# *Blackberry River*

## *Watershed Summary*

### WATERSHED DESCRIPTION AND MAPS

The Blackberry River watershed covers an area of approximately 17,341 acres in the northwestern corner of Connecticut (Figure 1). There are multiple towns located at least partially in the watershed, including the municipalities of North Canaan, Canaan, and Norfolk, CT. A small portion of the watershed extends into southern Massachusetts.

The Blackberry River watershed includes one segment impaired for recreation due to elevated bacteria levels. This segment was 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 as of the writing of this document. However, this does not mean there are no problems on those segments, but is an indication that there is not current data to evaluate the segments as part of an assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of waterbodies in the watershed (CT DEEP, 2010b).

The Blackberry River begins near Westside Road in Norfolk. The bacteria impaired segment (CT6100-00_02a) consists of 2.75 miles of the river in North Canaan, CT (Figure 2). This impaired segment of the Blackberry River begins at the southwest boundary of the Lime Quarry on Lower Road and flows through an area characterized by agricultural fields parallel to Route 44 and Lower Road (Figure 4). The impaired segment ends at the confluence with North Canaan Water Pollution Control Facility just east of the border with Salisbury.

The impaired segment of the Blackberry River has a water quality classification of B. Designated uses include habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of the Blackberry River, the specific recreation impairment is for non-designated swimming and other water contact related activities.

**Impaired Segment Facts**

**Impaired Segment Name:** Blackberry River (CT6100-00_02a)

**Municipalities:** North Canaan and Norfolk

**Impaired Segment Length (miles):** 2.75

**Water Quality Classification:** Class B

**Designated Use Impairment**: Recreation

**Sub-regional Basin Name and Code:** Blackberry River, 6100

**Regional Basin:** Blackberry

**Major Basin:** Housatonic

**Watershed Area (acres):** 17,341

**MS4 Applicable?** No

**Figure 1: Watershed location in Connecticut**

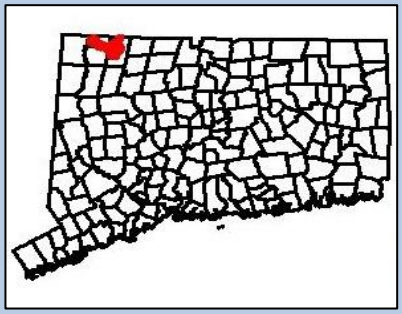


**Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report**

| Waterbody ID | Waterbody Name | Location | Miles | Aquatic Life | Recreation | Fish Consumption |
|---|---|---|---|---|---|---|
| CT6100-00_01 | Blackberry River-01 | From mouth at confluence with Housatonic River (at loop in river around island), US to confluence with North Canaan WPCF (near old Railroad grade, currently trail), North Canaan. | 0.78 | FULL | U | NOT |
| CT6100-00_02a | Blackberry River-02a | From confluence with North Canaan WPCF (near old Railroad grade, currently trail, DS of Route 44 crossing), US to drainage ditch at southwest boundary of Lime Quarry (parallel to Lower Road), North Canaan. | 2.75 | FULL | NOT | NOT |
| CT6100-00_02b | Blackberry River-02b | From drainage ditch at southwest boundary of Lime Quarry (parallel to Lower Road), US to Blast Furnace (Historical Park) at Lower Pond dam outlet on Iron Furnace Pond (perpendicular to Furnace Hill Road), North Canaan. | 1.18 | FULL | U | NOT |
| CT6100-00_03 | Blackberry River-03 | From Blast Furnace (Historical Park) at Lower Pond dam outlet on Iron Furnace Pond (perpendicular to Furnace Hill Road), North Canaan, US to confluence with North Brook (DS of Norfolk WPCF, south side of Route 44 at Ashpohtag Road intersection), Norfolk. | 4.19 | FULL | U | FULL |
| CT6100-00_04 | Blackberry River-04 | From confluence with North Brook (DS of Norfolk WPCF, south side of Route 44 at Ashpohtag Road intersection), US to Norfolk WPCF outfall (US end of site), Norfolk. | 0.46 | U | U | FULL |
| CT6100-00_05 | Blackberry River-05 | From Norfolk WPCF outfall (DS end of site), US to headwaters at confluence of Wood Creek and Spaulding Brook (US of Blackberry Street crossing, parallel to Route 44), Norfolk. | 1.03 | U | U | FULL |

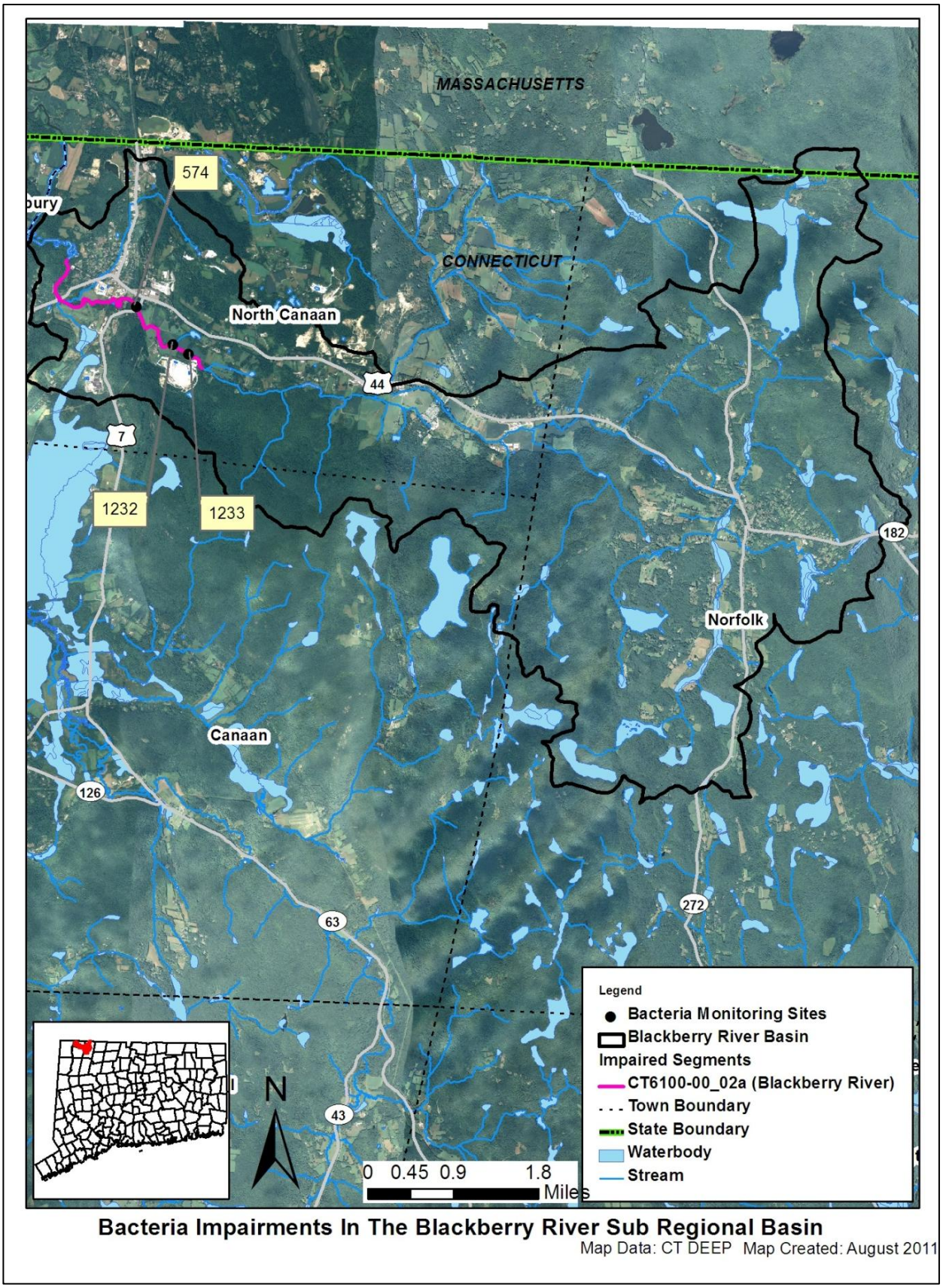
**Shaded cells indicate impaired segment addressed in this TMDL**

