



Indian River (CT5306) Summary

Silver Brook (CT5306-01_01)

WATERSHED DESCRIPTION

The Indian River sub-regional basin is located in the south central portion of Connecticut (Figure 1). There are three towns located in the watershed, including the municipalities of New Haven, Orange, and Woodbridge, CT (Figure 2).

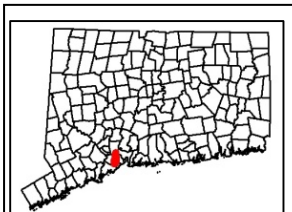


Figure 1:
Watershed location
in Connecticut

The Indian River sub-regional basin includes one segment, Silver Brook (CT5306-01_01), 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 in 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.

The headwaters of Silver Brook begin near Dogburn Road south of the Woodbridge-Orange town border. The impaired segment of Silver Brook (CT5306-01_01) consists of 1.6 miles of the brook and begins at the confluence with Trout Brook just upstream of Smith Farm Road in a forested area in Orange (Figure 2). The impaired segment of the brook flows south under Smith Farm Road and Racebrook Road (Route 114) before entering a forested area. The brook then passes under Old Tavern Road adjacent to a commercial shopping plaza and flows underneath a parking lot before entering another forested area. The brook then flows under Boston Post Road (Route 1) and continues to flow between residential developments on Silver Brook Road and Old Lambert Road. Silver Brook then enters another forested area, passing underneath Red Cedar Road before ending at the confluence of the Indian River. Indian River continues to flow south and empties into Indian Lake.

Impaired Segment Facts

Impaired Segment:

Silver Brook (CT5306-01_01)

Municipalities: New Haven, Orange, Woodbridge

Impaired Segment Length (miles): 1.6

Watershed Area (square miles): 2.76

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:

Indian River, 5306

Regional Basin: South Central Western Complex

Major Basin: South Central Coast

Table 1: Segments in the Indian River Sub-Regional Basin from the Connecticut 2012 Integrated Water Quality Report (impaired segment highlighted in gray)

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation
CT5306-01_01	Silver Brook - 01	From mouth at confluence with Indian River (just US of Indian Lake, parallel to Indian River Road), US to confluence with Trout Brook (just US of Smith Farm Road crossing), Orange.	1.6	NOT	NOT
CT5306-01_02	Silver Brook-02	From confluence with Trout Brook (just US of Smith Farm Road crossing), US to HW (west side of Dogburn Road, near Woodbridge town line), Orange.	3.1	U	NOT
NOT = Designated Use Not Supported U = Designated Use Not Assessed					

