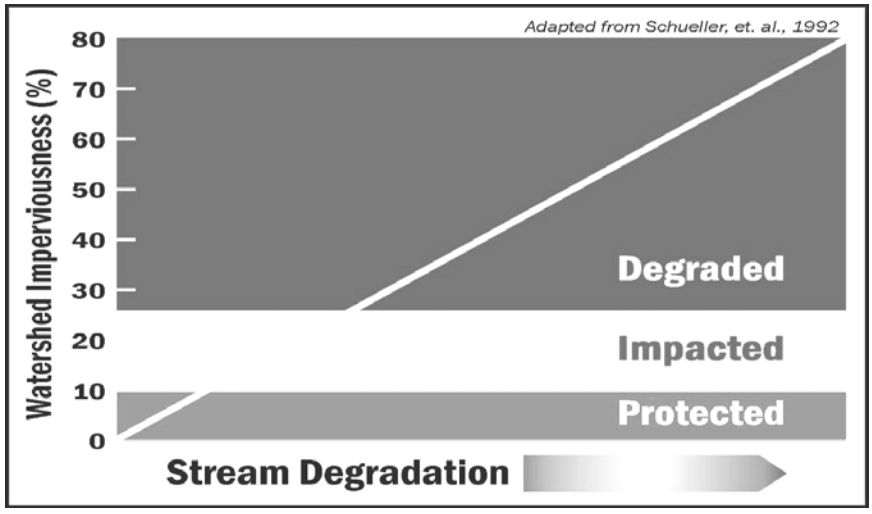
4.5 Watershed Land Use and their Threats to Water Quality

Civco and others (2002) have described land use as, "the common denominator underlying many of the issues that our communities face from nonpoint source water pollution and open space preservation to sustainable economic development and community character". Changes in land use are the result of community decision-making with regard to all of these community objectives. Development converts vegetated land to mostly impervious surfaces. When the pattern of development emanates from urban areas to suburban and rural areas, we call this pattern 'urban sprawl'. Therefore, as settlement expands into rural areas, building and road density increases in these areas increasing the area of impervious surfaces.

The area of impervious surfaces in a watershed is essential to understanding nonpoint source pollution potential and consequent management requirements (Schueler, 1994; Sleavin *et al.*, 2000). Impervious surfaces include any surface that water cannot infiltrate, such as parking lots, paved roads, sidewalks, buildings, rooftops, and highly compacted earth. Impervious surfaces not only increase the total volume of runoff, but also transmit pollutants readily and can even contribute to thermal pollution. Therefore, much of the impervious surface we recognize in our community is associated with transportation or buildings. Schueler (1994) noted that the transportation system typically contributes the most to total impervious area in a watershed.

Impervious surfaces lead to four major impacts to a watershed. In no particular order, these are *altering the natural flow of water*, *aquatic habitat loss*, *decreasing water quality*, and *loss of biological diversity.* As a watershed's imperviousness increases, the quality of its streams decreases. Early and recent work by the Center for Watershed Protection (CWP) in the Chesapeake Bay Watershed established a close relationship between a watershed's imperviousness and the state of water and habitat quality degradation in streams (CWP, 2003). Figure 4.5-1 illustrates this relationship and reflects the degree of stream degradation as *degraded, impacted,* and *protected.*

Figure 4.5-1. The Relationship between Watershed Imperviousness and Stream Degradation

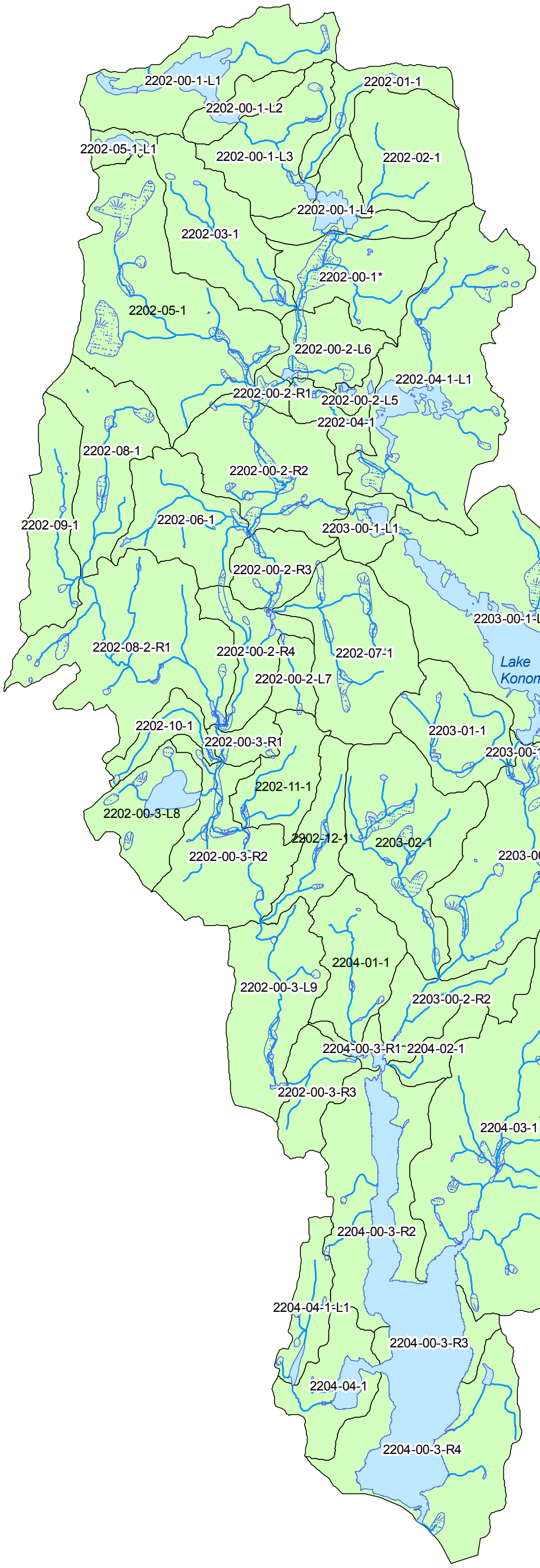


(adapted from UCONN NEMO, 2006 and Schueler, 2002)

4.5.1 Impervious Surface Build Out Analysis

UCONN CLEAR Geospatial Technology Program executed an analysis of possible future land use conditions to estimate the increase in impervious surfaces that could occur within the Niantic River Watershed under full buildout conditions. A buildout is an estimate of how much development can occur on buildable land based on current zoning densities. For this analysis, UCONN used current state and municipal land use and zoning data to approximate what future development might look like in the watershed. The analysis was done at the CTDEP basin level [12], which includes all levels of natural drainage basins. The basin delineations and their CTDEP assigned Basin Numbers are shown in Figure 4.5-2. To review the methodology and supporting material, refer to Appendix D.

[12] http://dep.state.ct.us/gis/dataguides/dep/layers/basin.htm


0
4,000
8,000
Scale In Feet
2202-00-1-L1
2202-01-1
2202-00-1-L2
2202-05-1-L1
2202-00-1-L3
2202-02-1
2202-00-1-L4
2202-03-1
2202-00-1*
2202-05-1
2202-00-2-L6
2202-04-1-L1
2202-00-2-R1
2202-00-2-L5
2202-04-1
2202-08-1
2202-00-2-R2
2202-09-1
2202-06-1
2203-00-1-L1
2202-00-2-R3
2203-00-1-L2
2202-08-2-R1
2202-00-2-R4
2202-07-1
Lake
Konomoc
2202-00-2-L7
2202-10-1
2203-01-1
2202-00-3-R1
2203-00-1
2202-11-1
2202-00-3-L8
2202-12-1
2203-02-1
2202-00-3-R2
2203-00-2-R1
2204-01-1
2202-00-3-L9
2203-00-2-R2
2204-00-3-R1
2204-02-1
2202-00-3-R3
2204-03-1
2204-00-3-R2
2204-04-1-L1
2204-00-3-R3
2204-04-1
2204-00-3-R4
clear
Niantic
River
Watershed
Plan
Scale: AS SHOWN
Project No: 1314-001
Filename: Basin Numbers.mxd
Drawn By: SEK
Date Drawn: 09-07-2006
DEPT OF ENVIRONMENTAL PROTECTION
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NIANTIC RIVER WATERSHED MANAGEMENT PLAN
CTDEP BASIN DELINEATIONS AND BASIN NUMBERS
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4.5-2

Impervious surface percents were calculated for current conditions and were estimated under full-buildout conditions. These are summarized in Table 4.5-1. The results are color-coded to correspond with NEMO watershed classifications. Basins at less than 10% impervious are shaded green, between 10 and 25% impervious are shaded yellow and above 25% impervious are shaded red. Maps of estimated current and future percent impervious surface area for basins follow the table (Figures 4.5-3 and 4.5-4, respectively).