**FULL = Designated Use Fully Supported**

**NOT = Designated Use Not Supported**

**U = Unassessed**

**Figure 2: GIS map featuring general information of the Blackberry 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 Blackberry River watershed consists of 70% forest, 14% urban area, 11% agriculture, and 5% water. Portions of the watershed in North Canaan, particularly near the impaired segment of the Blackberry River, are characterized by urban and agicultural land uses, with multiple agricultural operations located along the banks of the Blackberry River, both upstream and on the impaired segment. By contrast, the southern and eastern portions of the watershed are less developed (Figure 4).

**Figure 3: Land use within the Blackberry River watershed**

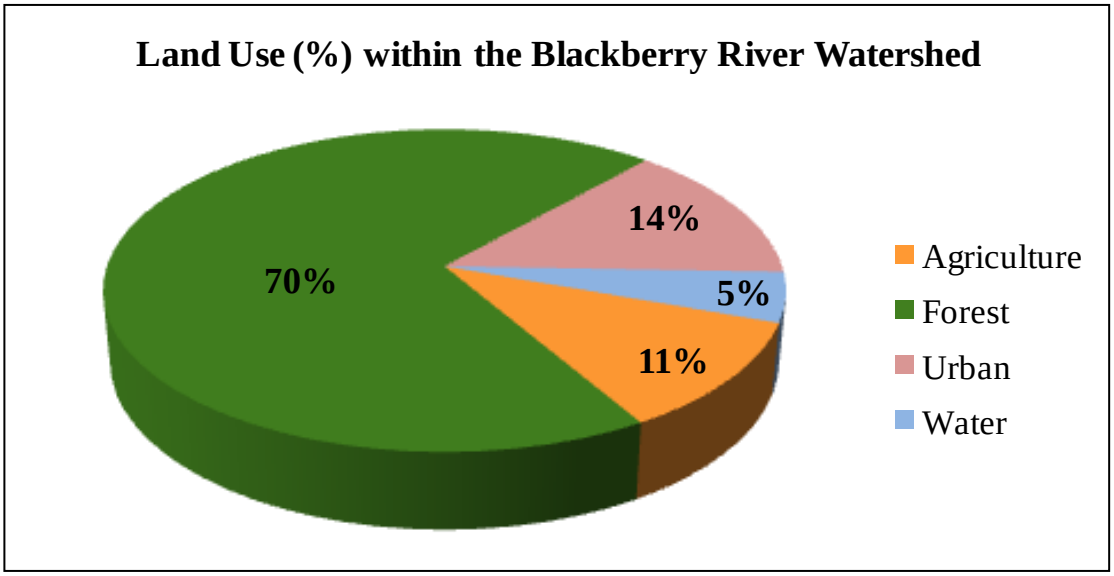
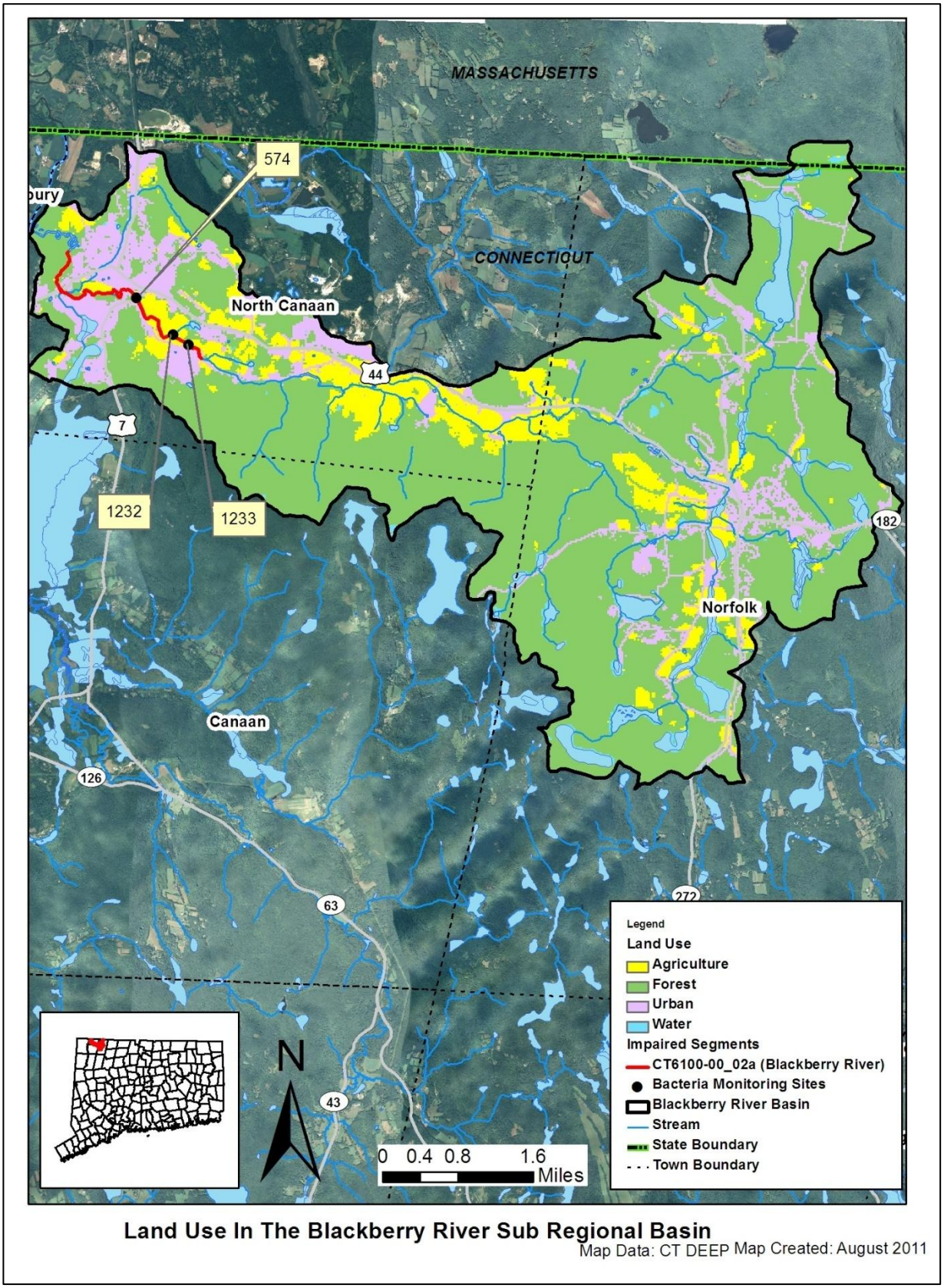