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

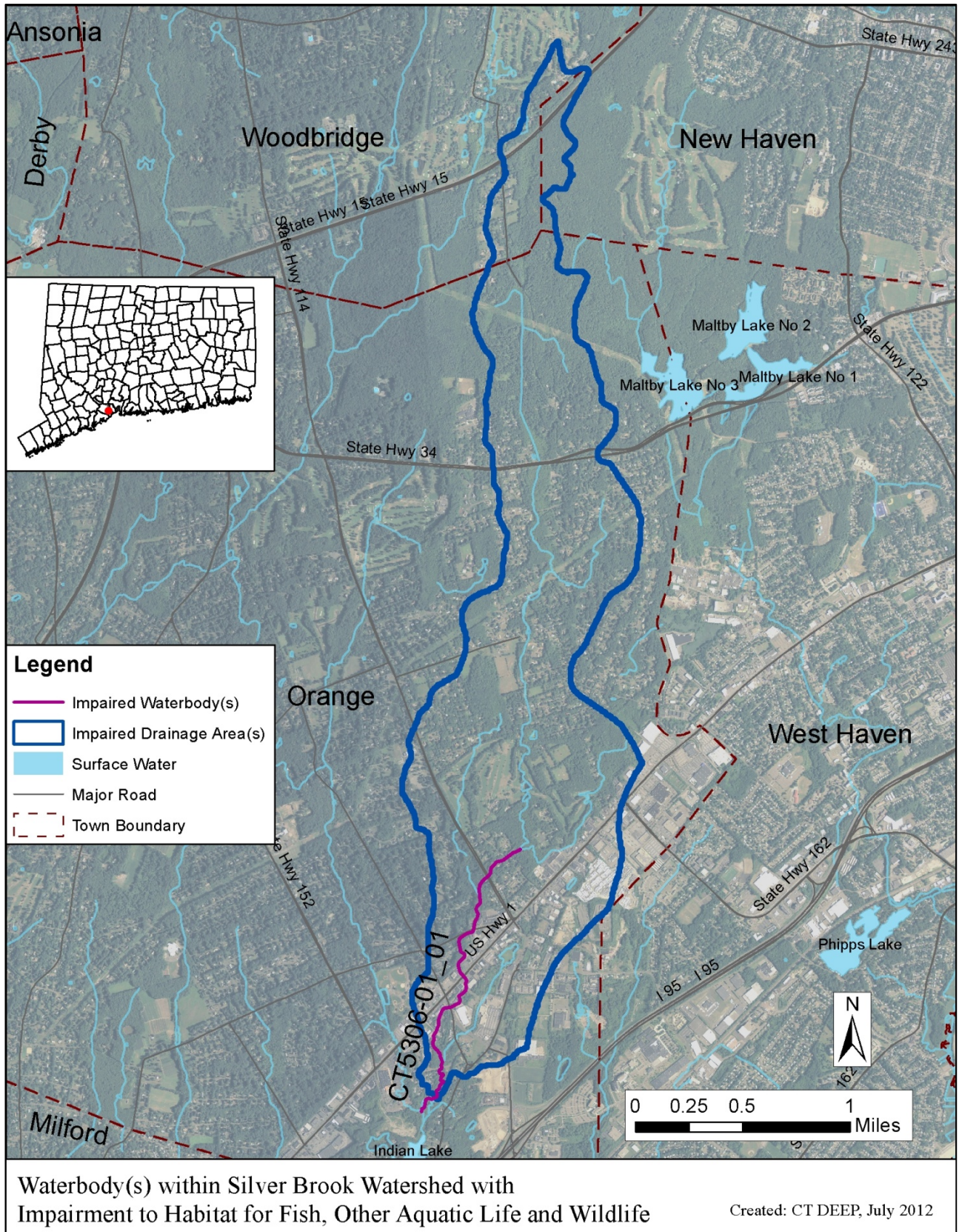
Biological Condition: Sustainable, diverse biological communities of indigenous taxa shall be present. Moderate changes, from natural conditions, in the structure of the biological communities, and minimal changes in ecosystem function may be evident; however, water quality shall be sufficient to sustain 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 Silver Brook (CT5306-01_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
CT5306-01_01	Silver Brook-01	x	x						2008