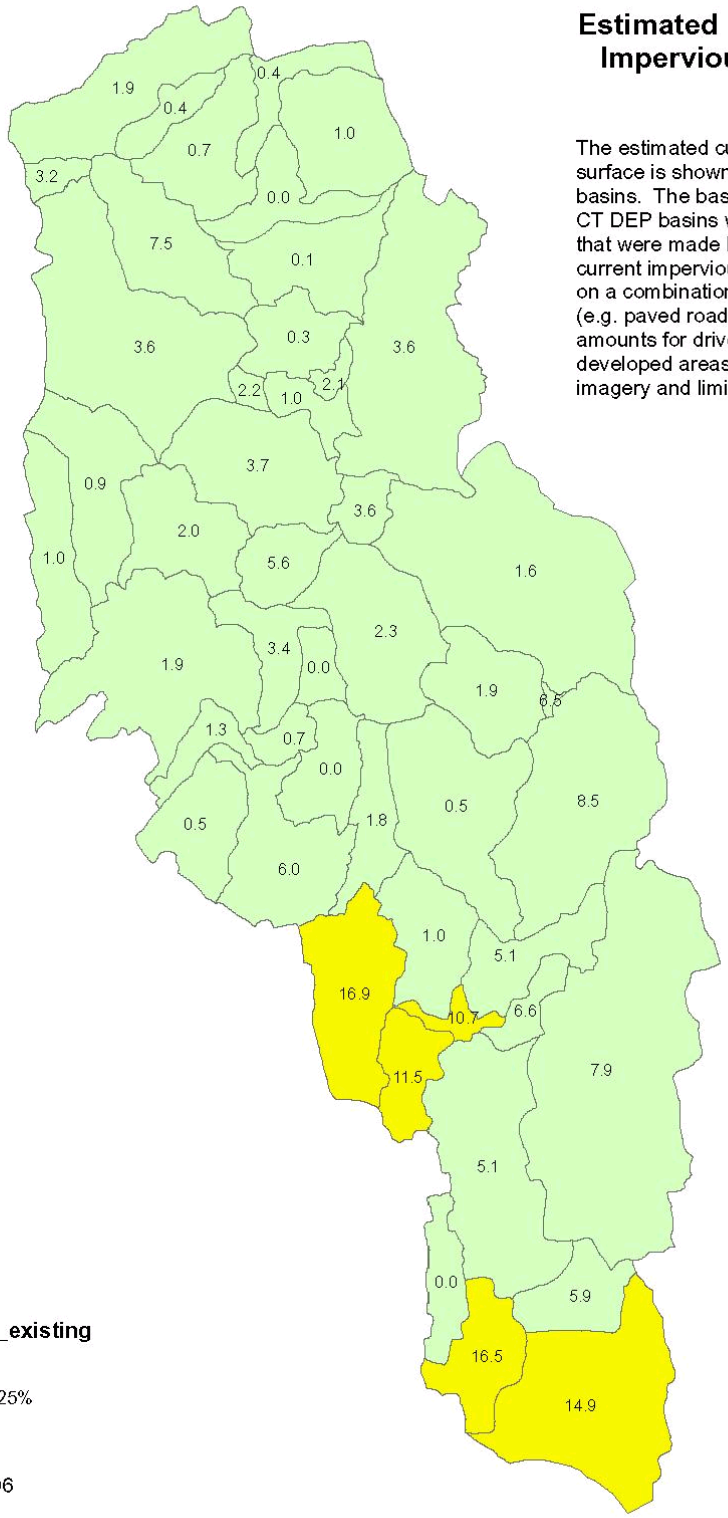
Table 4.5-1. Results of Impervious Surface Estimates based on Build-out Analysis of the Niantic River Watershed

BASIN_NO	Current IS%	IS% at Buildout
2202-00-1-L1	1.9	3.6
2202-01-1	0.4	3.9
2202-00-1-L3	0.7	3.5
2202-02-1	1.0	4.0
2202-00-1-L2	0.4	3.8
2202-00-1-L4	0.0	2.2
2202-03-1	7.5	9.5
2202-05-1-L1	3.2	3.6
2202-04-1-L1	3.6	4.4
2202-05-1	3.6	7.0
2202-00-1*	0.1	1.4
2202-00-2-L6	0.3	1.6
2202-00-2-L5	2.1	2.8
2202-00-2-R1	2.2	2.9
2202-04-1	1.0	1.3
2202-08-1	0.9	3.2
2202-00-2-R2	3.7	9.2
2202-09-1	1.0	2.7
2202-06-1	2.0	4.5
2203-00-1-L1	3.6	18.1
2203-00-1-L2	1.6	2.8
2202-00-2-R3	5.6	10.7
2202-07-1	2.3	10.0
2202-08-2-R1	1.9	3.6
2202-00-2-R4	3.4	5.6
2203-01-1	1.9	2.6
2202-00-2-L7	0.0	5.7
2203-00-2-R1	8.5	11.3
2203-00-1	6.5	6.5
2202-10-1	1.3	4.1
2202-11-1	0.0	4.2
2202-00-3-R1	0.7	3.5
2203-02-1	0.5	1.8
2202-12-1	1.8	4.5

BASIN_NO	Current IS%	IS% at Buildout
2202-00-3-R2	6.0	11.9
2202-00-3-L8	0.5	23.5
2204-03-1	7.9	21.1
2204-01-1	1.0	6.6
2202-00-3-L9	16.9	20.0
2203-00-2-R2	5.1	10.7
2204-02-1	6.6	32.8
2204-00-3-R1	10.7	16.5
2202-00-3-R3	11.5	20.7
2204-00-3-R2	5.1	6.7
2204-04-1-L1	0.0	0.1
2204-00-3-R3	5.9	6.0
2204-00-3-R4	14.9	23.2
2204-04-1	16.5	21.0

Estimated Current Percent Impervious Surface per Basin

The estimated current percent impervious surface is shown within color-coded basins. The basins are the standard CT DEP basins with some minor modifications that were made by project staff. Estimated current impervious surface percents are based on a combination of actual measured areas (e.g. paved roads) and estimates of impervious amounts for driveways, industrial/commercial developed areas, etc. based on 2004 aerial imagery and limited planimetric data.



Legend

Basins

Percent_IS_existing

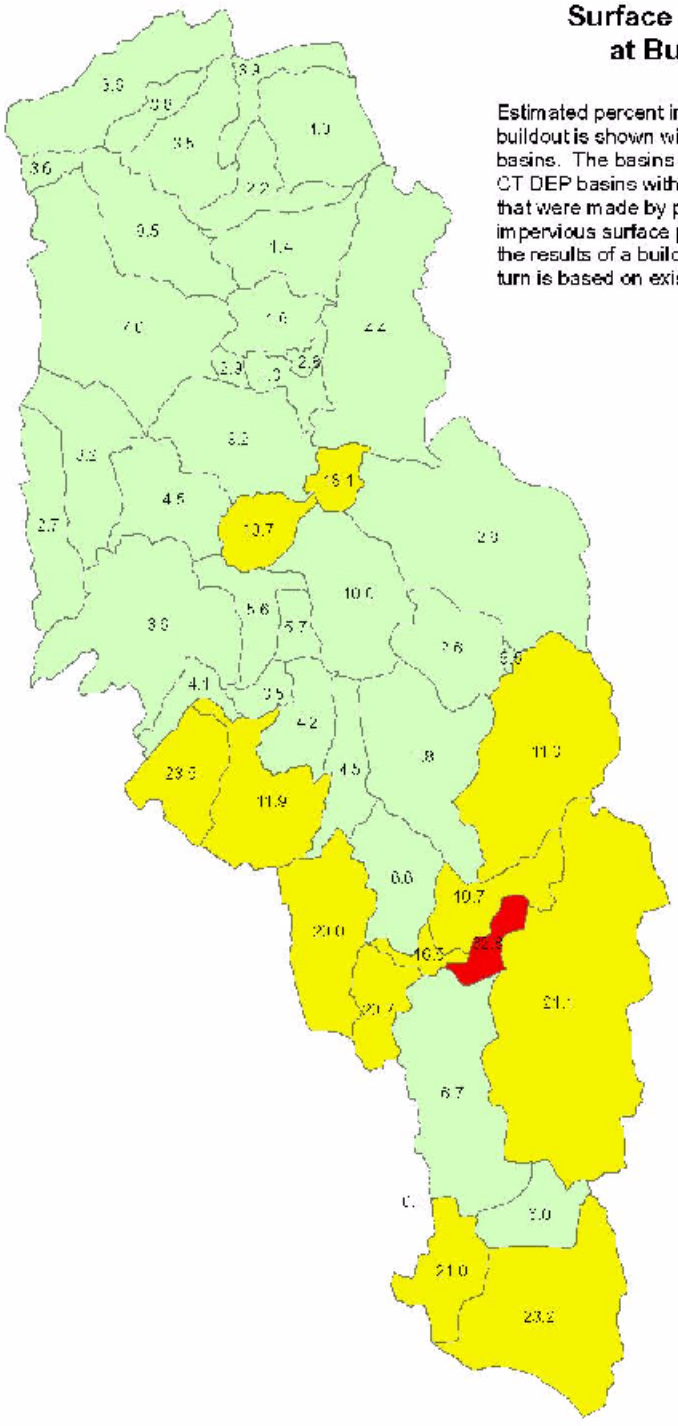
- < 10%
- 10% - 25%
- > 25%

July 14, 2006

Scale: AS SHOWN	DEPT OF ENVIRONMENTAL PROTECTION HARTFORD, CONNECTICUT	
Project No: 1314-001	NIANTIC RIVER WATERSHED MANAGEMENT PLAN	
Filename: Estimated_imp_area.mxd	ESTIMATED CURRENT PERCENT IMPERVIOUS AREA	
Drawn By: SEK	Kleinschmidt Energy & Water Resource Consultants 35 Pratt Street, Suite 201 Essex, Connecticut 06426 Telephone: (860) 767-5069 Fax: (860) 767-5097 www.KleinschmidtUSA.com	4.5-3
Date Drawn: 09-07-2006		

Estimated Percent Impervious Surface per Basin at Buildout

Estimated percent impervious surface at buildout is shown within color-coded basins. The basins are the standard CT DEP basins with some minor modifications that were made by project staff. Estimated impervious surface percents are based on the results of a buildout analysis which in turn is based on existing zoning.



Legend

Basins

Percent_IS_BO

- < 10%
- 10% - 25%
- > 25%.

July 14, 2006

Scale: AS SHOWN	DEPT OF ENVIRONMENTAL PROTECTION HARTFORD, CONNECTICUT	
Project No: 1314-001	NIANTIC RIVER WATERSHED MANAGEMENT PLAN	
Filename: Estimated_imp_area_at_buildout.mxd	ESTIMATED PERCENT IMPERVIOUS AREA PER BASIN AT BUILDOUT	
Drawn By: SEK	Kleinschmidt Energy & Water Resource Consultants 35 Pratt Street, Suite 201 Essex, Connecticut 06426 Telephone: (860) 767-5069 Fax: (860) 767-5097 www.KleinschmidtUSA.com	4.5-4
Date Drawn: 09-07-2006		

Niantic River Watershed Plan

clear

The results of this analysis must be viewed as one of many possible impervious surface buildouts that could occur with the Niantic River Watershed. By their nature, buildout analyses are best estimates of future conditions based on current land use plans, current subdivision and building practices and various assumptions. Buildout is not an exact science and there is no one correct "answer". Therefore, these results should be interpreted as possible, but not necessarily likely. For example, towns can increase and/or decrease permitted densities in residential zones and can change zone designations. Road frontage requirements could be relaxed or the number of interior lots served by a common driveway could be increased or decreased.

The analysis indicates that at buildout, impervious surface increases would cause eight basins to change from less than 10% impervious to greater than 10% impervious and one basin would change from less than 10% impervious to greater than 25% impervious. In the remaining basins, impervious area would increase but would likely stay below 10%. Basins where impervious surface increases are significant or where basins transition from under 10% to greater than 10% impervious surface area might be good candidates for mitigation plans to reduce future impervious surface increases.