**Figure 4: GIS map featuring land use for the Blackberry River watershed at the sub-regional level**



## 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 the impaired segment in the Blackberry River Watershed (stations organized downstream to upstream)**

| Waterbody ID | Waterbody Name | Station | Station Description | Municipality | Latitude | Longitude |
|---|---|---|---|---|---|---|
| CT6100-00_02a | Blackberry River | 574 | well field south of Route 7 crossing | North Canaan | 42.022752 | -73.325449 |
| CT6100-00_02a | Blackberry River | 1232 | Tractor Ford at quarry discharge | North Canaan | 42.017056 | -73.317833 |
| CT6100-00_02a | Blackberry River | 1233 | Tractor Ford at quarry discharge | North Canaan | 42.015583 | -73.314667 |

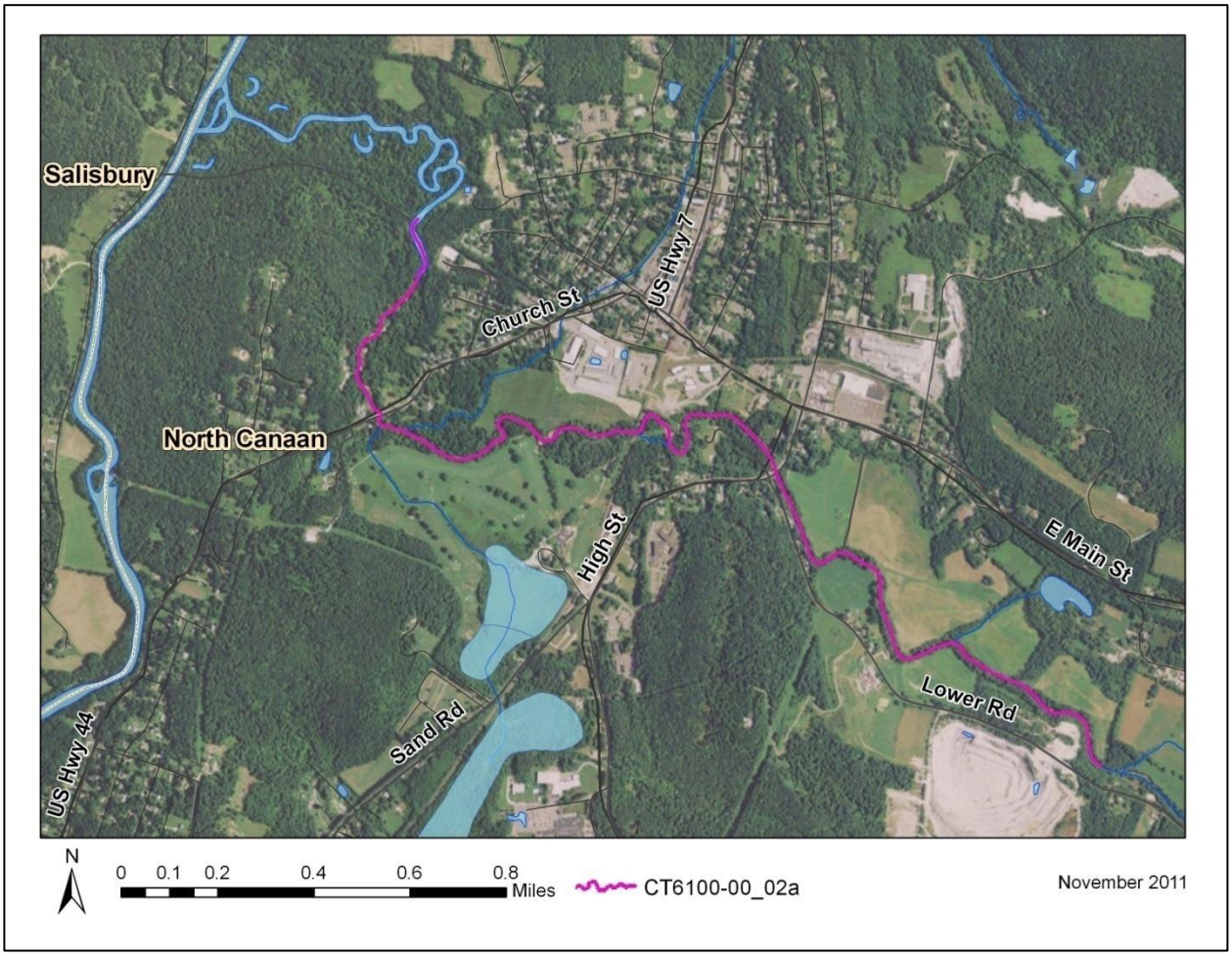
The Blackberry River (CT6100-00_02a) is a Class B freshwater river (Figure 5). Its applicable designated uses are habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from three sampling locations in 2003 (Stations 1232 and 1233) and 2006-2009 (Station 574) (Table 2).

Water quality criteria for *E. coli*, along with bacteria sampling results from 2003 and 2006-2009 are presented in Table 8. The annual geometric mean was calculated for Station 574 and exceeded the WQS for *E. coli* for all years. Single sample values at this station also exceeded the WQS for *E. coli* multiple times each year. Single sample values for Stations 1232 and 1233 did not exceed the WQS for *E. coli* for the one year sampled. A geometric mean could not be calculated for these stations as there were insufficient data for analysis.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Table 8). At Station 574, geometric means during both wet and dry-weather exceeded the WQS for *E. coli*. The geometric mean during wet-weather was higher than dry-weather.