Figure 2: The Silver Brook Watershed

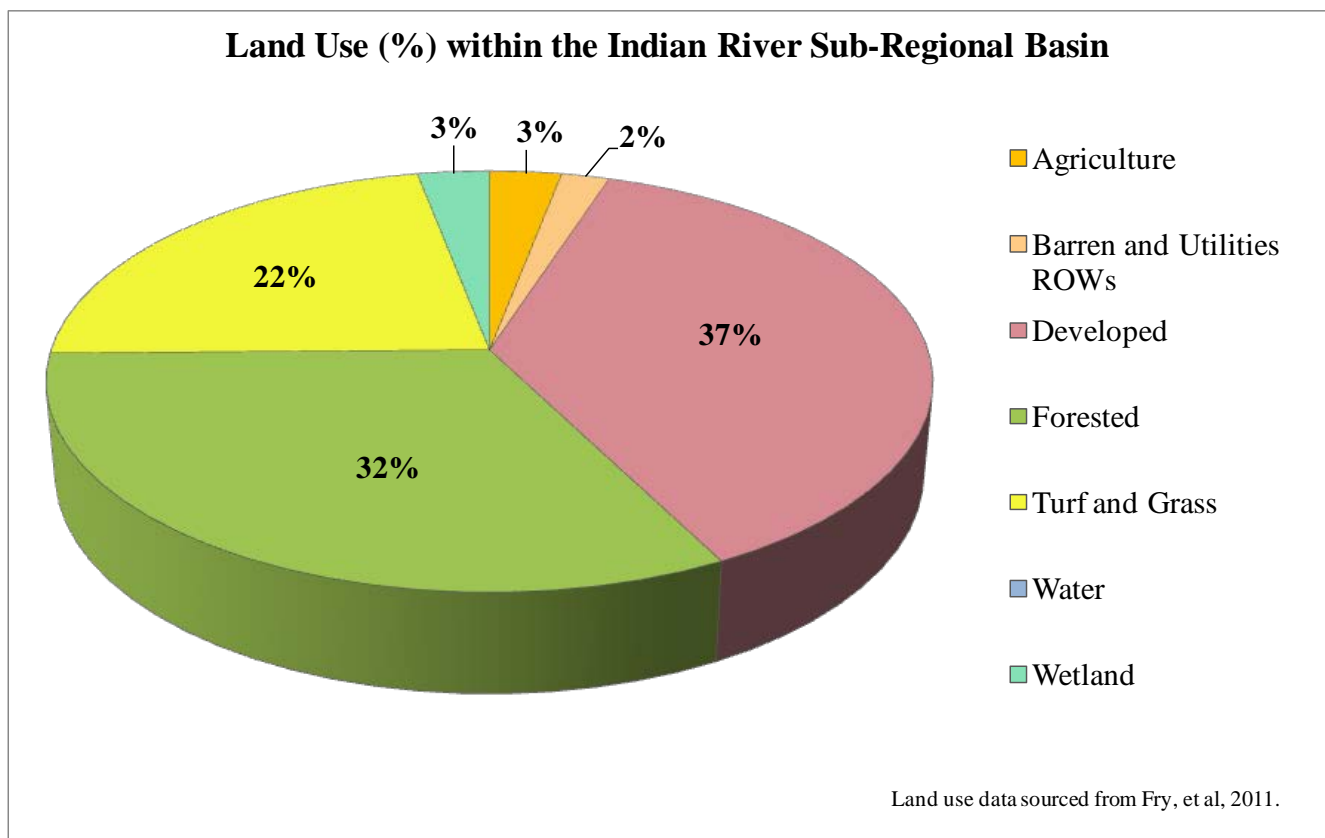


Land Use in the Watershed

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 Indian River sub-regional basin consists of 37% developed areas, 32% forests, and 22% turf and grasses. Other land uses include wetlands, agriculture, and barren land/utility right-of-ways.

Figure 3: Land uses within the Indian River 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. The watershed for the impaired segment in the Indian River sub-regional basin has impervious surface areas of **20%** (Silver Brook CT5306-01_01) (Figure 4).

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 each impaired waterbody in the Indian River sub-regional basin 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.