4.5.2 Watershed Vulnerability Assessment

A "tabletop" assessment of the watershed was completed to determine the areas of the watershed that demand the most priority for management. A GIS-based model considered various watershed characteristics (e.g., soil, land cover, depth to water table) to assign priority for conservation, restoration, and stormwater management. Areas ideal for protection against future water quality degradation scored high for the Conservation Priority Index (CPI), which generally highlights areas such as riparian corridors and forests. Areas prone to erosion or increased agricultural impacts score high for the Restoration Priority

Index (RPI). Urbanized areas, including transportation corridors, are typically included in the Stormwater Management Priority Index (SMPI).

This GIS-based assessment model was developed by Kleinschmidt using a guidance document produced by the University of Massachusetts and the U.S. Forest Service Watershed Exchange and Technology Partnership (de la Crétaz *et al.*, 2003). In the vulnerability assessment model, various attributes of data inputs, which are described in Appendix E, are assigned priority ranking for each of the three priority indices with high rankings being important for further study and possible mitigative actions, while the lower rankings play a less significant role in the corresponding index.

4.5.2.1 Vulnerability Assessment Results

The results of the model are presented as a map of the watershed (Figure 4.5-5) to display the three priority indices. The three indices (CPI, RPI, SMPI) can be shown on the same map because there are no overlapping values (scores) between them. Each index relies on a unique set of land cover types thereby allowing this discrete analysis. Figure 4.5-5 displays the 80th percentile rankings for each priority index. This percentile was calculated by determining the cumulative distribution frequency for each of the indices and modifying the display to show only those rankings that contained the 80th percentile and higher. By selecting the areas ("cells") with the highest ranking, the map indicates priorities for each of management approach. According to Barten *et al* (2002), the 90th percentile rankings "can be used to focus land conservation, pollution prevention, and pollution mitigation efforts on areas that should generate the greatest return on investment".

0 4,000 8,000
Scale In Feet

Salem
Montville
East Lyme
Waterford

Fairy Lake
Barnes Reservoir
Bogue Brook Reservoir
Lake Konomoc
Darrow Pond
Niantic Bay

New London Rd
Chesterfield Rd
Hartford - New London Tpke
Turner Rd
Butlertown Rd
Boston Post Rd
395
95

CPI 80th → 100th Percentile
RPI 80th → 100th Percentile
SMPI 80th → 100th Percentile

- DEP & Municipal Lands
- Towns
- Roads
- Lakes & Reservoirs
- Swamps & Marshes

Niantic River Watershed Plan

Scale:	AS SHOWN
Project No:	1314-001
Filename:	WVA results.mxd
Drawn By:	SEK
Date Drawn:	09-06-2006

DEPT OF ENVIRONMENTAL PROTECTION
HARTFORD, CONNECTICUT

NIANTIC RIVER WATERSHED MANAGEMENT PLAN

WATERSHED VULNERABILITY ASSESSMENT 80th PERCENTILE

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4.5-5

Table 4.5-2 displays the area summaries of the priority indices by jurisdiction. The areas are displayed both for the entire index range and also for the 80th percentile. For comparison, the acreage of the entire watershed is approximately 20,000 acres, or 31 square miles.

Table 4.5-2. Priority Index Acreages

Municipality	CPI Acreage		RPI Acreage	SMPI Acreage
	All Values	All Currently Protected Areas Removed	All Publicly Owned Currently Protected Areas Removed	All Values	All Values
	All Priority Index Values				
East Lyme	3,725	3,221 [a]	3,591 [d]	337	1,488
Montville	3,187	2,983 [b]	3,187	169	714
Salem	1,999	1,957 [c]	1,957 [e]	26	367
Waterford	4,169	4,169	4,169	167	1,355
Total	**13,080**	**12,330**	**12,904**	**699**	**3,925**
	80th Percentile Priority Index Values				
East Lyme	1,376	885 [a]	1,246 [d]	135	427
Montville	916	723 [b]	916	99	196
Salem	476	449 [c]	449 [e]	10	72
Waterford	819	819	819	54	378
Total	**3,588**	**2,876**	**3,430**	**298**	**1,073**

[a] Nehantic State Forest, The Sheffield Scientific School and the Chesterfield Road and Irvingdell Place Town Open Spaces Removed

[b] Morgan R. Chaney Sanctuary Removed

[c] Nehantic State Forest Removed

[d] The Sheffield Scientific School Removed

[e] Nehantic State Forest Removed

East Lyme

The town of East Lyme shows that the greatest concentration of conservation priority areas near the shorelines of Darrow and Clark Ponds (Figure 4.5-6). Additional areas for conservation surround wetlands and would form riparian buffers along Latimer and Cranberry Meadow Brooks and the tributaries to the larger water bodies. The following areas appear as CPI areas that may already have municipal or state protection measures enacted by the nature of their ownership:

- Chesterfield Road Town Open Space
- Irvingdell Place
- Nehantic State Forest
- Ponderosa Park
- The forested areas of Camp Pattagansett
- The Sheffield Scientific School (Yale University) Open Space

Camp Pattagansett, Ponderosa Park and the Sheffield Scientific School are privately owned, but listed as either existing preserved open space or recreation. Additional protection would likely only be achieved by purchasing these properties by state or municipal organizations. The Cavasin Dr. Town Open Space did not trigger a conservation priority ranking recommendation, which due to the it being located primarily in a residential area as classified in the 2004 land cover data set developed by UCONN (Appendix D.1). Refer to Appendix E for the details on land cover classifications included in each of the priority indices.

While the greater benefit for restoration probably lie in the larger areas, the plan acknowledges there are several small RPI areas that exist in East Lyme. The three primary RPI areas in East Lyme are croplands and other agricultural lands on Quailcrest, Chesterfield and Grassy Hill Roads. Each of these areas display priority ranking ranges from the 80^{th} to the 99.7^{th} or 99.9^{th} percentile.

0 3,000 6,000
Scale In Feet

Bogue Brook Reservoir
Chesterfield Rd
Powerline ROW
Cranberry Meadow Brook
Grassy Hill Rd
Hartford - New London Tpke
Turner Rd
Lake Konomoc
Walnut Hill Rd
Chesterfield Rd
Butlertown Rd
Niantic State Forest
Ponderosa Park
Sheffield Scientific School
Darrow Pond
East Lyme
Quailcrest Rd
Mayfield Rd
Chesterfield Rd. Town Open Space
Waterford
Camp Pattagansett
Latimer Brook
Irvingdell Place
Cavasin Dr. Town Open Space
395
95
Boston Post Rd
Clark Pond
Niantic Bay

CPI: 80th Percentile – 100th
RPI: 80th Percentile – 100th
SMPI: 80th Percentile – 100th

DEP & Municipal Lands
Towns
Roads
Lakes & Reservoirs
Swamps & Marshes

Niantic River Watershed Plan

Scale:	AS SHOWN
Project No:	1314-001
Filename:	VAMR- East Lyme.mxd
Drawn By:	SEK
Date Drawn:	09-07-2006

DEPT OF ENVIRONMENTAL PROTECTION
HARTFORD, CONNECTICUT

NIANTIC RIVER WATERSHED MANAGEMENT PLAN

WATERSHED VULNERABILITY ASSESSMENT- EAST LYME

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4.5-6

The power line right of way running in an east-west direction through East Lyme and Montville is the probably the most conspicuous SMPI target area. This area, which is most likely vegetated, is of concern because of the use of herbicides and frequent mowing. Each of the towns exhibit small pockets of SMPI areas throughout the towns. Though these show evidence of characteristics that would potentially degrade water quality, efforts should be focused on the larger tracts, or clusters, of SMPI areas for the greatest advantage in protecting water quality. In East Lyme along Chesterfield Road from the town boundary to approximately Mayfield Road exists the largest concentration of SMPI area. This locale has priority rankings ranging up to the 99.98th percentile. Other notable areas are a residential development along Walnut Hill Road, the area adjacent to Interstates 95 and 395 and the residential and commercial areas on the western shore of Niantic Bay.

Montville

The majority of the CPI areas are adjacent to water bodies and wetland in Montville (Figure 4.5-7). The larger water bodies include the Bogue Brook Reservoir and the northern end of Lake Konomoc. The Morgan R. Chaney Sanctuary is an approximately 200-acre sanctuary owned by the Connecticut Audubon Society, is designated as a Conservation Priority Index target area. Though this is privately owned it is unlikely that it would be sold and developed, therefore efforts in Montville should be focused on protecting riparian areas for future conservation.

Three RPI areas are prominent in Montville: harvested cropland on Day Road and Grassy Hill Road and pastureland off Beckwith Road. All areas have priority rankings ranging from the 80th to the 99.9th, 99.7th and 100th percentile for the Day Road cropland, Grassy Hill Road cropland and the pastureland, respectively.

0 2,000 4,000
Scale In Feet

Montville

Fairy Lake
New London Rd
Barnes Reservoir
Day Rd
Beckwith Rd
Powerline ROW
Chesterfield Rd
Bogue Brook Reservoir
Cranberry
Grassy Hill Rd
Hartford - New London Tpke
Turner Rd
Morgan R. Chaney Sanctuary
Great Swamp
Lake Konomoc
Butlertown Rd

CPI
RPI
SMPI
80th
Percentile
100th
DEP & Municipal Lands
Towns
Roads
Lakes & Reservoirs
Swamps & Marshes

Niantic River Watershed Plan

Scale: AS SHOWN	DEPT OF ENVIRONMENTAL PROTECTION HARTFORD, CONNECTICUT
Project No: 1314-001	NIANTIC RIVER WATERSHED MANAGEMENT PLAN
Filename: VAMR-Montville.mxd	WATERSHED VULNERABILITY ASSESSMENT- MONTVILLE
Drawn By: SEK	
Date Drawn: 09-07-2006	4.5-7

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The power line right of way running in an east-west direction through East Lyme and Montville is the main concern within the SMPI target areas. As with Montville, the major concern for water quality is from the use of herbicides and frequent mowing. Two other noticeable areas, aside from the small pockets of SMPI areas, are the commercial areas along Route 85 (Hartford-New London Turnpike) and the low-medium residential development along Grassy Hill Road. The priority rankings for each of these areas include percentiles ranging from 80 to 100. A barren plot adjacent to Lake Konomoc and Great Swamp exhibits concern with its proximity to the Morgan R. Chaney Sanctuary, which includes Great Swamp and Lake Konomoc. The priority rankings range from the 80th to the 99th percentile in this 5.5 acre plot.