Due to the elevated bacteria measurements presented in Table 8, this segment of the Blackberry River does not meet CT's bacteria WQS, was identified as impaired, and was 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 the Blackberry River**



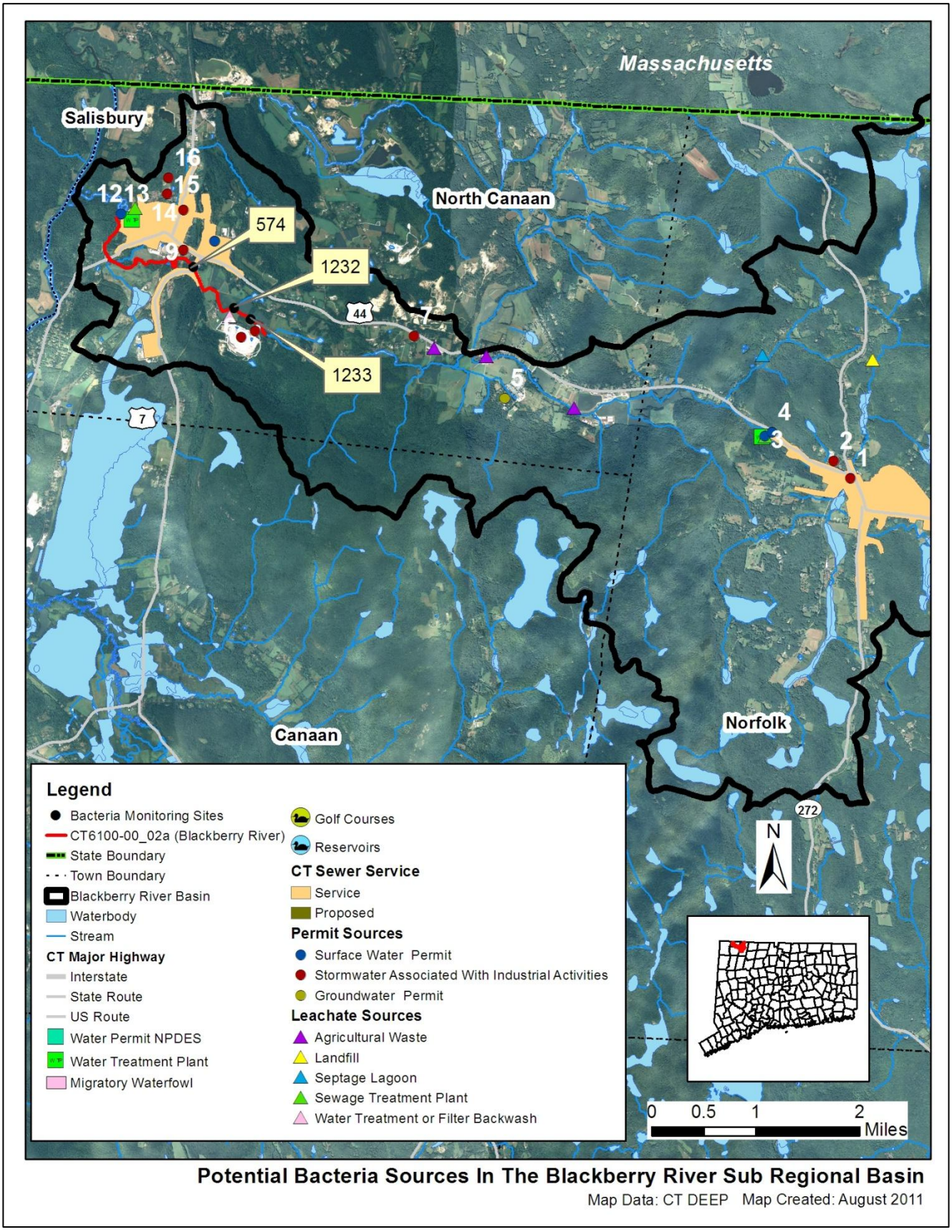
## POTENTIAL BACTERIA SOURCES

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 Blackberry River watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody 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 segment. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not mean that there are no data nor that there are no impairments in existence in the segment. 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 Blackberry River watershed**

| Impaired Segment | Permit Source | Illicit Discharge | CSO/SSO Issue | Failing Septic System | Agricultural Activity | Stormwater Runoff | Nuisance Wildlife/ Pets | Other |
|---|---|---|---|---|---|---|---|---|
| Blackberry River CT6100-00_02a | **x** | **x** | | **x** | **x** | **x** | **x** | **x** |

**Figure 6: Potential sources in the Blackberry 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 could 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 | 5 |
| GPL | Discharge of Swimming Pool Wastewater | 0 |
| GSC | Stormwater Discharge Associated with Commercial Activity | 0 |
| GSI | Stormwater Associated with Industrial Activity | 10 |
| GSM | Part B Municipal Stormwater MS4 | 0 |
| GSN | Stormwater Registration – Construction | 0 |
| LF | Groundwater Permit (Landfill) | 0 |
| UI | Underground Injection | 1 |

### *Permitted Sources*

As shown in Table 5, there are multiple permitted discharges in the Blackberry River watershed. Bacteria data from 2001 – 2003 from some of these industrial permitted facilities are included in Table 6. Although this data cannot be compared to a water quality standard as Connecticut only uses fecal coliform bacteria as the standard for shellfishing uses, multiple samples were high, with samples from multiple outfalls at Specialty Minerals (GSI0000550) exceeding 10,000 colonies/100 mL and samples from the North Canaan Transfer Station (GSI001294) and North Canaan Town Garage (GSI001268) exceeding 6,000 colonies/100 mL.

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 Blackberry River watershed**

| Town | Client | Permit ID | Permit Type | Site Name/Address | Map # |
|---|---|---|---|---|---|
| Canaan | Becton Dickinson And Company | GSI000224 | Stormwater Associated With Industrial Activities | Becton Dickinson & Company | 16 |
| Canaan | Specialty Materials Inc | GSI000550 | Stormwater Associated With Industrial Activities | Specialty Minerals, Inc. | 10 |
| Canaan | John B. Hull, Inc. | GSI002006 | Stormwater Associated With Industrial Activities | John B. Hull, North Canaan Fuel Oil Storage | 14 |
| Canaan | Specialty Materials Inc | CT0003981 | Surface Water Permit | Specialty Minerals, Inc. | 11 |
| East Canaan | O'Connor Bros., Inc. | GSI002282 | Stormwater Associated With Industrial Activities | O'Connor Bros | 7 |
| Norfolk | State Of Connecticut Department Of Transportation | GSI000046 | Stormwater Associated With Industrial Activities | Norfolk Maintenance Facility | 1 |
| Norfolk | Town Of Norfolk | GSI001357 | Stormwater Associated With Industrial Activities | Norfolk Public Works Garage | 2 |
| Norfolk | Town Of Norfolk | CT0101231 | Surface Water Permit | Norfolk Sewage Treatment Plant | 3 |
| Norfolk | Town Of Norfolk | CT0101231 | Surface Water Permit | Town Of Norfolk WPCF | 4 |
| North Canaan | Lone Oak, Inc | UI0000313 | Groundwater Permit | Lone Oak Campsites | 5 |
| North Canaan | State Of Connecticut Department Of Transportation | GSI000047 | Stormwater Associated With Industrial Activities | North Canaan Maintenance Facility | 9 |
| North Canaan | Town Of North Canaan | GSI001268 | Stormwater Associated With Industrial Activities | North Canaan Town Garage | 15 |
| North Canaan | Specialty Minerals Inc | GSI002305 | Stormwater Associated With Industrial Activities | Specialty Minerals Inc - Lower Road Quarry | 6 |
| North Canaan | Specialty Minerals Inc | GSI002306 | Stormwater Associated With Industrial Activities | Specialty Minerals Inc - Quarry Garage & Stockpile Area | 8 |
| North Canaan | Town Of North Canaan | CT0100064 | Surface Water Permit | North Canaan Sewage Plant | 12 |
| North Canaan | Town Of North Canaan | CT0100064 | Surface Water Permit | Canaan Fire District WPCF | 13 |

