



Southeast Shoreline (CT2000) Summary

Fenger Brook (CT2000-30_01)

WATERSHED DESCRIPTION

The Southeast Shoreline sub-regional basin is located in the southeastern portion of Connecticut (Figure 1). There are two towns located in the Fenger Brook watershed, including the municipalities of New London and Waterford, CT (Figure 2).

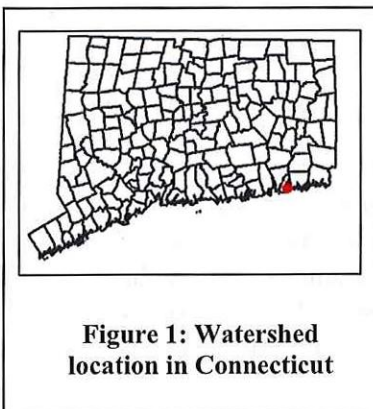


Figure 1: Watershed location in Connecticut

The Southeast Shoreline sub-regional basin includes one segment, consisting of the entire length of Fenger Brook, impaired for aquatic life use assessed by aquatic invertebrates. This segment was assessed by Connecticut

Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2012 303(d) list of impaired waterbodies. Some segments in the watershed were currently unassessed as of the writing of this document. This does not signify that no concerns exist with those segments, rather it is an indication that there are not current data to evaluate the segments as part of an assessment process. An excerpt of the 2012 Integrated Water Quality Report is included in Table 1.

Fenger Brook is 3.47 miles in length and the entire length of the brook (CT2000-30_01) is considered impaired. The Fenger Brook begins southeast of the Clark Lane and Chester Street intersection in Waterford, CT. The brook continues southerly through a large forested area along the Waterford-New London town line and passes under Route 1, adjacent to an auto body shop and several paved retail parking lots in Waterford before entering into another forested tract. A tributary enters the brook from the west as it passes under railroad tracks. It ends at Alewife Cove (tidal) just downstream of Niles Hill Road on the Waterford-New London town line (Figure 2).

Impaired Segment Facts

Impaired Segment:

Fenger Brook (CT2000-30_01)

Municipalities: New London and Waterford

Impaired Segment Length (miles): 3.47

Watershed Area (square miles): 3.1

Watershed Impervious Cover: 20%

Water Quality Classification: Class A

Designated Use Impairments: Habitat for Fish, Other Aquatic Life, and Wildlife

Sub-regional Basin Name and Code: Southeast Shoreline, 2000

Regional Basin: Southeast Shoreline

Major Basin: Southeast Coast



Table 1: Impaired segment in the Southeast Shoreline Sub-Regional Basin from the Connecticut 2012 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation
CT2000-30_01	Fenger Brook-01	From mouth at head of tide, Alewife Cove (just DS of Niles Hill Road (Route 213) crossing), US to headwaters (southeast of Clark Lane and Chester Street intersection), Waterford.	3.47	NOT	NOT
NOT = Designated Use Not Supported					

For surface water quality class A, the criteria to meet aquatic life use support includes the following:

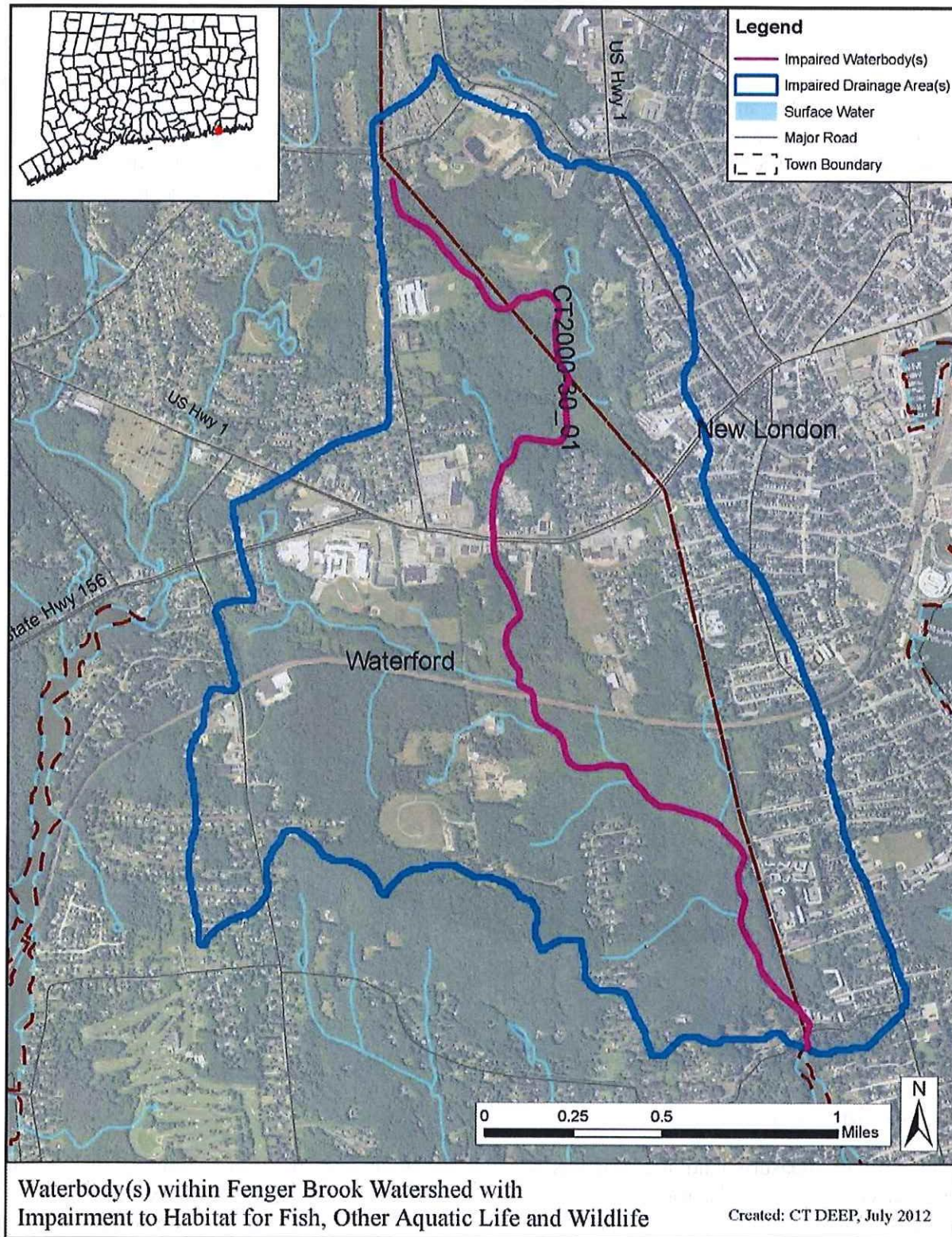
Biological Condition: Sustainable, diverse biological communities of indigenous taxa shall be present. Moderate changes, from natural conditions, in the structure of the biological communities, and minimal changes in ecosystem function may be evident; however, water quality shall be sufficient to sustain a biological condition within the range of Connecticut Biological Condition Gradient Tiers 1-4 as assessed along a 6 tier stressor gradient of Biological Condition Gradient (See Appendix G of the Water Quality Standards).

Data used to assess these waters are summarized in Table 2.

Table 2: Data used to assess Fenger Brook (CT2000-30_01). An "x" indicates that data has been used in the assessment process.

Segment ID	Waterbody Name	Macroinvertebrate Community	Fish Community	Volunteer RBV Data	Macroinvertebrate Model	Water Chemistry	Whole Effluent Toxicity	External Data	Listing Cycle
CT2000-30_01	Fenger Brook-01	x	x			x		x	2002