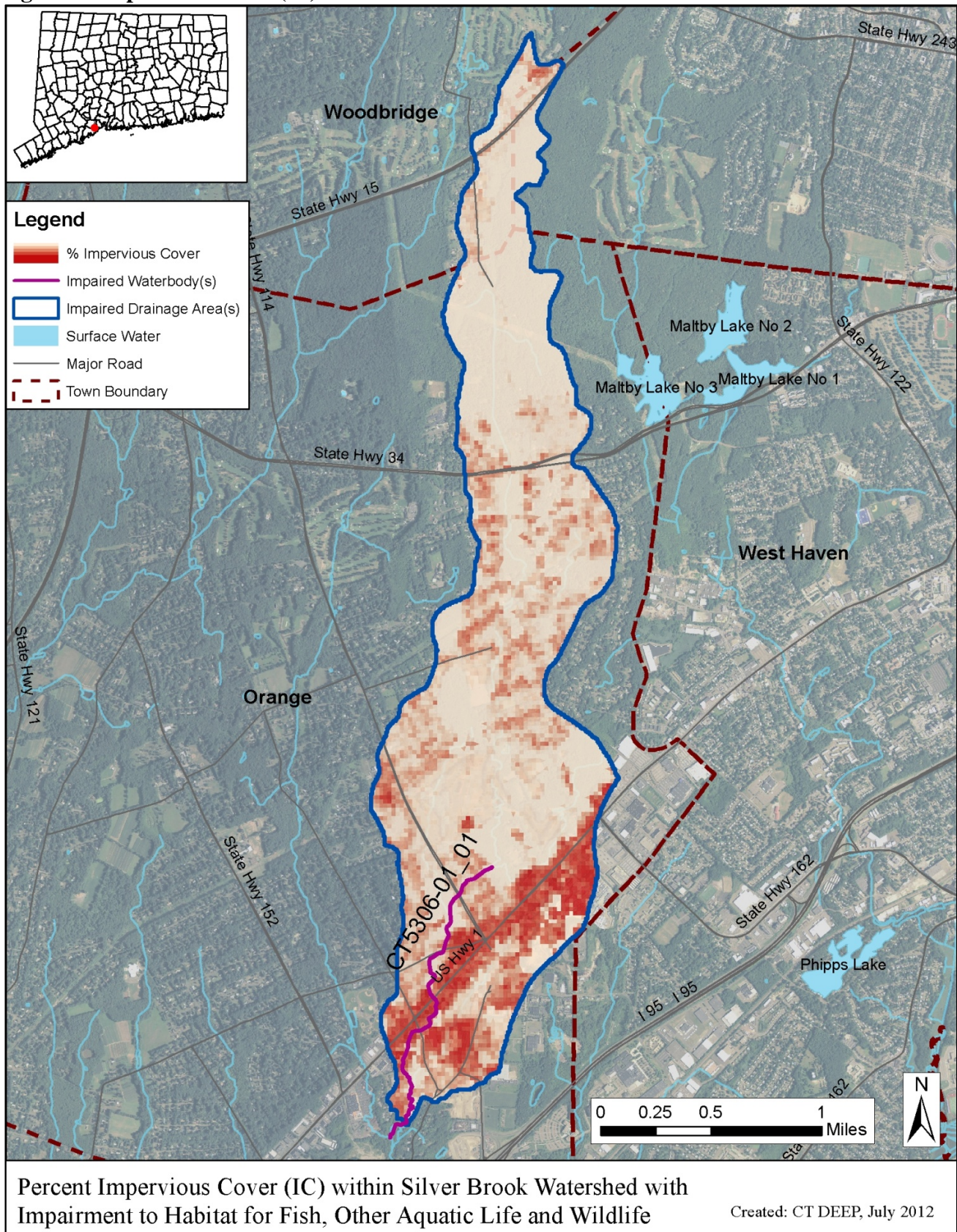
Table 3: Current impervious cover and the percent reduction to achieve the Plan target for each impaired segment in the Indian River Sub-Regional Basin

Impaired Segment	Current Watershed Impervious Cover	%IC Target ¹	Margin of Safety (MOS)	Percent IC Reduction to Meet Plan Target
Silver Brook (CT5306-01_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

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 Silver Brook Watershed



the effect of IC through stormwater management are discussed below as appropriate implementation practices for permitted and non-permitted stormwater discharges.

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 Indian River sub-regional basin 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)	0
GSI	Stormwater Associated with Industrial Activity (Industrial GP)	2
GSM	Part B Municipal Stormwater MS4 (MS4 GP)	3
GSN	Stormwater Registration – Construction (Construction GP)	0

Municipalities have been working hard to meet the challenges of stormwater management. The City of New Haven and the Towns of Woodbridge and Orange have developed and implemented programs to protect water quality. As indicated previously, all of New Haven, Woodbridge, and Orange 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 is also required to 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 Haven (Permit GSM000030) (from the 2010 Stormwater Management Plan Annual Report)

- Continued stenciling storm drains.
- Completed mapping all stormwater outfalls in the city.
- Continued catch basin cleaning, 4,500 cleaned in 2010.
- Continued routine street sweeping throughout the city at least every month between April and late November.
- Investigated the formation of a Storm Water Authority.
- Continued sampling of six stormwater outfalls.