**Table 6: Industrial permits on Blackberry River and available fecal coliform data (colonies/100mL). 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 |
|---|---|---|---|---|---|---|
| Norfolk | Town of Norfolk | GSI1357 | Blackberry River | outfall 3 | 08/23/00 | 980 |
| North Canaan | North Canaan Town Garage | GSI1268 | Blackberry Watershed | 1 | 11/25/01 | >6000 |
| North Canaan | North Canaan Town Garage | GSI1268 | Blackberry Watershed | 2 | 11/25/01 | 300 |
| North Canaan | North Canaan Town Garage | GSI1268 | Blackberry Watershed | Outfall #2 | 09/15/02 | 1,500 |
| North Canaan | North Canaan Trf Station | GSI1294 | Blackberry Watershed | 1 | 11/20/01 | 3,500 |
| North Canaan | North Canaan Trf Station | GSI1294 | Blackberry Watershed | 2 | 11/20/01 | >6000 |
| North Canaan | North Canaan Trf Station | GSI1294 | Blackberry Watershed | Outfall #1 | 09/15/02 | 990 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #1 | 09/20/01 | 1,000 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #1 | 10/16/02 | 500 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #1 | 07/09/03 | 20,000 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #2 | 09/20/01 | 650 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #2 | 10/16/02 | 1,600 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #2 | 07/09/03 | 3,900 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #3 | 09/28/01 | 90 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #3 | 10/16/02 | 100 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #3 | 07/09/03 | 10,000 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #4 | 09/20/01 | 10 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #4 | 10/16/02 | 100 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #5 | 10/16/02 | 200 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #5 | 07/09/03 | 1,400 |
| North Canaan | Specialty Minerals | GSI550 | Blackberry River | Outfall #6 | 07/09/03 | 40,000 |

### *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)

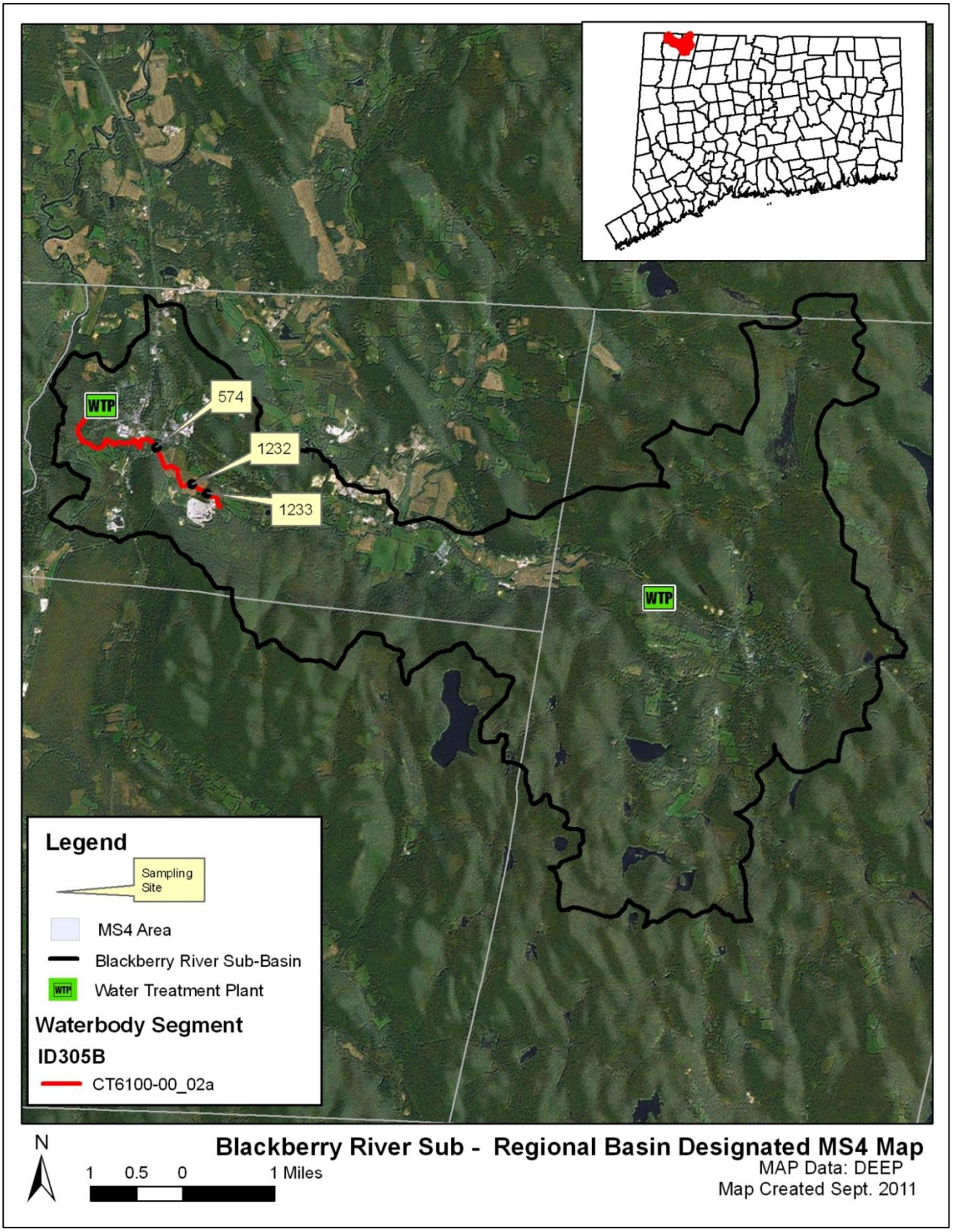
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some 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 segment of the Blackberry River watershed is located within the Towns of North Canaan and Norfolk, CT. As there are no urbanized locations as defined by the U.S. Census Bureau within this area, the towns are not MS4 areas and are 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 Blackberry River watershed**



***Publicly Owned Treatment Works***

As shown in Figure 6, there are two publicly owned treatment works (POTWs), or wastewater treatment plant, in the Blackberry River watershed. The Norfolk Water Treatment Plant is located in the eastern portion of the watershed and discharges to the Blackberry River, upstream of the impaired segment. The North Canaan Water Treatment Plant is located at the end of the impaired segment. Bacteria data from the discharge of the Norfolk Water Treatment Plant are included in Table 7. The plant did not exceed its permit limit on any date sampled.