Figure 2: The Fenger Brook Watershed

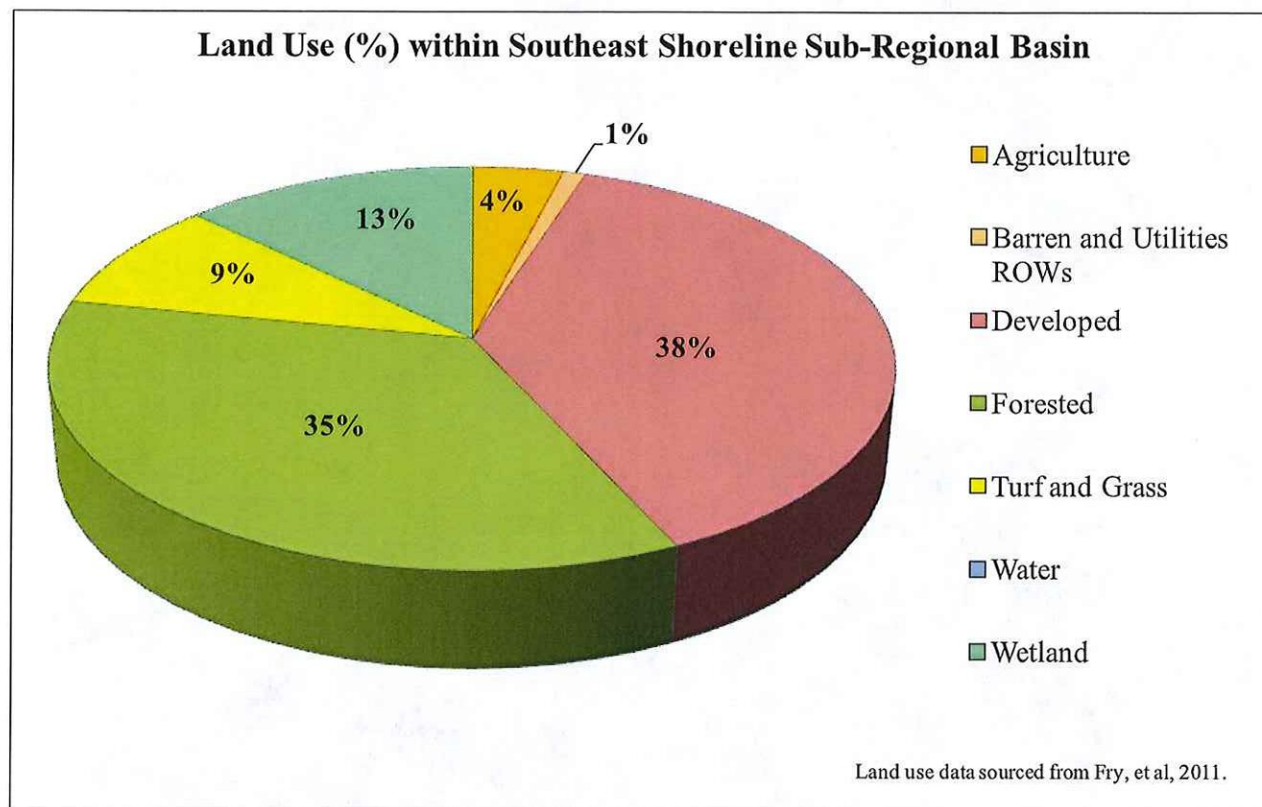


Land Use in the Watershed

The existing land use in a watershed can affect the water quality of the waterbodies within that watershed (USEPA, 2011b). In an undeveloped watershed, natural processes such as infiltration of stormwater into the soil and plant uptake of water and nutrients can occur. As watersheds become more developed with commercial, residential, and industrial land uses, the amount of stormwater runoff increases as the natural landscape is altered with impervious surfaces, such as rooftops, roads, and sidewalks. The amount of pollutants, such as nutrients and bacteria from leaking septic systems, oil and grease from automobiles, and sediment from construction activities, can also increase, can become entrained in this runoff, and negatively affect nearby waterbodies. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011b).

As shown in Figure 3, the Southeast Shoreline sub-regional basin consists of 38% developed areas, 35% forests, 13% wetlands, 9% turf and grasses, and 4% agriculture. Other land uses include barren land/utility right of ways.

Figure 3: Land uses within the Southeast Shoreline Sub-Regional Basin



Impervious Cover (IC)

Another way to measure land use impacts to aquatic life in streams is to evaluate the amount of impervious cover (i.e. roads, roofs, driveways, parking lots). Increasing the percentage of IC in a watershed is linked to decreasing stream health (CWP 2003, Bellucci 2007). Stormwater runoff from impervious surfaces contains pollutants such as oils, heavy metals, nutrients, bacteria sediment (USEPA

1983) and can cause temperature impacts to receiving waterbodies. The amount of stormwater pollutants transported during a rainstorm is directly related to the amount of impervious cover in the watershed.

The extent of land area associated with IC cover can be calculated by analyzing the types of land cover (developed, forested, agriculture, etc.) present in the landscape. The total percentage of impervious cover (%IC) can be compared to levels that are linked to impaired streams receiving excessive stormwater runoff. The %IC is used in the *Connecticut Watershed Response Plan for Impervious Cover* (Plan) as a surrogate to represent the impacts associated with stormwater runoff pollution. Figure 4 shows the %IC for the Fenger Brook watershed. This watershed has impervious surface areas of 20%.

CT DEEP has determined that to limit effect of stormwater pollution an IC area of less than 12% is needed to support habitat for fish, other aquatic life and wildlife use in these waterbodies. However, stormwater pollution is categorized under two types of pollutant loads: point and non-point sources. Point sources are permitted a waste load allocation (WLA) and regulated under the National Pollutant Discharge Elimination System (NPDES), but a load allocation (LA) is also contributed by non-point sources where no regulations are applicable. It is not feasible to draw a clear distinction between stormwater pollution originating from point and non-point sources because insufficient data are available for each parcel in the watershed and the fact that stormwater pollution is highly variable in frequency and duration. Consequently, a Margin of Safety (MOS) is incorporated into the %IC target in order to account for uncertainties regarding the relationship between water quality and sources (point and non-point). Therefore, a MOS of 1% IC was subtracted from the %IC target to account for uncertainty in the analysis, resulting in a combined target of 11% for Waste Load Allocation (WLA) and Load Allocation (LA). The reduction in impervious cover necessary to reach the target for the Fenger Brook watershed is shown in Table 3. The Plan target of 11% IC is intended to guide the application of Best Management Practices (BMP) and Low Impact Development (LID) techniques to reduce the *impact* of impervious surfaces.