Town of Orange (Permit GSM000034) (from the 2011 Stormwater Management Plan Annual Report)

- Mapped outfalls greater than 12 inches in diameter.
- All 170 outfalls were inspected by highway personnel of the Public Works Department.

Town of Woodbridge (Permit GSM000043) (from the 2009 Stormwater Management Plan Annual Report)

- Continues to run videos on the public access television station on Southern Connecticut Cablevision that addresses impacts on stormwater
- Created a Stormwater Committee.
- Continues to maintain an updated map of town-owned stormwater structures and outfalls.
- Mapped all outfalls, 15 inch and larger throughout the municipality.
- Mapped all outfalls, 12 inch and larger within the urban area.
- Updated town ordinances and policies to prohibit illicit discharges and the connection of non-stormwater flows as defined by the Permit to the town drainage system without a clean water discharge permit.
- Adopted an illicit discharge and connection stormwater ordinance.
- Completed dry weather testing of outfalls once during the 5-year plan.
- Conducted an inventory of town facilities to ensure that no products used for any facility were stored in direct contact to stormwater.
- Swept all town roads and municipal parking lots several times a year during winter operations and due to storm activity as needed.
- Public Works Department has continued to use a salt-mix product and less sand product.
- Continued annual cleaning and maintenance of approximately 1600 catch basins and structures.

- The Town Plan and Zoning Commission is continuing its work on updating the Town Zoning Regulations and will be updating as necessary the regulations as they pertain to stormwater management.
- Continued to review plans for all construction activities involving land disturbance greater than one-half acre.
- Continued to sample six outfalls in accordance with the Permit.

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.