**Table 7: Wastewater treatment plant Fecal Coliform (colonies/100 mL) data discharging to the Blackberry River**

| Town | Permittee | Permit Number | Receiving Water | Date | 30-Day Geometric Mean | 7-Day Geometric Mean |
|---|---|---|---|---|---|---|
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 05/31/2009 | 1.6 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 06/30/2009 | 1.5 | 5 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 07/31/2009 | 2.1 | 5 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 08/31/2009 | 1.2 | 2 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 09/30/2009 | 1.3 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 05/31/2010 | 1.6 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 06/30/2010 | 1 | 1 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 07/31/2010 | 1 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 08/31/2010 | 1.3 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 05/31/2011 | 2 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 06/30/2011 | 2 | 4 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 07/31/2011 | 1 | 1 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 08/31/2011 | 2 | 3 |
| Norfolk | Norfolk Sewer District | CT0101231 | Blackberry River | 09/30/2011 | 1.3 | 3 |
| **30-Day Geometric Mean Permit Limit = 200 colonies/100 mL**<br>**7-Day Geometric Mean Permit Limit = 400 colonies/100 mL** | | | | | | |

## 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 Blackberry 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 11% of the Blackberry River watershed. Dairy farming is the major agricultural enterprise in the watershed. Multiple agricultural fields and large livestock farms are located along the impaired segment and directly upstream of the impaired segment of the Blackberry River. As shown in Figure 6, agricultural waste has been identified directly upstream of the impaired segment. Station 574 is located directly downstream of the majority of these agricultural operations (Figure 4). The annual geometric mean for *E. coli* at this station exceeded Connecticut's WQS during all sampling years (Table 8), indicating that agricultural operations in this area are a likely source of bacteria to the Blackberry River.

### *Wildlife and Domestic Animal Waste*

Wildlife and domestic animals within the Blackberry River watershed represent another 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). As the majority of the watershed is undeveloped, wildlife waste is a potential source of bacteria to the Blackberry River.

The Canaan Country Club is located within the Blackberry River watershed near the impaired segment (Figure 6). Geese and other waterfowl are known to congregate in open areas including agricultural crop fields, recreational fields, and golf courses. 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.

Though only a small portion of the watershed is characterized by residential development, much of this development is located near the impaired segment. Waste from domestic animals such as dogs, may also be contributing to bacteria concentrations in the Blackberry River.

### *Insufficient Septic Systems and Illicit Discharges*

As shown in Figure 6, only a small portion of the watershed relies on the municipal sewer system. The majority of the watershed relies on onsite wastewater treatment systems, such as septic systems. 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 Towns of North Canaan and Norfolk do not have a specific health director and are part of the Torrington Area Health District (http://www.tahd.org/).

The area surrounding the western portion of the impaired segment of the Blackberry River is serviced by the municipal sewer system (Figure 6). Sewer system leaks and other illicit discharges can contribute bacteria to nearby surface waters.

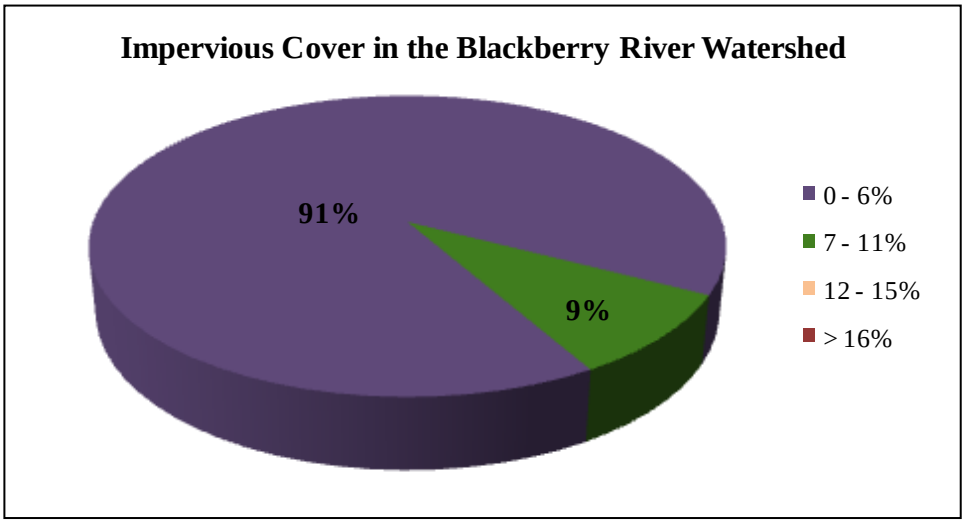
High geometric means during dry-weather may indicate the presence of insufficient septic systems, leaking sewer pipes, or other illicit discharges. As shown in Table 8, the geometric mean for dry weather exceeded the WQS at Station 574 on the Blackberry River. The area around this station is serviced by both the municipal sanitary sewer system and private septic systems and may be receiving bacteria from leaks in the systems or other illicit discharges.

***Stormwater Runoff from Developed Areas***

The majority of the Blackberry River watershed is undeveloped. However, approximately 14% of the land use in the watershed is considered urban, and this area is concentrated around the impaired segment (Figures 2 and 9). 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 into the soil. Studies have shown a link between the amount of impervious area in a watershed and water quality conditions (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).

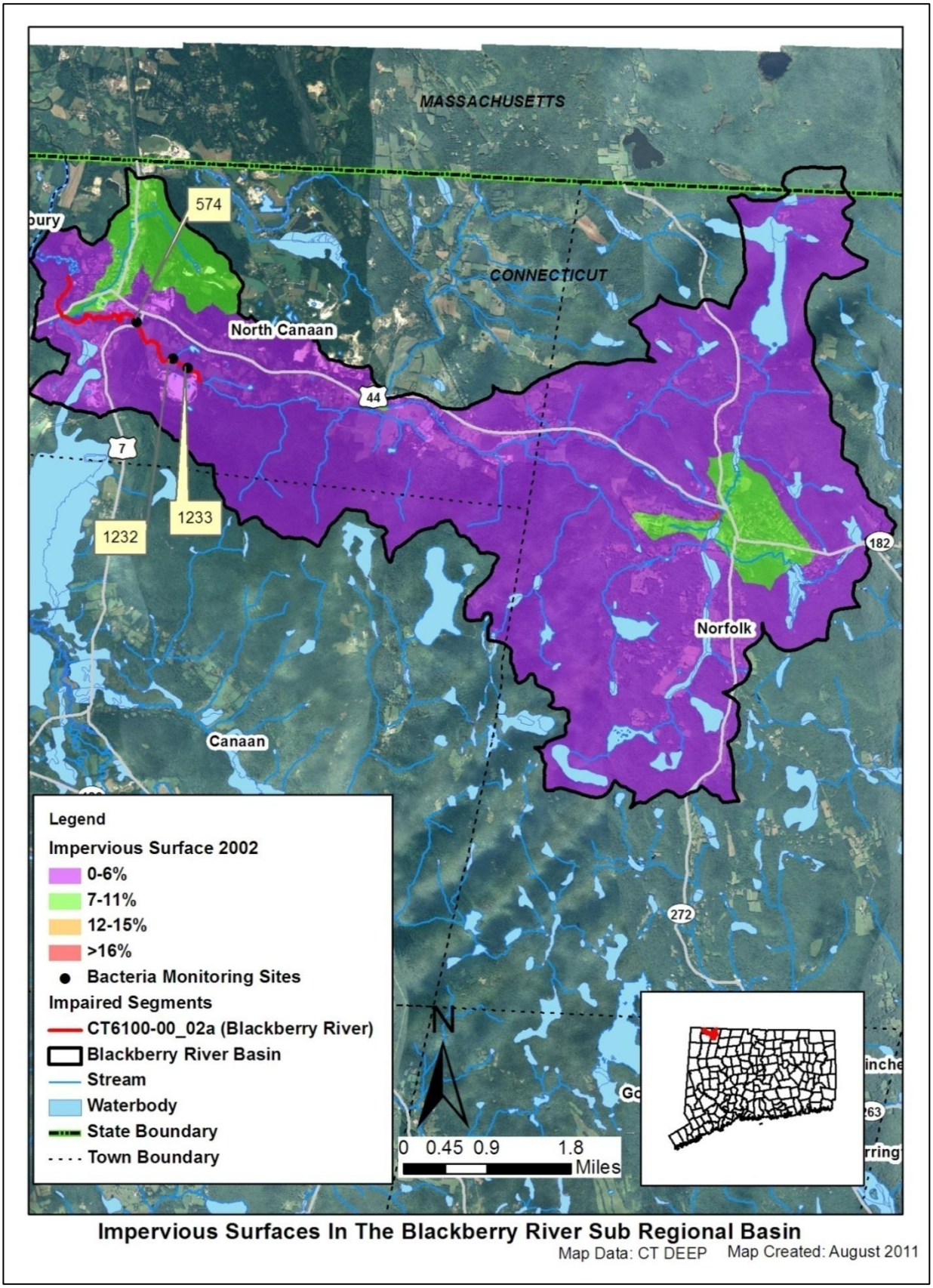
The majority of the Blackberry River watershed has less than 6% impervious surfaces (Figure 8). However, portions of the watershed near the western section of the impaired segment have between 7 and 11% impervious cover (Figure 9). Water quality data taken at Station 574, located near the more heavily urbanized portion of the watershed, were consistently high indicating that stormwater runoff may be a source of bacteria to the Blackberry River (Table 8).