Salem

The town of Salem shows that the greatest concentration of conservation priority areas are located near the shorelines of Fairy Lake, Horse Pond and Barnes Reservoir (Figure 4.5-8). Additional areas for conservation surround wetlands and would form a riparian buffer along the tributaries to the larger water bodies. The Nehantic State Forest is designated as a CPI target area, but could be excluded from any further action because of the fact that it is a State Forest.

Salem shows a small target area of RPI along New London Road near Skyline Drive. This area is classified as a horse farm operation in the 2004 land cover classifications. Of greater concern in Salem, is an RPI area along Beckwith Road that is designated as Harvested Cropland in the land cover. The priority ranking for this area received "scores" ranging up to the 99th percentile. The proximity of this target area to wetlands should elevate the concern with this area as it reached the 99th percentile in this study.

Salem

0 1,500 3,000
Scale In Feet

Fairy Lake

Niantic State Forest

Horse Pond

Barnes Reservoir

New London Rd

Skyline Dr

Corrina Ln

Beckwith Rd

Day Rd

Powerline ROW

Chesterfield Rd

Bogue Brook Reservoir

Grassy Hill Rd

CPI 80th → 100th Percentile

RPI 80th → 100th Percentile

SMPI 80th → 100th Percentile

DEP & Municipal Lands

Towns

Roads

Lakes & Reservoirs

Swamps & Marshes

Niantic River Watershed Plan

Scale:	AS SHOWN
Project No:	1314-001
Filename:	VAMR-Salem.mxd
Drawn By:	SEK
Date Drawn:	09-07-2006

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HARTFORD, CONNECTICUT

NIANTIC RIVER WATERSHED MANAGEMENT PLAN

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4.5-8

The SMPI target areas in Salem are all a result of the commercial, residential and transportation development in the watershed. Very small tracts are shown scattered throughout the town along roadways and in residential areas. The two focal points of SMPI in Salem are a commercially developed area along Route 85 (New London Road) and in a residential development at the end of Corrina Lane, adjacent to a wetted area. Both of these priority areas have scores ranging from the 80th percentile up to the 99.6th percentile.

Waterford

The CPI areas that have the potential for conservation surround wetlands, the southern shoreline of Lake Konomoc and would form riparian buffers along the smaller tributaries (Figure 4.5-9). The West Farms Land Trust appears as a CPI area that may already have protection measures enacted by the nature of its ownership/organization, though it is privately owned. Kiddie Beach, which is a municipally owned area does not appear as CPI because it is located in a residential area. Again, refer to Appendix E for the details on land cover classifications included in each of the priority indices.

A few very small areas are included in the RPI in Waterford. There are only two relatively sizable RPI areas. One is a harvested cropland near the town boundary and adjacent to Interstate 95 with a priority ranking ranging from the 80th to the 99.7th percentile. The other larger area is a pastureland north of the Hartford Turnpike at the headwaters of a small tributary to Oil Mill Brook with a priority ranking ranging from the 80th to the 96.6th percentile.

The SMPI areas in Waterford are concentrated along commercial and residential areas along the Hartford Turnpike, Interstate 95 and the western shore of Niantic Bay. Unlike the other towns, the SMPI has very

0 2,500 5,000
Scale In Feet

Chesterfield Rd
Butlertown Rd
Hartford Tpke
Lake Konomoc
Brook
Mill
Oil
Qualicrest Rd
395
95
West Farms Land Trust
Kiddie Beach
Boston Post Rd
Waterford
Niantic Bay

CPI
RPI
SMPI
80th
Percentile
100th
DEP & Municipal Lands
Towns
Roads
Lakes & Reservoirs
Swamps & Marshes

Niantic River Watershed Plan

Scale: AS SHOWN	DEPT OF ENVIRONMENTAL PROTECTION HARTFORD, CONNECTICUT
Project No: 1314-001	NIANTIC RIVER WATERSHED MANAGEMENT PLAN
Filename: VAMR-Waterford.mxd	WATERSHED VULNERABILITY ASSESSMENT- WATERFORD
Drawn By: SEK	
Date Drawn: 09-07-2006	4.5-9

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few smaller pockets of priority areas. The commercial area along the Hartford Turnpike is the largest area of SMPI with priority ranking ranges from the 80th percentile up to the 99.98th percentile. The residential development adjacent to Niantic Bay is classified as being medium to high density with priority rankings reaching up to the 99.8th percentile.

4.5.2.2 Discussion

In Figure 4.5-5, the Conservation Priority Index shows lands along waterways and among the CTDEP and municipal lands, which would be beneficial to put into conservation, if they are not already, to help protect water quality by acting as buffers from those land uses that threaten water quality. The Restoration Priority Index identifies lands in agricultural areas where application of BMPs or other management activities, such as restoration of ecological functions, may help to improve or protect against further degradation of water quality. The Stormwater Management Priority Index distinguishes lands where improved stormwater management activities may protect water quality (de la Crétaz *et al.*, 2003).

Priority areas represented on the assessment map require added consideration by land use decision-makers *(i.e.* planning and zoning officials, developers, and resource managers). Parcels that correspond to the priority area should raise extra concern when development or other land use changes are proposed. These results are not intended to impose new regulation or *de facto* prohibitions on proposed land uses, rather they highlight the need for careful site plan review and field verification with regard to valuable watershed land characteristics. Riparian corridors provide an illustrative example of this point; streamside vegetated zones are of the highest conservation priority in this watershed.

For restoration or stormwater management priorities, the assessment results may trigger a site investigation of soils to account for soil types and their characteristics along with slope gradient that will determine the most appropriate management option. For example, the USDA NRCS maintains an online soil survey generated from the National Cooperative Soil Survey (NCSS). This tool allows landowners and land use decision-makers to learn about the soils associated with a given property, including the soil's suitability for various uses. This information is paramount to make sensible location decisions for development and stormwater management practices. The web survey may be accessed at: http://websoilsurvey.nrcs.usda.gov/app/. Site specific soil surveys always provide a better estimate of appropriate BMP decisions, but the NRCS may be used for the purposes of general planning.

The Connecticut State Office of NRCS performed an analysis of soil suitability and common stormwater management practices in Connecticut (USDA NRCS, 2005)[13]. By looking at soil suitability based on several characteristics NRCS was able to determine the benefits and limitations of using selected stormwater management practices. In the case of the Niantic River, this information will be very useful in selecting stormwater management measures.

4.5.3 Stormwater Management Modeling Results

"Estimate current and future watershed nonpoint source pollution conditions and source loadings bases on projected land use changes"

The overall goal of assembling an analysis of current pollutant loading estimates, versus futures loading estimates, is to determine the potential risk of pollutant loadings in addition to localized hot-spots where more focus may be required. Assessing these risks on a watershed scale are difficult with such a

[13] ftp://ftp-fc.sc.egov.usda.gov/CT/water/CT-TP-2005-3.pdf

variety of land covers, land uses, point and nonpoint pollution and even differences between the ages of certain land covers. Additionally, proximity of pollutant sources and the respective course of transport may affect the actual loading to certain waterbodies. In order to complete this assessment, various generalizations and assumptions were made across the watershed using the best available information to equally assess the current and future pollutant loadings.

The purpose of this study is not to calculate the *actual* pollutant loadings from a certain subcatchment, but rather what the potential loading may be during various scenarios to aid in the planning and development process. Calibration of pollutant loadings to observed data were not attempted. This study is intended solely to provide planners with information that may help in making either zoning or water quality/treatment ordinance and decisions.

4.5.3.1 Model Description

Estimating current and future nonpoint source pollution within a watershed is a complicated task and best accomplished with computer software tools. A model was developed to simulate the current and the potential future contributions of pollutants to the watershed.

Various models were assessed for their applicability to the Niantic River Watershed, and the USEPA Stormwater Management Model version 5.008 (SWMM5) was chosen as the most versatile model. The SWMM model allows for easy integration of data import and exports from GIS and simple modifications to model data for various run scenarios. Additionally, the model has a flexible interface for land cover types, pollutant loadings and BMP management.

Pollutant contributions were determined on a subcatchment basis dependent on the type of land cover and soils data. The SWMM model used the Event Mean Concentration (EMC) approach, which assumes a

constant concentration of a pollutant in modeled runoff, regardless of the storm duration. Thus, the amount of pollutant concentration (in kg or lbs) is directly associated to the volume of runoff received from the subcatchment. The amount of runoff is determined from the soil type, percent impervious, and the land cover within the subcatchment; *i.e.* the more impervious a subcatchment, or the less infiltration within the subcatchment because of poor soil conditions, the higher the volume of runoff received and the greater pollutant loading.

4.5.3.2 Modeled Pollutants

The following key pollutants were studied within the SWMM model:

- Total Suspended Solids (TSS)
- Total Kjeldahl Nitrogen (TKN)
- Total Nitrogen as NO_2 & NO_3 (TN)
- Total Phosphorous (TP)
- Biological Oxygen Demand (BOD)

Total Suspended Solids (TSS) is particulate matter that is transmitted within runoff and may be created from either picking up particles as flow passes over the ground, or from erosion within the subcatchment. These sediments usually stay 'suspended' in the flow and do not settle out until the flow slows down, usually within a waterbody. TSS loading can lead to excessive sedimentation, transportation and deposition of excessive nutrients, and clouding of water reducing light penetration. **Total Kjeldahl Nitrogen** (TKN) is the contribution of organic nitrogen and ammonia in runoff. This is usually contributed by sewage or manure discharges to water bodies. **Total Nitrogen as Nitrate** (NO_3) **and Nitrite** (NO_2) (TN) is usually contributed to waterbodies from the over application of fertilizers, atmospheric deposition, or runoff from excessive agricultural farming practices. Excessive TN can lead to algal

blooms within waterbodies reducing water quality and dissolved oxygen levels. **Total Phosphorous** (TP) includes both the amount in solution and also in particulate form. It is usually obtained from agricultural drainage, wastewater, and potentially industrial discharges. Phosphorous can contribute to the eutrophication of surface waterbodies. Finally, **Biological Oxygen Demand** (BOD) is the amount of oxygen required by microorganisms to degrade the wastes biologically. Heavy concentrations of BOD can lead to low dissolved oxygen levels and be harmful to aquatic species.

Pollutant loading was analyzed using a comparative process of percent change of a certain pollutant contribution for the same storm event. Viewing it from this perspective allows a 'risk' based assessment of which pollutants possess the highest potential for pollutant loading in a given subcatchment. Should an area be designated as high risk to a certain pollutant, then development within the subcatchment may be assessed to determine if there currently is excessive loading, or with development, if loading may become an issue.