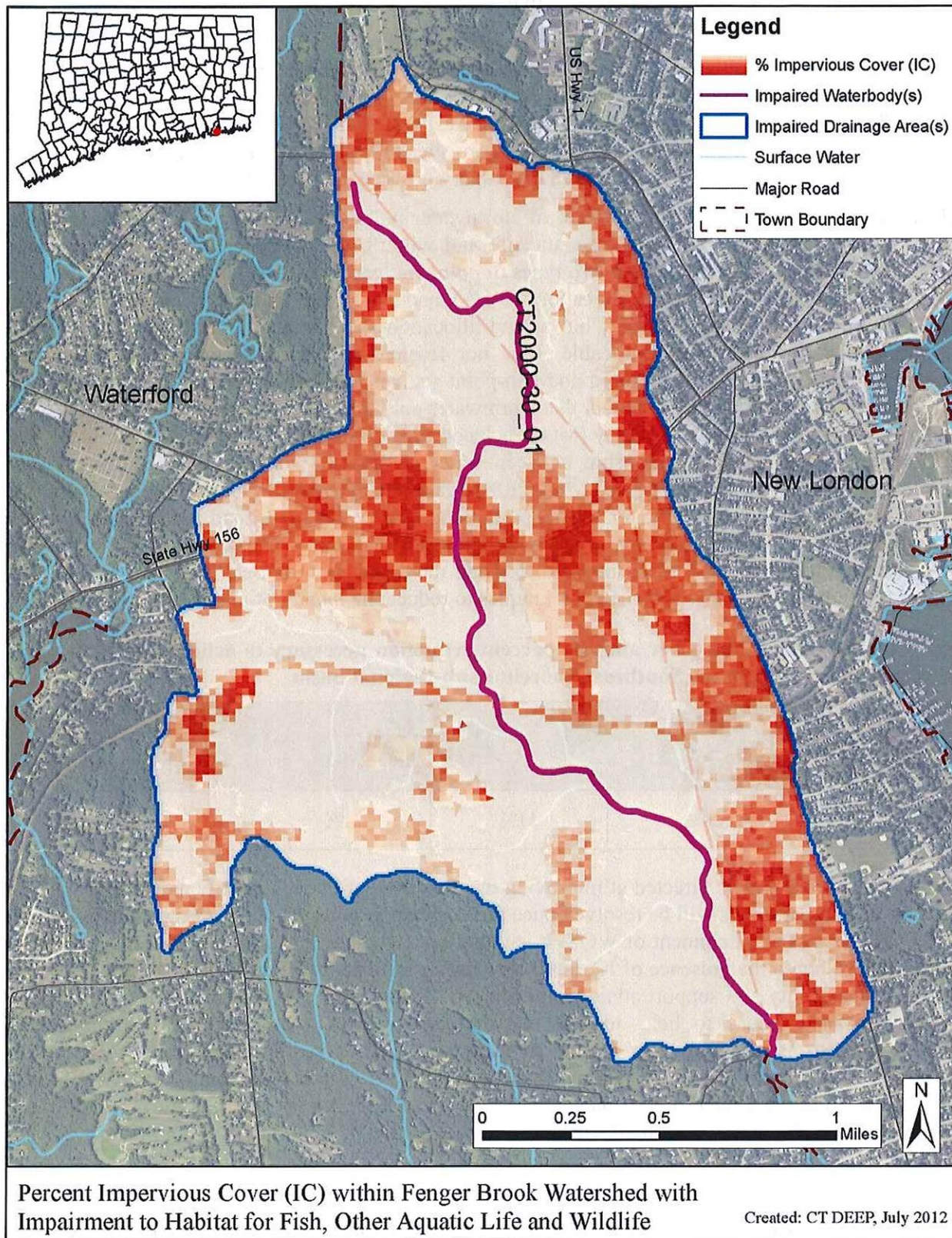
Table 3: Current impervious cover and the percent reduction necessary to achieve the Plan target for the impaired segment in the Southeast Shoreline sub-regional basin

Impaired Segment	Current Watershed Impervious Cover	%IC Target ¹	Margin of Safety (MOS)	Percent Reduction to Meet Plan Target
Fenger Brook (CT2000-30_01)	20%	11%	1%	45%

Implementation of this Plan is directed at improving the condition of the aquatic life use support in these waterbodies. The impairments will be resolved once the instream monitoring and assessment as conducted by CT DEEP indicates an attainment of WQS. It is important to note that the aquatic life use impairment may not be due solely to the presence of IC, but that reducing the effect of IC within the basin is expected to improve water quality and support attainment of aquatic life use goals. Additionally, the IC reduction targets are guidance values to help address the component of the impairment which the current information suggests is attributable to IC due to stormwater pollutants. The reduction targets are not recommended as regulatory limits for incorporation into permits. Best Management Practices to reduce the effect of IC through stormwater management are discussed below as appropriate implementation practices for permitted and non-permitted stormwater discharges.

¹ These are target goals, not end-of pipe effluent limits, unless otherwise indicated in a permit issued pursuant to the National Pollutant Discharge Elimination System (NPDES) program.

Figure 4: Impervious cover (%) for the Fenger Brook Watershed



CURRENT MANAGEMENT ACTIVITIES

Permitted Stormwater Sources

The control of stormwater pollution from regulated sources is noteworthy for addressing the effect of IC. Regulated stormwater discharges consist of those authorized under the General Permit for the Discharge of Stormwater from Municipal Separate Storm Sewer Systems (MS4 GP), General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (Construction GP), General Permit for the Discharge of Stormwater Associated with Industrial Activity (Industrial GP), and General Permit for the Discharge of Stormwater from Commercial Activities (Commercial GP). Each of these general permits requires the implementation of control measures and some type of a stormwater management plan (for more information go to www.ct.gov/deep/stormwater).

Permitted sources existing within the watershed that could potentially contribute to impairments in the Fenger Brook watershed are identified in Tables 4 and Figure 5. 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 basin.