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




High geometric means during wet-weather may indicate that stormwater runoff is contributing to bacterial impairment in the river segment. As shown in Table 8, the geometric mean for wet weather exceeded the WQS at Station 574 on the Blackberry River. As the area surrounding these stations is characterized by development (Figure 4), this segment is likely receiving bacteria from stormwater runoff.

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



## Additional Sources

Specialty Minerals, located on Daisy Hill Road in North Canaan, produces finely ground dolomite limestone for use in industrial practices from dolomite ore from the nearby Lime Quarry. Discharge from Specialty Minerals has been shown to contain high levels of fecal coliform bacteria (Table 6), indicating this plant may also be a source of *E. coli* bacteria.

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Blackberry River. 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

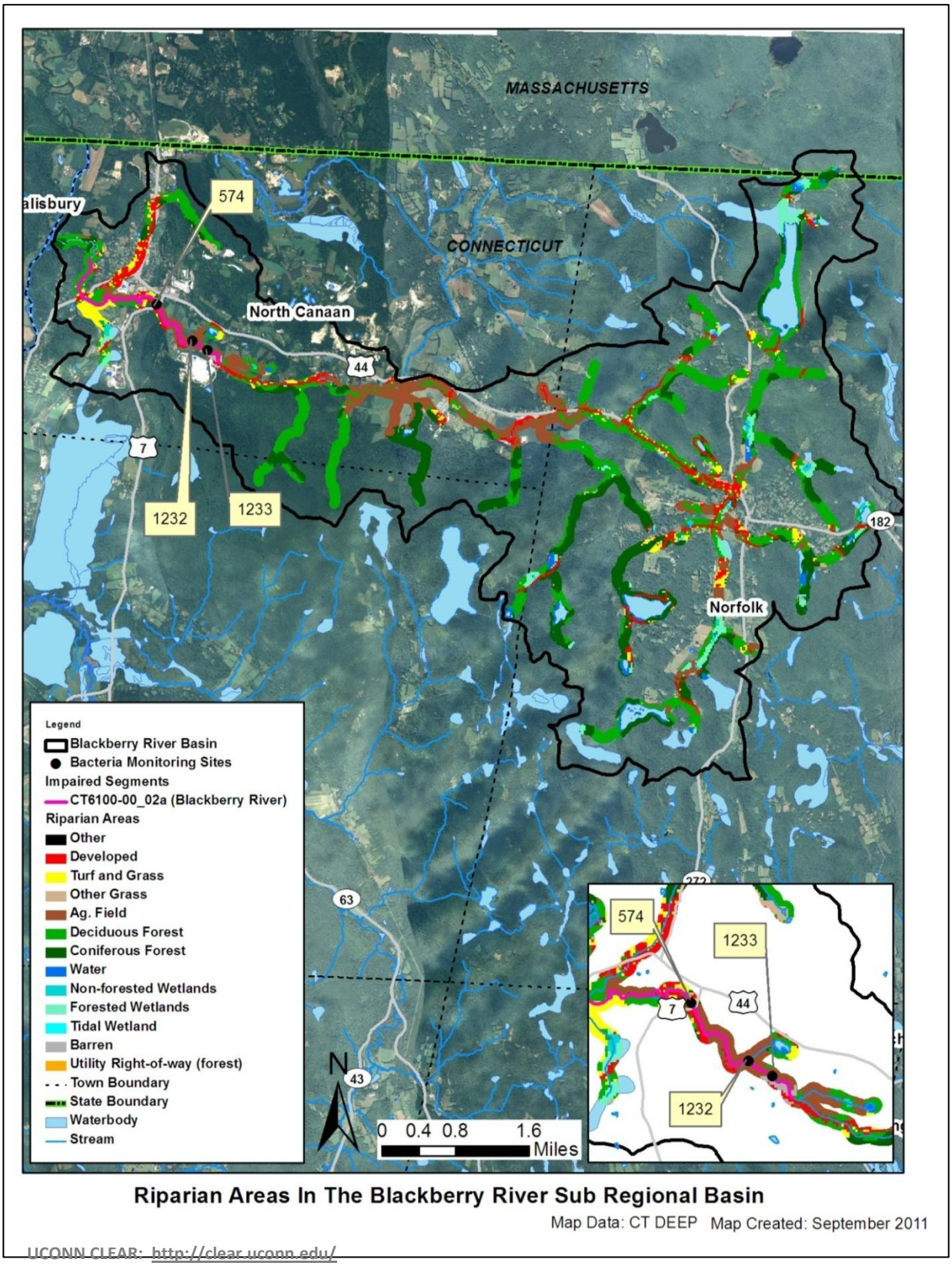
### *Riparian Buffer Zones*

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 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 unique 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. Land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of the Blackberry River is characterized by agricultural land use (Figure 10). Riparian areas upstream of this impaired segment are also characterized by agricultural land use. As previously noted, if not properly treated, runoff from agricultural fields may contain pollutants such as bacteria and nutrients.