4.5.3.3 Model Scenarios

In order to assess the potential risk from various pollutants, the baseline existing conditions must be established. The existing land covers, soil types and pollutant loadings were modeled within SWMM using a hypothetical storm event.

For the proposed conditions, areas that are currently considered 'developable' had to be determined. Any land areas considered developable were then changed from the existing land cover type to a general composite 'developable' cover. Further discussion of how this was developed may be seen in the methodology section in Appendix F. Summary statistics for each of the subcatchments were calculated within the GIS, which then were used to determine the loading EMC for each

subcatchment. Additionally, a composite curve number for each subcatchment was determined and used in the routing of the storm event.

After the developed conditions were determined assuming maximum buildout of all lands, certain BMPs were applied to the land covers in areas considered developed. For detailed information on how the developable lands were determined refer to Appendix F.3. There may be existing loadings that will remain unchanged even with further development, so the BMPs are only applied to future development. This allows an analysis of the efficiency of general BMP implementation throughout the watershed.

The following results discuss these various analyses and the results with respect to specific pollutants and BMP implementation.

4.5.3.4 Results

Maps outlining the potential pollutant loading have been prepared and can be found in Appendix F.5. There are five figures for each of the targeted pollutants previously described. Different figures outlining the potential pollutant loading have also been prepared. For each of the targeted pollutants there are four figures that follow the format below:

- Existing Conditions
- Proposed Fully Developed Conditions
- Proposed Fully Developed w/ BMP Implementation
- Percent Change Pollutant Loading

This results in a total of sixteen figures (Figures F-1 to F-16). An additional figure (F-17) has been prepared to show the percent of land area that is considered developable by subcatchment. This figure is important to show *how* the watershed could potentially change, and why some

pollutant levels may be increasing while others may decrease. The following pages discuss some of the results which may be seen on the respective figures.

Total Suspended Solids (TSS) - Total suspended solids is usually a contribution of sediment through activities that disturb the ground surface or result in bare earth subject to potential erosion. There are two areas that are specifically highlighted, especially in the existing conditions, that are worth noting.

The first is a large residential construction project just east of Darrow Pond in the Town of East Lyme. For land covers such as a construction project, the area receives a relatively high EMC value for TSS contribution.

Similarly, the Town of Montville has a fairly large quarry and extractive mining facility northwest of Bogue Brook Reservoir. Mining activities by nature have exposed and unstabilized material potentially subject to erosion. These areas, because of their land covers, have the potential for high TSS loading.

Of important note is the fact that an area may have potentially high EMC contributions, but may not actually contribute the whole portion to a receiving waterbody. For example, a quarry is subject to excessive erosion, but is inherently an inwardly draining feature and should retain most of the TSS contribution within stormwater runoff. Similarly, areas that are under construction or barren unstabilized lands should have construction BMPs in-place reducing the actual contribution of TSS to receiving waterbodies.

On a broad scale, the development of the watershed over-abundantly shows an increase in TSS loading from subcatchments when

comparing existing conditions (F-9) to potential full development conditions (F-10). Areas that become developed and move from stabilized fields or woodlands towards urban developments will generally contribute more TSS to receiving waterbodies. Considering the various developments and the applications of BMPs, there is a chance to reduce the loading of TSS on a watershed scale, but is still considered a significant increase over existing conditions. Not all new developments will have BMPs in place, such as low to medium density residential developments, or even most common roadways.

Comparing the percent developable land to percent change in TSS loading shows that areas currently developed have the lowest *increase* in TSS loading. In some cases, the relative loading even in the fully developed scenario is low. For example, the military installation is mostly fields and grass areas with a low average TSS contribution. Should the land use change from its currently designated use, then the area may experience a significant increase.

Suspended solids from runoff do not maintain their suspension continuously towards the outfall of a subcatchment. Values shown for TSS concentrations are quite high for general water quality standards, as they do not account for natural processes that may help to eliminate some of the concentration. As runoff passes through a large wetland expanse, and velocities are reduced, and there may be a significant reduction in TSS through filtration and settling action. The values shown on the TSS figures show a decent representation of potential areas of risk through existing and potential development.

Biological Oxygen Demand (BOD) - Biological Oxygen Demand represents the amount of oxygen required by microorganisms to biodegrade wastes. When human or animal activities replace woodlands or fields, which do contain a background BOD, the level of BOD increases

substantially. Some of the BOD may come from failing septic systems, lawns and gardens, commercial landscaping and even animal wastes.

Figures F-1 through F-3, shows BOD contribution as mg/L from each subcatchment. The ranges displayed represent normal water quality standard ranges according to Table 4.5-3.

Table 4.5-3. BOD Loading Quality Ranges

BOD (mg/L)	Water Quality
<2.0	Very Good
3.0 - 9.0	Somewhat Polluted
>10	Polluted

Following these ranges of subcatchment contributions, there are currently areas that are considered high contributors of BOD to receiving waterbodies, most notably a subcatchment at the southern most end of the watershed. There are several other locations that show increased levels BOD contribution and are mostly associated to currently developed residential areas. The residential BOD contribution, whether it is low or high density residential, is the highest EMC contributor of all land covers. Seeing that developed land is proposed to be majority residential and associated facilities, there would be a significant increase in BOD loadings. The proposed development condition (F-2) shows a tremendous increase in BOD loading with continued development at the prescribed residential densities. From the numerical modeling standpoint, the only factors limiting this increase in loadings are restricted residential development from buffers around riparian zones and waterbodies. These are not acting so much as a 'filter' within the model, but rather a limiting factor to percent land available for development. In all actuality, these buffers reduce loading to receiving bodies, but that reduction is not directly accounted for in the model.

Through the implementation of BMPs (Figure F-3), there is a potentially large reduction in BOD loading. Since the highest contributor of BOD is from residential land covers, and the most likely use of stormwater management may be through detention and retention basins, there is a potential 50% reduction in BOD loadings with these BMPs. The choice of BMP is fairly important with respect to BOD loading and without any treatment, could lead to severe degradation of stream and lake water quality.

Forested lands have a relatively low BOD loading, thus, with such a dramatic change in land cover to residential, there is an associated severe increase in BOD loading as shown in Figure F-4.

Total Phosphorus (TP) - Phosphorus is one of the key pollutants of concern with respect to urban stormwater runoff quality. Phosphorus can be found in animal wastes, detergents and fertilizers, automobile exhaust, atmospheric deposition or erosion. Phosphorus is usually associated directly with the amount of suspended solids; a reduction of TSS can indirectly result in a reduction of TP. Total phosphorus consists of both the organic and inorganic forms. Phosphorous is usually considered the limiting nutrient in freshwater tributaries and lakes, as such, and its contribution can become more important than nitrogen loading.

The existing conditions model shows areas of elevated TP contribution, typically in subcatchments with more pastureland or horsefarms. There is a significantly higher level of phosphorus contribution from these lands than compared to other land cover types.

With respect to determining what lands are developable, pasturelands and horse farms are considered developable lands, and since they have such an increased loadings, there is a potential reduction in TP

loading through the development of the land in certain subcatchments. This can actually be seen in a subcatchment directly southwest of Lake Konomoc at its outlet (F-6).

Through the use of BMPs, reductions of TP may be possible. In general, as land is developed into commercial and residential uses, the amount of TP phosphorus increases, thus requiring BMPs to reduce overall system loading. The most efficient BMP is through a retention basin with efficiencies around 60%, followed by dry detention and extended detention basins with 30 and 15% respectively. The highest increases in BMP loading are in subcatchments with the most new potential development.

Total Nitrogen (TN) - Nitrogen is the other major pollutant of concern in urban stormwater runoff, in addition to phosphorus. Excessive nitrogen is a nutrient that can lead to algal blooms and eutrophication of waterbodies. Sources of nitrogen include failed septic systems, excessive fertilization of lawns or crops, atmospheric deposition, plant debris and animal wastes. Residential areas have a relatively high nitrogen loading with respect to other land uses; an exceptionally high nitrogen loading may be seen from golf courses, but would have a lower density than other more common land covers.

Total nitrogen encompasses the sum of the Nitrate and Nitrite (NO_3 and NO_2) in addition to the Total Kjeldahl Nitrogen (TKN) as ammonia and organic nitrogen. These values were modeled separately, but summed for analysis as total nitrogen. Atmospheric deposition of nitrogen was not directly accounted for within the model.

The existing conditions model shows elevated levels of nitrogen loading (Figure F-13) across the watershed with an excessive loading around an existing construction development east of Darrow Pond. Levels

of nitrogen appear directly correlated to the amount of development in a certain subcatchment. In areas adjacent to the lower Niantic River, which are already developed, there is a limited increase in nitrogen loading. Additionally, these areas appear to be sewered for the most part reducing the chances of direct waste discharge to the bay, which could be seen with a failing septic system.

Proposed conditions show a marked increase in potential nitrogen loading with areas of >50% increase (Figures F-14 and F-16). Methods of reducing nitrogen loading are limited and efficiencies are relatively low. The highest reported efficiency of nitrogen removal is from retention basin facilities with approximately a 70% efficiency rate, although more common and practical are either dry detention with a 30% efficiency or wet retention with a 15% efficiency.

It appears that with the proposed conditions of significant residential development, there may be excessive nitrogen loading to receiving waterbodies. More stringent BMPs operating in series may be required to limit nitrogen loading helping to prevent the eutrophication of receiving waterbodies.