Table 4: General categories of stormwater permitted discharges

Permit Code	Permit Description Type	Number in watershed
GSC	Stormwater Discharge Associated with Commercial Activity (Commercial GP)	1
GSI	Stormwater Associated with Industrial Activity (Industrial GP)	2
GSM	Part B Municipal Stormwater MS4 (MS4 GP)	2
GSN	Stormwater Registration – Construction (Construction GP)	1

Municipalities have been working hard to meet the challenges of stormwater management. The City of New London and the Town of Waterford have developed and implemented programs to protect water quality. As indicated previously, all of New London and Waterford are regulated under the MS4 program. The MS4 GP requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants from storm sewer discharges to improve water quality. The SMP 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 new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

Subsequent to the initial preparation and implementation of the SMP, each municipality must submit an annual update outlining the steps they are taking to meet the six minimum measures. Relevant stormwater management measures are summarized below.

City of New London (Permit GSM00111) (from the 2010 Stormwater Management Plan Annual Report)

- Acquired 500 storm drain markers and currently installed 45; a coordinated community outreach educational volunteer program is planned to install the remaining markers in 2011.
- Posted the 2008 and 2009 Stormwater Management Plans as well as General Permit of Stormwater from Small Municipal Separate Storm Sewer Systems and annual reports on the city's website.
- Continued to clean up parks on an ongoing basis through a coordinated crew of volunteers called "Sound Community Services."
- Continued the Old Mill vegetation-planting program to keep vegetation thriving along the tributary to the Thames River.
- Developed an illicit discharge ordinance in 2009
- Continued requirements for the development of Sediment and Erosion Control Plans for disturbance of any area greater than a half acre.
- Continued Zoning Regulations for Stormwater Drainage in parking areas and Erosion and Sedimentation Controls.
- Continued to sweep City streets a minimum of once a year, downtown district streets swept two times a week during warm weather months.
- Acquired a refurbished drain cleaner, which is used on a daily basis; City's mission to clean every basin once a year.
- Continued Capital Improvement Program for the City of New London, which has spent \$30,000 to date on drainage system improvements
- Continued to sample six outfalls per year.
- Distributed the brochure "Every day solutions to protect our water from stormwater pollution: A guide to healthy habits for cleaner water."

Town of Waterford (Permit GSM000023) (from the 2010 Stormwater Management Plan Annual Report)

- Distributed educational brochures entitled "Step by Step," A Citizens Guide to Curbing Polluted Runoff" and made other informational brochures available at the Department of Public Works.
- Completed stenciling program in which a minimum of 30% of basins in town were prioritized and stenciled using the CTDEP Long Island Sound Fund, Storm Drain Marker Program.
- Completed mapping all of the outfalls greater than 15 inches and installed it on the town GIS system.
- Continued to map any new outfalls >12."
- Continued dry weather sampling of six stormwater outfalls.

- Continued annual staff-training program on inspection protocol, identifying potential illicit discharges and town policies on prohibiting non-stormwater and illicit discharges.
- Revised regulations for erosion and sediment control and stormwater control measures for all construction activities.
- Developed post-construction and run-off control regulations.
- Continued annual street sweeping of municipality's entire 119 miles of road.
- Continued annual cleaning of all stormwater structures.
- Eliminated the use of sand on roads during winter snow storms.

MS4 GP discharges

MS4 dischargers must implement the Stormwater Management Plan (SMP) required by the MS4 permit reissued on January 9, 2011, and as amended. The SMP includes best management practices (BMPs) grouped into six Minimum Control Measures, which consist of Public Education and Outreach, Public Involvement/ Participation, Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff, Post Construction Stormwater Management in New Development and Redevelopment, and Pollution Prevention/Good Housekeeping. Compliance with the MS4 GP, as amended, including implementation of the SMP and six Minimum Control Measures.

Construction GP discharges

The Construction GP regulates the runoff from construction with 5 or more acres of soil disturbance for projects with municipal land use approvals and with 1 or more acres of soil disturbance for projects without municipal land use approvals. The Construction GP requires controls to reduce the discharge of sediment during construction and includes measures to address the long term impacts related to post-construction stormwater discharges. While the Construction GP reissued on April 9, 2010 (current permit) does not address impaired waters, the proposed modified Construction GP, expected to be reissued in 2013, specifies post-construction runoff standards. These post-construction discharges require the retention and/or infiltration of stormwater using LID and runoff reduction methods. Although the proposed post-construction performance standards are not based on the percentage of impervious cover, the runoff retention standards specified will serve to reduce and/or disconnect impervious area.

Industrial GP discharges

Industrial facilities are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include control measures (similar to BMPs) to reduce or eliminate the discharge of pollutants from the site. Typically, industrial sites are highly impervious. However site constraints, and cost considerations will complicate the reduction of impervious cover. To address the effect of IC, industrial sites where site expansion or redevelopment is planned should focus on the reduction and minimization of impervious area. The industrial facility can consider which BMPs are appropriate for the site as well as those to address specific sources.