**Figure 10: Riparian buffer zone information for the Blackberry River watershed**



## CURRENT MANAGEMENT ACTIVITIES

The Towns of North Canaan and Norfolk have developed and implemented some programs to protect water quality from bacterial contamination. 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). Two 319 grants were awarded in the watershed in 2008 and 2009 to improve manure disposal and storage practices on Route 44 in North Canaan, CT. More information about this project is available through CT DEEP (http://www.ct.gov/dep/lib/dep/water/nps/success_stories/mm_blackberry.pdf)

## RECOMMENDED NEXT STEPS

The Towns of North Canaan and Norfolk have developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Blackberry River and have been prioritized below.

### 1) Ensure there are sufficient buffers on agricultural lands along the Blackberry River.

If not already in place, agricultural producers should 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 livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located within the riparian buffer zone along the impaired segment and directly upstream from the impaired segment (Figure 10).

### 2) Continue monitoring of permitted sources.

Previous sampling of discharge from Specialty Minerals and other permitted sources have shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). 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. The table below (Table 8) details the appropriate waste load allocations for use as permit limits for permittees as permits are renewed and updated, with the Blackberry watershed.

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 8 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 Blackberry 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 8. 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** |
| 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 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.

**3) Evaluate municipal education and outreach programs regarding animal waste.**

As most of the Blackberry River watershed is undeveloped, any education and outreach program should highlight the importance of not feeding waterfowl and wildlife and managing waste from horses, dogs, and other pets. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the Blackberry River 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 Blackberry River 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-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

**4) Identify areas along the developed portions of the Blackberry River to implement Best Management Practices (BMPs) to control stormwater runoff.**

As noted previously, the towns within the Blackberry River watershed are not MS4 communities and thus, are not regulated by the MS4 program. However, as 14% of the watershed is considered urban and portions near the impaired segment of the Blackberry River have an impervious cover of 7-11%, stormwater runoff may still be contributing bacteria to the waterbody. Most of the developed areas are located in the Town of North Canaan. To identify specific areas that are contributing bacteria to the impaired segment, the town should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Blackberry River. To treat stormwater runoff, the town should also identify areas along the more developed sections of the Blackberry River, particularly near Station 574, to install BMPs designed to encourage stormwater to infiltrate into the ground before entering the Blackberry River. 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.

Towns that are not MS4 communities could also choose to adopt the 6 minimum measures required under the MS4 permit. Though not required, adopting these minimum measures would provide a framework for addressing areas of the watershed that may be contributing bacteria through stormwater runoff. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

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

**5) Develop a system to monitor septic systems.**

Though a portion of the residents within the Blackberry River watershed rely on the municipal sanitary sewer system, most residents rely on septic systems. If not already in place, North Canaan and Norfolk

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 also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

**6) Implement a program to evaluate the sanitary sewer system.**

A small portion of the Blackberry River watershed relies on a municipal sewer system. This area is concentrated in northwestern corner of the watershed near the downstream portion of the impaired segment (Figure 6). It is important for North Canaan to develop a program to evaluate its sanitary sewer and reduce leaks and overflows. This program should include periodic inspections of the sewer line.

## BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

### Table 9: Blackberry River Bacteria Data

***Waterbody ID:*** CT6100-00_02a

***Characteristics:*** Freshwater, Class B, 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: **87%**

Single Sample: **98%**

***Data:*** 2003 and 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

**Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Blackberry River with annual geometric means calculated by station (stations organized downstream to upstream)**

| Station Name | Station Location | Date | Results | Wet/Dry | Geomean |
|---|---|---|---|---|---|
| 574 | Adjacent well field south of Route 7 crossing | 6/1/2006 | 670 | dry | 656 |
| 574 | Adjacent well field south of Route 7 crossing | 6/14/2006 | 1100 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 6/29/2006 | 720 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/12/2006 | 990 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/19/2006 | 390 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/26/2006 | 1400 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/2/2006 | 340 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/9/2006 | 490 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/14/2006 | 520 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/23/2006 | 595[†] | dry | |

**Single sample *E. coli* (colonies/100 mL) from all monitoring stations on Blackberry River with annual geometric means calculated by station (stations organized downstream to upstream) (continued)**

| Station Name | Station Location | Date | Results | Wet/Dry | Geomean |
|---|---|---|---|---|---|
| 574 | Adjacent well field south of Route 7 crossing | 6/6/2007 | 660 | wet | 568 |
| 574 | Adjacent well field south of Route 7 crossing | 6/12/2007 | 2600 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 6/27/2007 | 280† | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/5/2007 | 3900 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/10/2007 | 210 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/17/2007 | 240 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/25/2007 | 230† | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/2/2007 | 480 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/9/2007 | 965† | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/30/2007 | 410 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 9/6/2007 | 170 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 9/13/2007 | 1600 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 5/22/2008 | 650 | wet | 724 |
| 574 | Adjacent well field south of Route 7 crossing | 6/5/2008 | 3300 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 6/9/2008 | 1500 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 6/19/2008 | 320 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 6/26/2008 | 250 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/8/2008 | 270 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/23/2008 | 4100 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/31/2008 | 740 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/4/2008 | 2100 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/14/2008 | 120 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 9/9/2008 | 540 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 6/11/2009 | 480 | wet | **982* (87%)** |
| 574 | Adjacent well field south of Route 7 crossing | 6/17/2009 | 360 | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/2/2009 | **24001*† (98%)** | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 7/9/2009 | 840 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/16/2009 | 500 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 7/23/2009 | 475† | wet | |
| 574 | Adjacent well field south of Route 7 crossing | 8/6/2009 | 875† | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/12/2009 | 450 | dry | |
| 574 | Adjacent well field south of Route 7 crossing | 8/19/2009 | 2600 | dry | |

**Single sample *E. coli* (colonies/100 mL) from all monitoring stations on Blackberry River with annual geometric means calculated by station (stations organized downstream to upstream) (continued)**

| Station Name | Station Location | Date | Results | Wet/Dry | Geomean |
|---|---|---|---|---|---|
| 1232 | Downstream of Tractor Ford at quarry discharge | 11/3/2003 | 10 | dry | NA |
| 1233 | Upstream of Tractor Ford at quarry discharge | 11/3/2003 | 10 | dry | NA |

**Shaded cells indicate an exceedance of water quality criteria**

**†Average of two duplicate samples**

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

**Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on the Blackberry River**

| Station Name | Station Location | Years Sampled | Number of Samples | | Geometric Mean | | |
|---|---|---|---|---|---|---|---|
| | | | Wet | Dry | All | Wet | Dry |
| 574 | Adjacent well field south of Route 7 crossing | 2006-2009 | 24 | 25 | 724 | 1010 | 526 |
| 1232 | Downstream of Tractor Ford at quarry discharge | 2003 | 0 | 1 | NA | NA | NA |
| 1233 | Upstream of Tractor Ford at quarry discharge | 2003 | 0 | 1 | NA | NA | NA |

**Shaded cells indicate an exceedance of water quality criteria**

**Weather condition determined from rain gauge at the Norfolk 2 SW in Norfolk, CT**

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