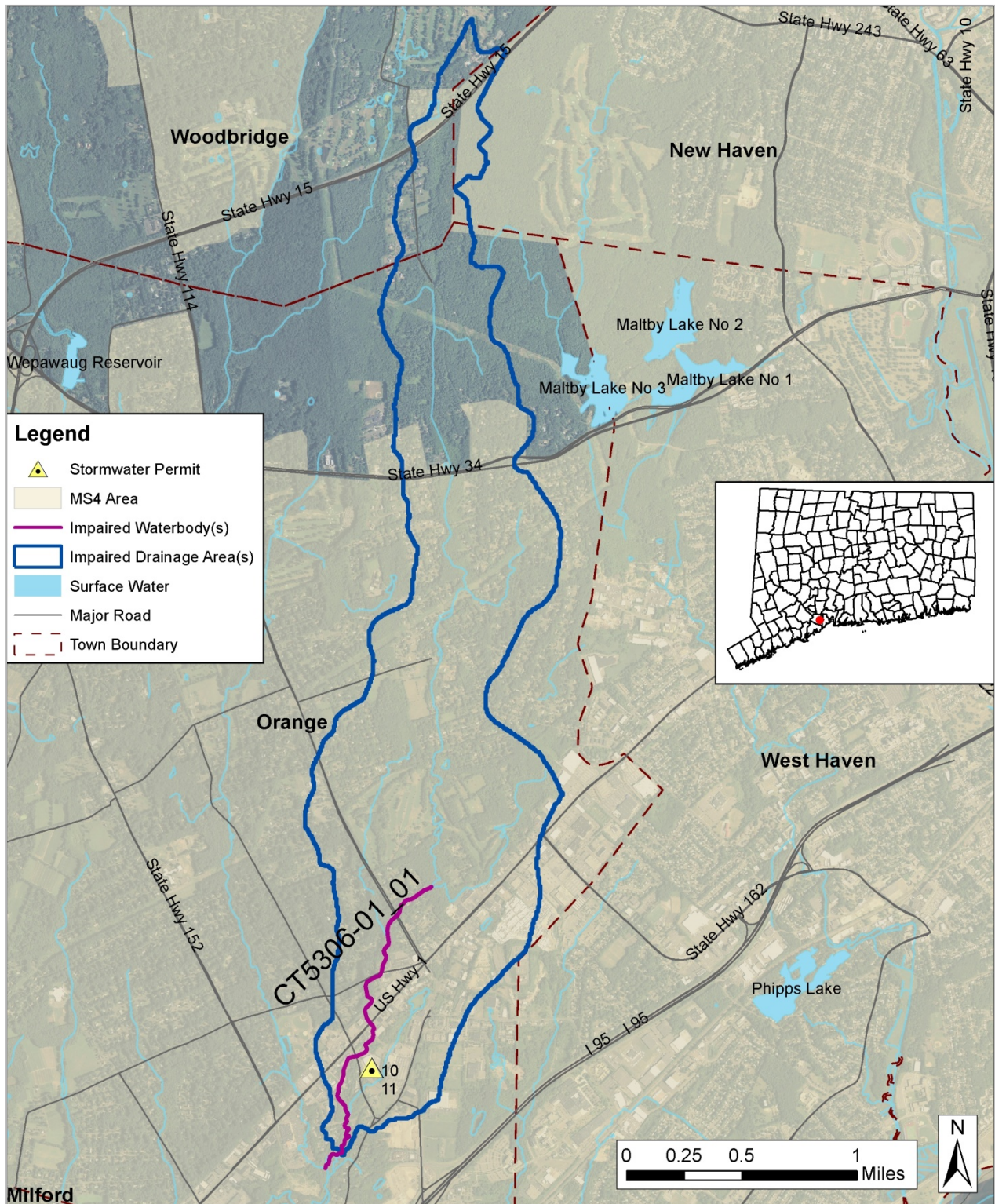
Non-Regulated Discharges

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 Silver Brook Watershed

Municipality	Permit ID	Permittee	Permit Type	Latitude	Longitude	# in Figure 5
Orange	GSI001978	Kx Industries, L.P.	Industrial GP	41.261	-73.005	10
Orange	GSI002019	Kx Technologies LLC	Industrial GP	41.261	-73.005	11
Orange	GSM000036	Town of Orange	MS4 GP	--	--	--
New Haven	GSM000030	City of New Haven	MS4 GP	--	--	--
Woodbridge	GSM000043	Town of Woodbridge	MS4 GP	--	--	--

Figure 5: Permitted Stormwater Facilities in the Silver Brook Watershed including MS4s (numbers correspond with permits in Table 5)



Permit(s) within Silver Brook Watershed with Impairment to Habitat for Fish, Other Aquatic Life and Wildlife

Created: CT DEEP, July 2012

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 Indian River Sub-Regional Basin through the implementation of BMPs to control stormwater runoff.

As noted previously, 37% of the Indian River sub-regional basin is considered developed and the municipalities within the watershed are MS4 communities regulated by the MS4 program. The amount of IC for the impaired segment in the basin is 20% (Silver Brook).

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 Silver Brook and its tributaries by evaluating local stormwater control ordinances.

As the amount of IC in the Silver 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.