Commercial GP discharges

The Commercial GP regulates commercial sites with impervious surfaces exceeding 5 acres, such as malls and "big box" stores. The strategy to address the control of stormwater pollutants from these sites is called a Stormwater Management Plan (SMP). While the Commercial GP reissued on May 1, 2001

(current permit) does not discuss stormwater discharges to impaired waters, future versions of the permit will include measures similar to the Industrial and MS4 GPs. The commercial site can consider which BMPs are appropriate for the site as well as those to address specific sources.

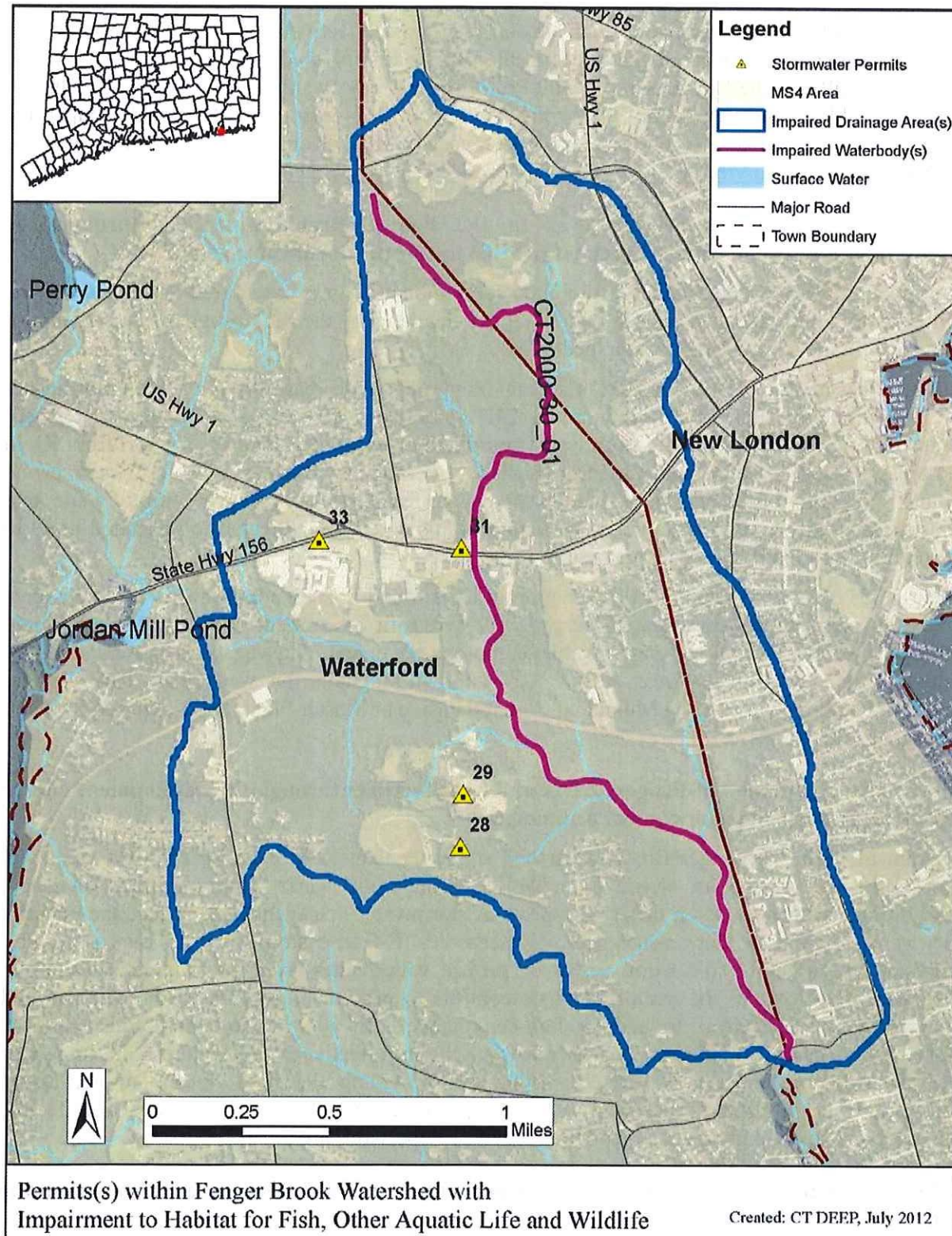
Non-Regulated Discharges

Many municipalities in Connecticut do not do not fall under the current MS4 permit (reissued January 9, 2011). Non-MS4 municipalities can voluntarily implement the BMPs within the MS4 permit and this document. Any facilities that discharge non-regulated stormwater can update their Pollution Prevention Plans to include BMPs that can reduce pollutants from entering surface waters. These BMPs could include revised housekeeping procedures to reduce pollutants or techniques that increase infiltration to reduce runoff. Additionally, sites or areas that are not regulated by a NPDES permit (such as small scale commercial and construction sites, residential sites, etc.) should consider implementation measures to minimize and/or disconnect impervious areas. Improving water quality within the community to address nonpoint source pollution requires actions, large and small, by the community.

