upstream of Child Hill Road[1]	7/8/2008	230	dry	
1830	Upstream of Child Hill Road[1]	7/15/2008	98	dry	

Single sample *E. coli* (colonies/100 mL) data from Station 1830 on Muddy Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1830	Upstream of Child Hill Road[1]	6/2/2009	210	dry	305
1830	Upstream of Child Hill Road[1]	6/9/2009	230	wet	
1830	Upstream of Child Hill Road[1]	6/16/2009	1900	wet	
1830	Upstream of Child Hill Road[1]	6/23/2009	160	dry	
1830	Upstream of Child Hill Road[1]	6/30/2009	200	wet	
1830	Upstream of Child Hill Road[1]	7/8/2009	840	wet	
1830	Upstream of Child Hill Road[1]	7/14/2009	160	dry	
1830	Upstream of Child Hill Road[1]	7/21/2009	1000	wet	
1830	Upstream of Child Hill Road[1]	7/28/2009	190	dry	
1830	Upstream of Child Hill Road[1]	8/4/2009	270	dry	
1830	Upstream of Child Hill Road[1]	8/11/2009	220	dry	
1830	Upstream of Child Hill Road[1]	8/18/2009	200	dry	
1830	Upstream of Child Hill Road[1]	9/1/2009	220	dry	

Shaded cells indicate an exceedance of water quality criteria

[†]Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

[1] Full Station Name is : Upstream of Child Hill Road/Roseland Park Road/Paine District Road

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for Station 1830 on Muddy Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
1830	Upstream of Child Hill Road/Roseland Park Road/Paine District Road	2006-2009	21	28	254	476	159

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gages at West Thompson Lake, Grosvenor Dale in Thompson, CT and at Hartford Bradley International Airport

Table 9: Peckham Brook Bacteria Data

Waterbody ID: CT3708-08_01

Characteristics: Freshwater, Class AA, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **50%**

Single Sample: **91%**

Data: 2006 and 2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Peckham Brook with annual geometric means calculated

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
2435	Dugg Hill Road	2/6/2006	360	wet	70
2435	Dugg Hill Road	5/1/2006	31	dry	
2435	Dugg Hill Road	8/8/2006	110	dry	
2435	Dugg Hill Road	10/17/2006	20	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Peckham Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
2435	Dugg Hill Road	5/31/2011	52†	wet**	148
2435	Dugg Hill Road	6/2/2011	10	dry**	
2435	Dugg Hill Road	6/7/2011	10	dry**	
2435	Dugg Hill Road	6/9/2011	160	wet**	
2435	Dugg Hill Road	6/14/2011	3700	wet**	
2435	Dugg Hill Road	6/16/2011	70	dry**	
2435	Dugg Hill Road	6/21/2011	96†	dry**	
2435	Dugg Hill Road	6/23/2011	760	wet**	
2435	Dugg Hill Road	6/28/2011	240	dry**	
2435	Dugg Hill Road	6/30/2011	210	dry**	
2435	Dugg Hill Road	7/5/2011	360	dry**	
2435	Dugg Hill Road	7/7/2011	150	dry**	
2435	Dugg Hill Road	7/12/2011	210	dry**	
2435	Dugg Hill Road	7/14/2011	360	dry**	
2435	Dugg Hill Road	7/21/2011	110	dry**	
6319	100 Paine District Road	5/31/2011	41	wet**	**254* (50%)**
6319	100 Paine District Road	6/2/2011	120	dry**	
6319	100 Paine District Road	6/7/2011	74	dry**	
6319	100 Paine District Road	6/9/2011	360	wet**	
6319	100 Paine District Road	6/14/2011	**4400* (91%)**	wet**	
6319	100 Paine District Road	6/16/2011	150	dry**	
6319	100 Paine District Road	6/21/2011	130	dry**	
6319	100 Paine District Road	6/23/2011	700	wet**	
6319	100 Paine District Road	6/28/2011	165†	dry**	
6319	100 Paine District Road	6/30/2011	120	dry**	
6319	100 Paine District Road	7/5/2011	145†	dry**	
6319	100 Paine District Road	7/7/2011	220	dry**	
6319	100 Paine District Road	7/12/2011	320	dry**	
6319	100 Paine District Road	7/14/2011	610	dry**	
6319	100 Paine District Road	7/21/2011	1200	dry**	

Shaded cells indicate an exceedance of water quality criteria

†Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for all monitoring stations on Peckham Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
2435	Dugg Hill Road	2006-2011	5	14	127	385	85
6319	100 Paine District Road	2011	3	11	289	1035	204

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gages at West Thompson Lake, Grosvenor Dale in Windham, CT.

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