4.5.3.5 Pollutant Loadings by Receiving Waterbodies

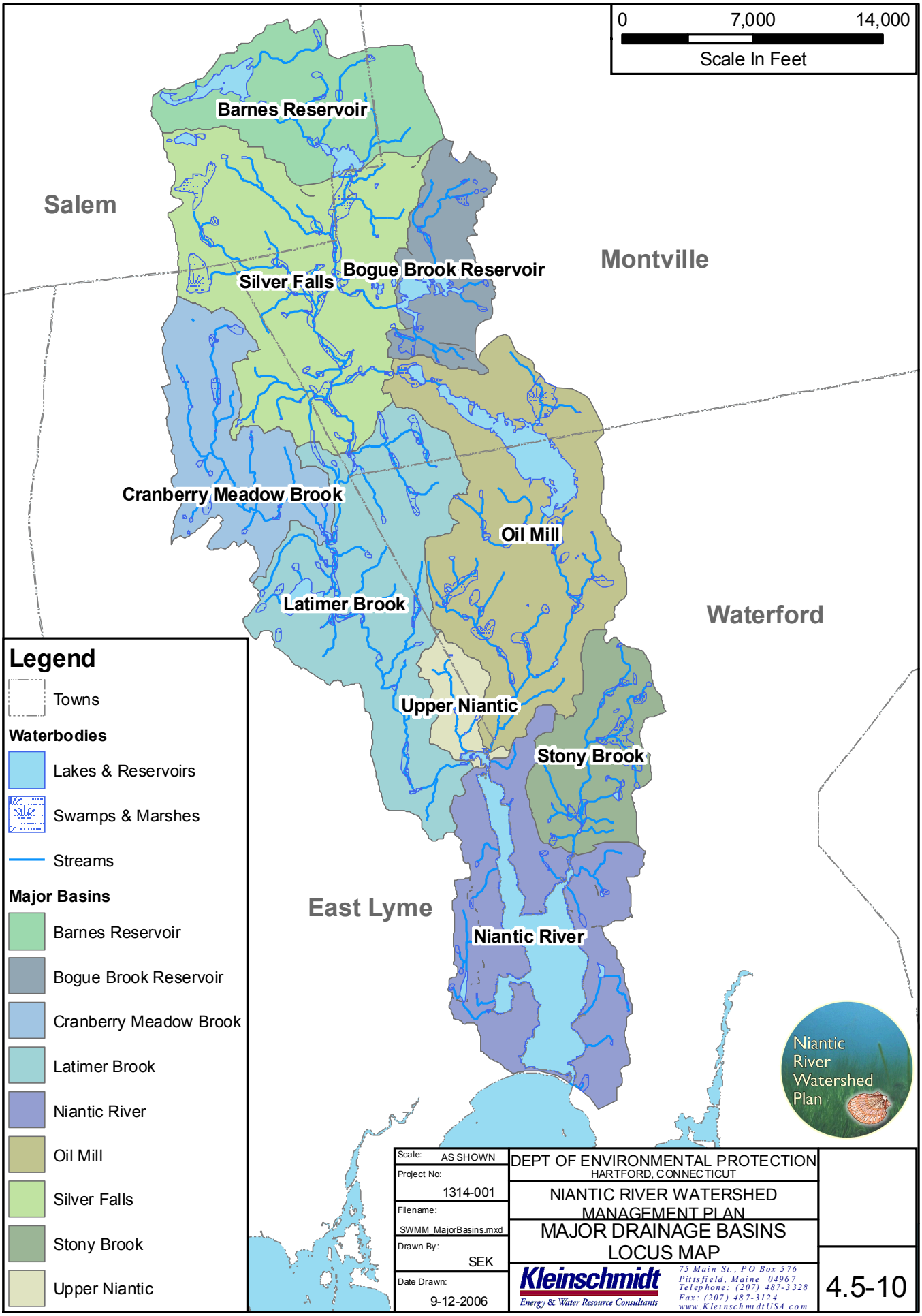
Within the Niantic River Watershed, there are several waterbodies that may currently be considered sensitive and require protection from further pollution. Major waterbodies have been outlined and the total pollutant loadings have been evaluated. This may be useful for determining, with respect to other receiving waterbodies in the watershed, which may be receiving excessive pollutants currently and which may be more susceptible to further changes from development.

Table 4.5-4 is a list of receiving waterbodies separated by major catchments (Figure 4.5-10). Each location defines the total pollutant load received from the synthetic storm event from all contributing subcatchments without BMPs implemented. In 'real-life' conditions, the pollutant load may be lower because of natural treatments upstream, or it may be higher from local erosion within a stream or an unknown point source. The summary does provide a reference for which each subcatchment can be compared.

Table 4.5-4 – Summary of Total Pollutant Loadings by Major Receiving Waterbody

Pollutant	Receiving Waterbody	Oil Mill Brook	Latimer Brook					Niantic River		
		Oil Mill	Lower Latimer Brook	Silver Falls	Barnes Reservoir	Cranberry Meadow Brook	Bogue Brook Reservoir	Niantic River	Stony Brook	Upper Niantic
TN Load	Existing (lbs)	3,475	4,750	4,231	1,455	1,968	983	5,464	1,638	486
	Developed (lbs)	4,596	5,984	5,274	2,237	2,258	1,394	6,325	2,118	715
	Difference (lbs)	1,121	1,234	1,043	782	290	411	861	480	229
	Drainage Area (ac)	3,692.5	3,128.3	3,639.6	1,848.8	1,667.7	1,080.5	3,014.4	1,273.0	412.4
	Developed (lbs/ac)	1.2	1.9	1.4	1.2	1.4	1.3	2.1	1.7	1.7
	Existing Normalized (lbs/acre)	0.9	1.5	1.2	0.8	1.2	0.9	1.8	1.3	1.2
	Increase Normalized (lbs/acre)	0.30	0.39	0.29	0.42	0.17	0.38	0.29	0.38	0.56
TP Load	Existing (lbs)	646	676	855	249	392	169	739	283	79
	Developed (lbs)	696	818	823	337	351	206	834	315	105
	Difference (lbs)	50	142	-32	88	-41	37	95	32	26
	Drainage Area (ac)	3,692.5	3,128.3	3,639.6	1,848.8	1,667.7	1,080.5	3,014.4	1,273.0	412.4
	Developed (lbs/ac)	0.19	0.26	0.23	0.18	0.21	0.19	0.28	0.25	0.25
	Existing Normalized (lbs/acre)	0.17	0.22	0.23	0.13	0.24	0.16	0.25	0.22	0.19
	Increase Normalized (lbs/acre)	0.014	0.045	-0.009	0.048	-0.025	0.034	0.032	0.025	0.063
BOD Load	Existing (lbs)	6,627	11,765	9,737	1,779	3,978	1,942	19,677	4,195	1,006
	Developed (lbs)	31,206	34,403	37,050	16,202	14,222	9,533	35,159	14,193	5,037
	Difference (lbs)	24,579	22,638	27,313	14,423	10,244	7,591	15,482	9,998	4,031
	Drainage Area (ac)	3,692.5	3,128.3	3,639.6	1,848.8	1,667.7	1,080.5	3,014.4	1,273.0	412.4
	Developed (lbs/ac)	8.5	11.0	10.2	8.8	8.5	8.8	11.7	11.1	12.2
	Existing Normalized (lbs/acre)	1.8	3.8	2.7	1.0	2.4	1.8	6.5	3.3	2.4
	Increase Normalized (lbs/acre)	6.66	7.24	7.50	7.80	6.14	7.03	5.14	7.85	9.77
TSS Load	Existing (lbs)	225,986	325,441	1,210,247	62,724	78,932	37,878	144,304	92,383	18,762
	Developed (lbs)	286,621	457,166	441,335	150,401	137,614	21,591	250,744	151,109	43,902
	Difference (lbs)	60,635	131,725	-768,912	87,677	58,682	-16,287	106,440	58,726	25,140
	Drainage Area (ac)	3,692.5	3,128.3	3,639.6	1,848.8	1,667.7	1,080.5	3,014.4	1,273.0	412.4
	Developed (lbs/ac)	77.6	146.1	121.3	81.4	82.5	20.0	83.2	118.7	106.5
	Existing Normalized (lbs/acre)	61.2	104.0	332.5	33.9	47.3	35.1	47.9	72.6	45.5
	Increase Normalized (lbs/acre)	16.4	42.1	-211.3	47.4	35.2	-15.1	35.3	46.1	61.0

*Top two values for current loading per acre, and loading increase per acre, have been highlighted in each row


0
7,000
14,000
Scale In Feet
Barnes Reservoir
Salem
Montville
Silver Falls
Bogue Brook Reservoir
Cranberry Meadow Brook
Oil Mill
Latimer Brook
Waterford
Upper Niantic
Stony Brook
East Lyme
Niantic River
Legend
Towns
Waterbodies
Lakes & Reservoirs
Swamps & Marshes
Streams
Major Basins
Barnes Reservoir
Bogue Brook Reservoir
Cranberry Meadow Brook
Latimer Brook
Niantic River
Oil Mill
Silver Falls
Stony Brook
Upper Niantic
Niantic River Watershed Plan
Scale: AS SHOWN
Project No: 1314-001
Filename: SWMM_MajorBasins.mxd
Drawn By: SEK
Date Drawn: 9-12-2006
DEPT OF ENVIRONMENTAL PROTECTION
HARTFORD, CONNECTICUT
NIANTIC RIVER WATERSHED MANAGEMENT PLAN
MAJOR DRAINAGE BASINS LOCUS MAP
Kleinschmidt
Energy & Water Resource Consultants
75 Main St., PO Box 576
Pittsfield, Maine 04967
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4.5-10

4.5.3.6 Discussion

The results appear to provide a decent approximation of increases in the potential pollutant load in various subcatchments, but seem to approximately higher than the expected loadings for certain pollutants. Part of the higher loading than would seem appropriate is from the process of using Event Mean Concentrations, which are a generalization of loadings and do not allow for washoff or 'first-flush' conditions. Additionally, there are various features within a watershed that allow for the removal of pollutants. For example, a simple sump in a catch basin can allow for the removal of larger solids, whereas flow that passes through a wetland or is retained behind a culvert may allow for the removal of finer sediments. The model has assumed that once a unit of land has contributed a pollutant to runoff that it remains in the concentration of the runoff.

The model also generalizes the potential land use buildup scenario for the watershed, and does not consider variations of residential density or commercial uses dependent on zoning. The average buildout scenario aims to mimic the existing 'built-out' coverages, but does not vary these conditions dependent on current zoning regulations. The effect of adding this into the analysis is not expected to significantly affect the resultant 'increases' from the model.

Similarly, there has been a generalization of land use covers and not a specific placement of potential large developments, which may be qualified as 'point-sources'. Future models may incorporate either planned or approved large construction projects to determine the potential impact from such a development on a site specific basis.

4.6 Summary of Water Quality Concerns and Watershed Management Challenges for the Niantic River Watershed

Based on what scientific research informs us about the water quality and ecological health of the Niantic River, we may conclude with some confidence that it is in "good" condition. For an estuary of its size, with a significantly urbanized watershed, the Niantic's biological indicators suggest it is doing better than other northeastern estuaries of similar characteristics. Both water quality and aquatic habitat, however, are subject to considerable risk of degradation based on current trends in land use and nonpoint source pollution. Despite recent victories by watershed communities to collect and treat domestic wastewater, limit marine pollution sources and manage stormwater, increased sedimentation, nutrient-loading, bacteria pollution and other impacts generated by increased impervious surfaces and lost wetland areas in the future, much still needs to be done to, at a minimum, maintain watershed health.