Table 5: Permitted stormwater facilities within the Fenger Brook Watershed

Municipality	Permit ID	Permittee	Permit Type	Latitude	Longitude	# in Figure 5
Waterford	GSI001409	Town Of Waterford	Industrial GP	41.330	-72.123	28
Waterford	GSI001985	Murphy Road Recycling	Industrial GP	41.332	-72.123	29
Waterford	GSC000343	Waterford And Miner	Commercial GP	41.342	-72.123	31
Waterford	GSN002151	Town Of Waterford	Construction GP	41.342	-72.131	33
Waterford	GSM000023	Town of Waterford	MS4 GP	--	--	--
New London	GSM000111	City of New London	MS4 GP	--	--	--

Figure 5: Permitted Stormwater Facilities in the Fenger Brook Watershed including MS4s (numbers correspond with permitted facilities listed in Table 5)



RECOMMENDED NEXT STEPS

CT DEEP can assist with reducing the effect of IC by providing technical and financial assistance to the watershed towns and local citizen watershed advocacy groups, effectively administering stormwater permitting programs, and monitoring aquatic life in the surface waters. Under Section 319 of the Clean Water Act (§319 C.W.A.), the U.S. Environmental Protection Agency awards a grant annually to the CT DEEP to fund eligible projects that control and/or abate nonpoint source pollution through a competitive bid process. More information on grant programs can be found on the Department's website (http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325594&deepNav_GID=1654).

1) Reduce the effect of impervious cover in the Fenger Brook watershed through the implementation of Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 38% of the Southeast Shoreline sub-regional basin is considered developed and the municipalities within the watershed are MS4 communities regulated by the MS4 program. The amount of impervious cover in the Fenger Brook watershed is 20%.

Reducing the effect of IC in the watershed is an important step to decrease the impacts of stormwater runoff on water quality. For new development, LID principles (<http://www.ct.gov/deep/watershed>) should be utilized to retain and infiltrate stormwater runoff and/or reduce the amount of runoff from IC. In developed areas, IC should be disconnected from surface waterbodies, where practicable. Disconnection of impervious surface runoff should be pursued to the degree feasible when reconstruction of a site and/or its infrastructure occurs. For example, stormwater outfalls could be redirected to vegetated areas to encourage natural filtration before reaching nearby waterbodies.

An excellent guide on how to implement a reduction in IC is found in Appendix 3 of the core document and on the web (<http://clear.uconn.edu/projects/tmdl/>). A retrofit assessment of the watershed would identify areas where BMPs such as gravel wetlands, porous pavement, and vegetated buffers could be implemented to most effectively treat stormwater runoff throughout the watershed. This type of assessment could be linked to existing Municipal Comprehensive or Master Plans, MS4-required SMPs or watershed management plans.

2) Prevent future degradation of Fenger Brook and its tributaries through the development and/or strengthening of local stormwater control ordinances.

As the amount of IC in the Fenger Brook watershed is greater than 12%, the adoption of a municipal stormwater ordinance can be an effective method to protect the water quality in the watershed. Stormwater ordinances can focus on different aspects of stormwater management to reduce the quantity and quality of the stormwater that reaches nearby waterbodies. Effective stormwater ordinances prohibit non-stormwater discharges (to the storm sewer or surface waterbodies) such as sanitary sewage and wastewater discharges, require the use of adequate controls to prevent erosion and sedimentation, and specify enforcement mechanisms to address non-compliance. In addition to local ordinances, the establishment of a stormwater utility (i.e. a user fee) can be an effective way to address the impact of stormwater runoff from impervious surfaces while also providing the fiscal means of addressing municipal stormwater infrastructure needs. Utility fees are usually based on the size of effective impervious area and so, strongly encourage the reduction of impervious area.