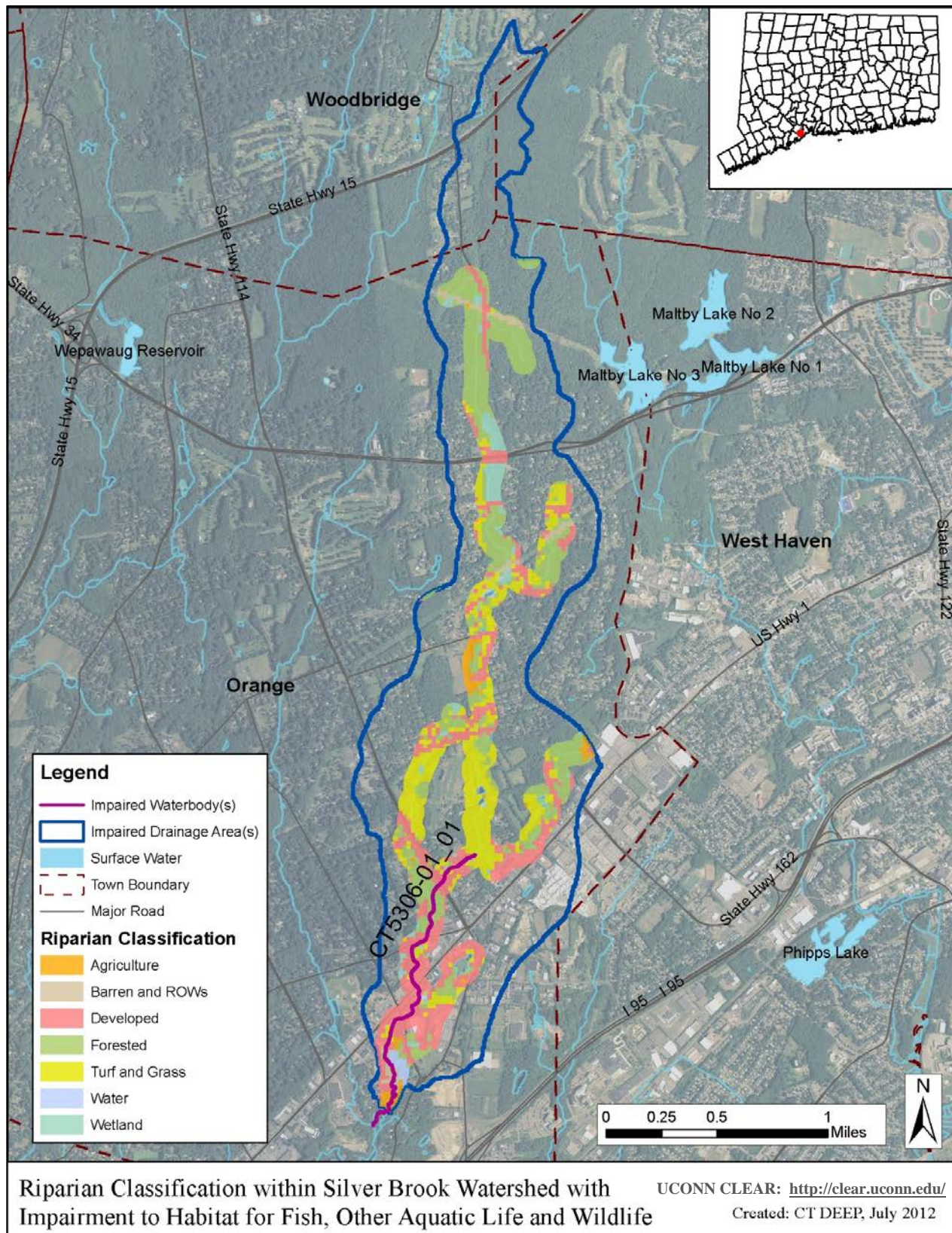
3) Protect existing buffers along the riparian corridor and other conservation lands throughout the watershed.

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 the impaired segment of the Indian River sub-regional basin from the effect of IC, and offer these streams added protection 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 segment in the Indian River sub-regional basin are characterized by a mix of land uses including developed, forested, and turf and grasses (Figure 6). The riparian zone for the impaired segment of Silver Brook is more developed than the upstream reaches of the brook which are primarily forested. 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 Silver Brook Watershed



Riparian Classification within Silver Brook Watershed with Impairment to Habitat for Fish, Other Aquatic Life and Wildlife

4) Continue to encourage citizen involvement to ensure the long-term protection of Silver 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 Silver 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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