Today, a dozen or more stormwater outfalls discharge untreated runoff into the Niantic River and an unknown quantity of outfalls discharge into the tributaries throughout the watershed. These outfalls have been implicated as the primary sources of bacterial and nutrient pollution to the river that cause elevated bacteria levels periodically closing shellfish beds, limiting other recreational uses and disrupting the ecosystem. Yet, despite recent development of municipal stormwater management program plans, on-the-ground remediation of these water quality problem sources has not yet been achieved. According to the municipalities these plans are in the process of being implemented.

The principal effects of impervious surfaces and wetland loss on the Niantic River and its tributaries include:

- Changes in hydrology of streams, wetlands and floodplains
- Fragmentation of contiguous forests
- Increased pollutant loads delivered in urban stormwater (bacteria, sediment, nutrients)

- Channel erosion in headwater streams
- Water level fluctuations that degrade wetlands and rare, threatened or endangered plant species habitat
- Conditions that favor the establishment of invasive plant species

Certain subsets of the Niantic River Watershed appear to be more susceptible to development, increased impervious surfaces and wetland loss, according to estimates generated by the study's buildout analysis. In this study, these areas were identified on a drainage basin scale. Fourteen drainage basins could potentially be covered by impervious surface beyond the 10% threshold. In fact, five drainage basins are currently estimated to have over 10% impervious surface already and could gain more impervious area from now until buildout. Table 4.6-1 lists the basins that will be most susceptible to alteration to impervious surface and associated issues (refer to Figure 4.5-2 for the location of these basins):

Table 4.6-1. Summary of Current and Buildout Percent Impervious by Basins

	Drainage Basin Number	Current Percentage of Impervious Surface	Estimated Percentage of Impervious Surface at Buildout
1	2203-00-1-L1	3.6	18.1
2	2202-00-2-R3	5.6	10.7
3	2202-07-1	2.3	10.0
4	2203-00-2-R1	8.5	11.3
5	2202-00-3-R2	6.0	11.9
6	2202-00-3-L8	0.5	23.5
7	2204-03-1	7.9	21.1
8	2202-00-3-L9	16.9	20.0
9	2203-00-2-R2	5.1	10.7
10	2204-02-1	6.6	32.8
11	2204-00-3-R1	10.7	16.5
12	2202-00-3-R3	11.5	20.7
13	2204-00-3-R4	14.9	23.2
14	2204-04-1	16.5	21.0

The results of the vulnerability assessment for the Niantic River Watershed identified specific 'critical' areas that require conservation measures to protect water resources, restoration measures to mitigate land areas with high pollution potential and stormwater management measures to deal with highly probable or existing stormwater

problems. The analysis estimated these areas of the watershed at a 10 x 10 meter grid scale (the scale utilized by the GIS analytical tool). Of course, implementation of management measures (conservation, restoration, stormwater management) can not occur at this scale, therefore it will be necessary to target measures at the zoning district or parcel level associated with these priority areas. Table 4.6-2 provides estimates of how much land (area) is included in these priority areas.

Table 4.6-2. Estimated Watershed Vulnerability Acreages by Town

Municipality[1]	Estimated Acreage for Conservation Measures[2]	Estimated Acreage for Restoration Measures	Estimated Acreage for Stormwater Management Measures
East Lyme	885	135	427
Montville	723	99	196
Salem	449	10	72
Waterford	819	54	378
Total	**2,876**	**298**	**1,073**

[1]All towns have fully embraced sanitary sewer projects for densely developed commercial and coastal residential locations. It is assumed that their existing programs will be sufficient to assess and respond to areas where septic treatment is no longer an appropriate option.

[2]This is the minimum estimated acreage for conservation measures. All lands currently under protection have been removed from this estimate, however, some lands removed are privately owned and therefore their future not necessarily secured.

Development of the stormwater model allowed for a summation of potential pollutants currently contributing to receiving waterbodies, in addition to an estimate of potential increases in pollutant contributions due to a full build-out scenario. Areas of concern highlighted from this analysis include the current dense developments abutting the Niantic River. These areas are invariably direct discharge locations without time for natural pollutant degradation or attenuation of flows. Buffers are limited or non-existent and most of the development is doesn't incorporate stormwater treatment measures; stormwater is merely collected and conveyed as efficiently as possible towards the Niantic River. The modeling showed that future development will only contribute to already existing high levels of pollutant contributions.

Additional results of the model showed that the upper reaches of the watershed are susceptible to large increases in developed area. Increased development, cleared buffers, and increased impervious areas lead to higher levels of pollutants conveyed to tributary streams. Monitoring of contributing streams is essential to measure and adjust upstream activities, especially as developed areas continue to increase.

Results of the stormwater model should be used by the towns to evaluate areas of potential development, and whether where this development currently is considered a high pollutant contributor, or if it may be at high risk from future development. Additionally, pollutants of concern have been plotted individually allowing a focus on where the current and potential future 'hot-spots' may be located.

These studies of the Niantic River Watershed were performed to gain an understanding of the current health of the watershed. With the communities working together, these results of these studies can be turned into action by using zoning actions to stop or slow the expansion of impervious surfaces and work with developers to minimize the impact of impervious surfaces and mitigate any new impervious coverage. Public monies should be used wisely to purchase lands targeted for conservation measures, work with land owners to restore or improve the health of agricultural lands and enforce stormwater management measures.

5.0 WHO CURRENTLY MANAGES AND PROTECTS THE NIANTIC RIVER WATERSHED?

This section introduces the discussion of who will be responsible for implementing the recommendations in this plan. It is paramount to the planning effort to understand the existing political framework and its components so that if we can be understood where this watershed plan and how its recommendations fit into the community. Therefore, a review of the current "institutional environment" was completed in order to better under the levels of government and other stakeholders who would be responsible for decision-making associated with the implementation of this plan.

The fact that the Niantic River Watershed is a *natural* system and not a *political* division creates several challenges for managing it. Federal, state, and local jurisdictions are charged with managing the natural resources of the watershed, including the activities of people desiring to use them. Resource management issues such as nonpoint source pollution are addressed through a variety of disparate policies and programs that are infrequently coordinated to meet common objectives. Hence, this planning effort has emphasized the coordination of governmental and nongovernmental stakeholders in managing nonpoint source pollution in the Niantic River Watershed.

Beginning at the federal level, agencies such as USEPA, NOAA and the ACOE are driven by their mandates under the Clean Water Act to manage nonpoint source pollution in the Niantic River Watershed. They administer their statutory mandates in partnership with CTDEP and its various subdivisions. The CTDEP BWPLR contains the majority of water quality programs concerned with nonpoint source pollution, which are primarily, but not limited to, Section 319 Nonpoint Source Pollution Management Program, Office of Long Island Sound Programs, Inland Wetlands, Water Quality Program, Watershed Management Program, and Total Maximum Daily Load Program. Other bureaus of CTDEP dealing with the management of fish and wildlife and waste management, have important, yet not as central roles in managing the watershed.

As mentioned earlier, CTDEP is one of the major driving forces behind this planning effort. In addition to administering CZARA Section 6217[14] funding through OLISP, CTDEP must assume responsibility for managing the Niantic River because of its current impairments (303(d) List), which will inevitably lead to the development of a TMDL for bacteria and nutrients for the river. CTDEP NPS Management Program delivers other financial support for managing nonpoint source pollution.

Other federal and state agencies involved in the management of the Niantic River Watershed include those agencies that provide funding or technical assistance for management of the watershed. On the federal level, USGS and USDA NRCS play important roles in delivering scientific information and technical know-how in support of watershed management. Similarly, USFWS and NOAA Fisheries have responsibility over fish and wildlife and provide data regarding these resources as well as, play a regulatory role when issues of imperiled species are present.

The greater proportion of land use decisions lie at the local level with the four municipalities of the watershed. The rubric of planning and zoning regulations in these communities constitute the body of policy guiding land use and stormwater management in the watershed. The range of policies includes areas that are essential to the management of the watershed and nonpoint source pollution. These include planning and zoning policies dealing with inland wetlands, storm sewer system management, road construction, on-site wastewater disposal, open space protection, groundwater/wellhead protection, and soil loss/erosion control. Table 5.0-1 summarizes the planning and regulatory framework for water resource protection in the four towns within the Niantic River Watershed. Each of the towns are making great efforts to do their part in protecting the waters of their communities. A more effective approach may be to match protection items for a consistent watershed wide approach to protecting water quality. For example, the towns of East Lyme and Waterford each have a 100-foot upland review for wetlands and watercourses, where the towns of Montville and Salem have different buffer areas; if all towns in the watershed had a 100-foot upland review area, the collaboration may provide optimal protection to these important wetted areas.

[14] Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990

Nongovernmental organizations are active in the management of the Niantic River Watershed. Save the River/Save the Hills[15] is a non-profit 501(c)(3) grassroots environmental organization based on the Niantic River Estuary in Waterford and East Lyme, Connecticut. The mission of the organization is, *to abate and prevent pollution of the river by, operating a pumpout boat; advocating the preservation of the Oswegatchie Hills; advocating sewers for East Lyme waterfont neighborhoods; encouraging the towns of Waterford and East Lyme to fulfill their obligations under the Federal Phase II Storm Water Regulations and preserve the natural beauty of the Oswegatchie Hills* (Save the River, Save the Hills, 2006). Friends of the Oswegatchie Hills Preserve[16] is another watershed-based group involved in conservation activities in the watershed. The organization's website describes their mission: T*o raise public awareness and gain the funds necessary to purchase the remaining undeveloped land within Oswegatchie Hills and create a Nature Preserve for future generations to enjoy*.