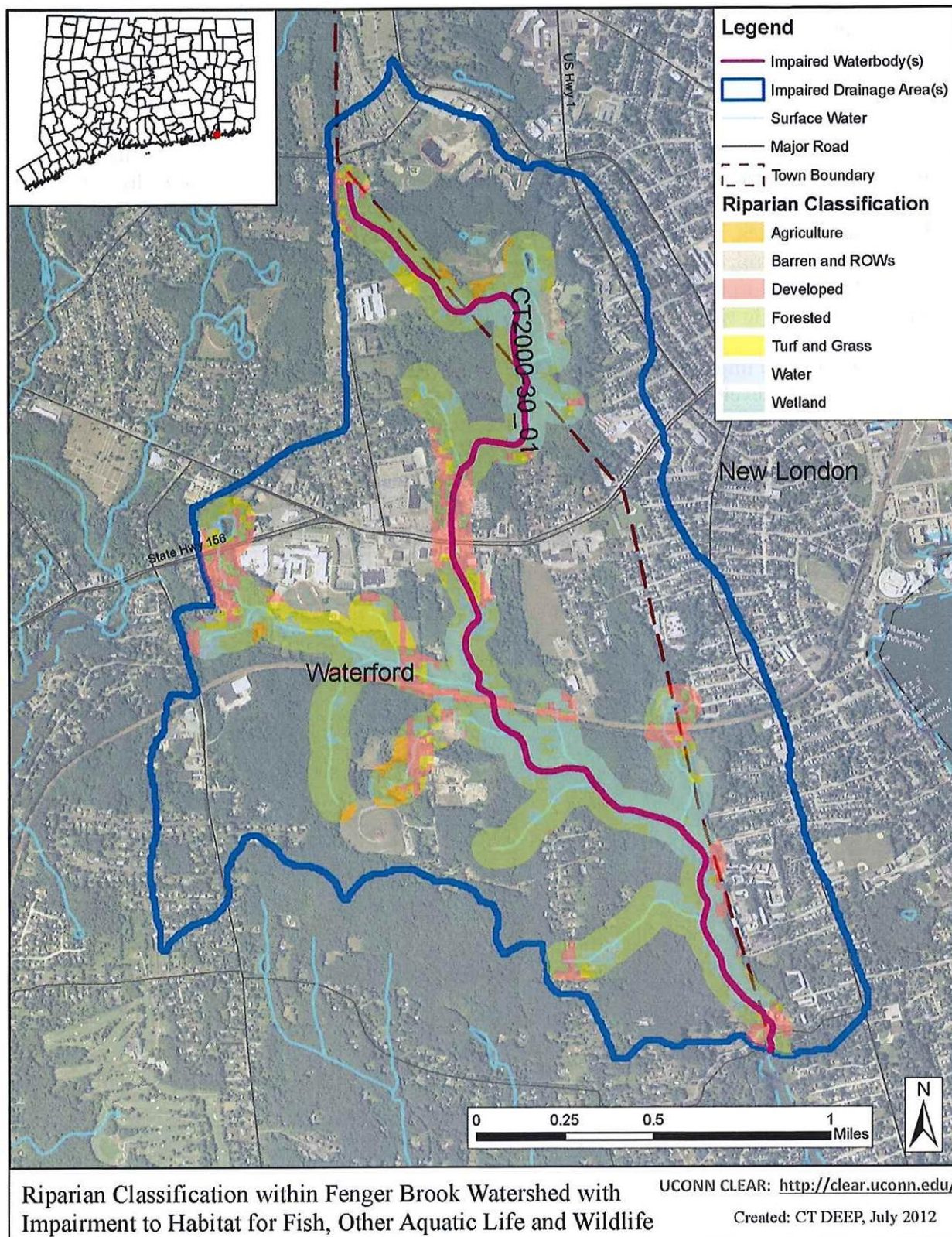
3) Protect existing buffers along the riparian corridor and other conservation lands throughout the watershed.

Riparian buffers and other natural landscapes can protect the water quality of waterbodies within a watershed. The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The incorporation of buffer requirements in the municipal land use approval process will help protect these areas near Fenger Brook from the effect of IC, and these streams can be protected from further degradation due to stormwater runoff.

Riparian zones differ from the uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. These areas can reduce the impacts of IC by filtering pollutants and slowing runoff. 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. They also can protect the shoreline from erosion, aid in flood control, provide habitat for wildlife, shade waters for fish, and offer scenic value. 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, 2011a).

The riparian zones for the impaired segments in the Fenger Brook Watershed are characterized by a mix of land uses including developed, forested, and consisting of wetlands (Figure 6). Development is focused along the Route 1 corridor near the middle reaches of the brook as well as near the mouth of the brook as it empties into the tidal Alewife Cove. A tributary entering Fenger Brook from the west has a concentrated developed area near its headwaters and passes underneath Rope Ferry Road and between a residential development and Waterford High School. The IC within all developed areas is typically transporting stormwater via structured drainage systems that often discharge within the riparian areas or directly to surface waters.

Figure 6: Riparian buffer zone information for the Fenger Brook Watershed



4) Encourage greater citizen involvement to ensure the long-term protection of Fenger Brook and its tributaries.

Groups of concerned citizens within a watershed with a shared goal of maintaining or restoring water quality for the use of its residents for future generations have shown to be effective in ensuring the long-term protection of a waterbody. These groups include watershed associations and municipal conservation commissions. Activities include water quality monitoring, developing a public education strategy, and working with local boards to upgrade existing water resource protection laws. Education of citizens regarding the management of stormwater runoff from individual properties is important to ensure long term protection.

5) Evaluate and implement Low Impact Development practices for future development and retrofit opportunities.

LID techniques and BMPs to reduce the impact of stormwater within the Fenger Brook watershed are important tools to reduce the effect of IC. A list of these techniques includes (but is not limited to): rain gardens, bioretention areas, "green streets" techniques, porous asphalt, porous concrete, permeable pavers, other permeable pavement systems, green roofs, cisterns and rain barrels, engineered vegetated swales, and tree box filters.

Some resources for more information are:

- NEMO (Nonpoint Education for Municipal Officials) is a University of Connecticut Program for local land use officials addressing the relationship of land use to natural resource protection (<http://nemo.uconn.edu/>)
- CT DEEP's Watershed Municipal Outreach and Low Impact Development Program (<http://www.ct.gov/deep/cwp/view.asp?A=2719&Q=464958>).

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