[15] www.savethe river-savethehills.org

[16] www.oswhills.org

Table 5.0-1. Municipal Regulatory Framework For Water Resource Protection (Fall 2005)

Watershed Protection Item	East Lyme	Montville	Salem	Waterford
Wetland/watercourse regulations	100 ft upland review area for wetlands and watercourses.	50 ft upland review area for wetlands and watercourses.	75 ft upland review area for wetlands and watercourses.	100 ft upland review area for wetlands and watercourses.
Floodplain protection	Development in floodplains regulated via FEMA standards (require flood-proofing for commercial structures and raising floors of residential structures 1 foot above base flood elevation).	Follow state regulations.	Uses state standard model regulations, for subdivisions of at least 5 acres or 50 lots.	Development in floodplains regulated via FEMA standards (require flood-proofing for commercial structures and raising floors of residential structures 1 foot above base flood elevation).
Zoning overlay districts/ Zones for resource protection	AqP and AqS overlay zones; CAM; TM; Greenway Conservation District.	One aquifer protection zone, already built out.	Have a Seasonal Residential Zone and Commercial Recreation Zone, which help preserve area at Gardner Lake.	Has Open Space District where specified uses by permit are less intensive (does not include Niantic River area).
Aquifer protection	AqP and AqS overlay zones. Town will be looking at adopting state model regulations but must wait for Level A mapping.	One aquifer protection zone, already built out.	For Planned Recreation/Residential Community, applicants must show aquifer protection considerations in environmental mgt report.	No special districts or provisions in place.
Stormwater Management	Informally apply state stormwater design manual but nothing is codified. POCD recommends a variety of more protective BMPs.	Use CT stormwater design manual; regulations now being updated to specify its use.	Various regulations in place. Stormwater control established for roads and parking areas (with bituminous & curbs favored). PRDs have 13% max impervious surface limit.	No specific requirements but require stormwater to be contained on site. The Special Development District addresses imperviousness.
Erosion & Sedimentation Control	Development requires E&S Control Plan per State Guidelines for disturbances of 1/2 acre or more and within 50 ft of "sensitive resources".	Recommends use of CT E&S Control Guidelines.	Applies E&S regulations based on CT E&S Control Guidelines for disturbances of 1/2 acre or more.	Use standards similar to state guidelines. E&S control plans approved at time of site plan approval - includes construction phasing & maintenance.

Watershed Protection Item	East Lyme	Montville	Salem	Waterford
Alternative subdivisions	Use minimum area buildable land criteria for subdivisions (20,000 SF min. for lots at least 40,000 SF). No wetlands on buildable land and no slopes greater than 20%. POCD recommends consideration of adopting soils-based net buildable area zoning. Cluster/open space subdivisions allowed in RU-40 & up.	Minimum lot size is 40,000 SF in RM-40 and 20,000 SF in RM-20.	Yes: for purpose of increasing residential choices and/or preserve open space and natural resources. Also: Net Buildable Area criteria apply for lots after Dec. 1 2003.	Cluster subdivisions are allowed in all residential zones. Town uses minimum buildable area. Steep slopes >25% are non-buildable except for access.
Watershed planning approach	No holistic planning other than for public water supplies.	Town shares development plans with Norwich CTDPUCs of two watersheds - Lake Konomoc and Stony Brook Reservoir.	No formal regulations or planning on watershed basis, but Salem has signed the Eightmile River Watershed Compact.	Uses a watershed approach for the Jordan Cove Watershed.
Coastal Site Plan Review	Yes.	Yes.	No.	Yes.
Sewered Area	Yes -- most of town south of I-95; beach areas done and some areas north of I-95 along Rt 161.	Not in Niantic Watershed.	No.	Yes – most of the neighborhoods along the Niantic River shoreline except for homes along Konomoc Avenue and north of I-395.

Watershed Protection Item	East Lyme	Montville	Salem	Waterford
Other	Pesticide report required for sites ever used as farmlands/commercial. ERT report required for subdivisions of 20 lots or more in sensitive areas. Waterford-East Lyme Shellfish Commission has brochure - how homeowners can help protect WQ of Niantic River. Formation of the Niantic River Gateway Conservation Zone to establish conservation along the river.	No control of herbicides/pesticides.	N/A	Waterford-East Lyme Shellfish Commission has published a watershed-focused brochure describing ways homeowners can help protect the water quality of the Niantic River. Formation of the Niantic River Gateway Conservation Zone to establish conservation along the river.
List of Commissions or Officials with Authorities over Water Resources	Planning Commission; Zoning Commission; Conservation Commission; Health Department; Building Department; Water & Sewer Commission; East Lyme Harbor Management/Shellfish Commission; Niantic River Gateway Commission; Regional Planning Commission; Route 11 Greenway Authority Commission .	Planning & Zoning Commission; Wetland Commission; Water Pollution Control Authority; Regional Planning Commission; Route 11 Greenway Authority Commission.	Planning & Zoning; Inland Wetlands and Conservation; Building Official; Sanitarian; Regional Planning Commission; Route 11 Greenway Authority Commission.	Planning & Zoning; Conservation Commission; Sanitarian; Waterford Shellfish Commission; Niantic River Gateway Commission; Regional Planning Commission; Route 11 Greenway Authority Commission.

Note: Refer to Appendix A for Acronyms.

5.1 Town Summaries of Planning and Regulatory Authorities

A review of the institutional environment in which watershed management occurs on the local level was conducted for this study. Discussions with planning officials and reviews of local policy were executed in order to compile this information. These town-by-town summaries detail the planning and regulatory authorities that affect water quality. The results of this review will allow for recommendations to be made to the existing watershed management framework. Much of this information comes from the zoning regulations adopted for each town.

East Lyme (Website: *www.eltownhall.com*)

The Town of East Lyme has several commissions with authorities over the management of water resources. The names of these commissions and a brief description of their authority is provided here:

- Planning Commission - oversees subdivision regulations and re-subdivision and the compilation of The Plan of Conservation and Development.
- Conservation Commission – review applications and grants permits for activities with inland wetland/watercourse jurisdiction.
- Health Department (Ledge Light Health District) – approval of septic system applications.
- Zoning Commission – Site Plan, Special Permit Review and Zone Changes.
- Water and Sewer Commission – oversees water and sewer infrastructure.
- Regional Planning Commission – a sub-unit of the Southeastern Connecticut Council of Governments (SCCOG) and is composed of one representative from the planning commission of each member municipality.
- Niantic River Gateway Commission – a special joint commission formed by ordinances in East Lyme and Waterford to set standards for development with the Conservation Zone along the Niantic River.

- East Lyme Harbor Management/Shellfish Commission – dedicated to improving public safety on the waterways and opening new recreational shellfishing grounds (in Niantic Bay).

The following is a list of local policies and programs, administered by the Town of East Lyme, summarizing local mechanisms as they relate to watershed management. Some of this information is captured in Table 5.0-1.

- *Wetlands Regulations:* 100-foot upland review area for wetlands and watercourses.
- *Floodplains:* The town regulates development in floodplains (Section 20) based on the FEMA standards (require flood-proofing for commercial structures and raising floors of residential structures 1 foot above base flood elevation).
- *Overlay Districts/Zones for Resource Protection*
  - *AqP Overlay Zone* (aquifer & primary recharge)
  - *AqS Overlay Zone* (secondary recharge zone)
  - *Coastal Boundary Overlay District (CAM)*
  - Tidal Marsh District *(TM)*
- *Aquifer Protection:* The town has AqP and AqS overlay zones. The Zoning Commission is the current regulatory commission for aquifer protection and will be looking at state model regulations but must wait for Level A mapping, which is anticipated to be complete no later than June 1, 2008.
- *Stormwater Management (includes detention and retention, road design, impervious surfaces limits, curbs and swales, parking, and maintenance)*: East Lyme's Engineering Department is informally using the State *Stormwater Quality Manual* to guide new development but nothing is codified in town ordinances. The Plan of Conservation and Development (POCD) recommends incorporating more protective best management practices (BMPs) for Stormwater Management (pre-treatment requirements in aquifer protection areas or for commercial and industrial development; covers for storage piles; storage tank requirements; appropriate sewered areas and non-sewered areas to inhibit over-development).

- *Erosion and Sediment (E&S) Control:* For subdivision proposals in East Lyme, any disturbance of ½ acre or more requires an E&S control plan as well as if the disturbance occurs within 50 feet of the following sensitive resources: tidal wetlands, watercourses, beaches, dunes, naturally-eroding coastal bluffs. E&C Plans must be developed in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control.
- *Slopes:* There is some consideration for slopes in East Lyme's subdivision ordinances, which apply to the minimum buildable area criteria, *i.e.* no more than 20% of the lot can have topography exceeding 25% slope (applies to lots of 20,000 SF or more). No protection exists relative to commercial developments.
- *Provisions for Alternative Subdivisions:* Plan of Conservation and Development recommends consideration of adopting soils-based net buildable area zoning.
- *Coastal Site Plan Review*: Required, if any part of subdivision is within the coastal boundary.
- *Other*
    - Pesticide Report – required for sites once classified as farmlands per CGS 12-107c or other commercial use with regular applications of pesticides. Applicant must provide history of pesticide use and evaluation of potential human health impacts.
    - Environmental Review Team (ERT) report – required for subdivisions of 20 lots or more if 50% of subdivision area is considered environmentally sensitive (wetlands, slopes over 25%, flood hazard areas, ridges, watercourses).

Montville (*www.townofmontville.org*)

The Town of Montville has several positions and commissions with authorities over the management of water resources. The names of these positions and commissions and a brief description of their authority are provided here:

- Planning and Zoning Commission – Site Plan and Special Permit Review.

- Wetland Commission - review applications and grants permits for activities with inland wetlands/watercourses.
- –Union Health District – septic approvals.
- Water Pollution Control Authority – oversees public sewer system management and planning.

The following is a list of local policies and programs, administered by the Town of Montville, summarizing local mechanisms as they relate to watershed management. Some of this information is captured in Table 5.0-1.

- *Wetlands Regulations:* 50-foot upland review area from wetlands and watercourses.
- *Flood Plains:* Development in floodplains is regulated similar to state regulations.
- *Overlay Districts for Resource Protection:* One aquifer protection zone exists (see next item).
- *Aquifer Protection:* There are no real restrictions in the one aquifer protection zone; the zone is already developed.
- *Stormwater Management (includes detention and retention, road design, impervious surfaces limits, curbs and swales, parking, and maintenance):* The town engineer reviews stormwater per the *Stormwater Quality Manual*. Currently, the stormwater measures are not codified but regulations are being upgraded to specify the use of the *Manual*.
- *Erosion and Sediment Control:* Ordinances recommend use of CT E&S control guidelines for development (but guidelines are not codified in the regulations).
- *Watershed Approach (Regulations by Major Watersheds):* Town shares development plans with Norwich DPUC of Lake Konomoc and Shiny Brook Reservoir Watersheds.
- *Provisions for Alternative (Cluster, Open Space) Subdivisions:* Montville has cluster subdivision alternative, but it is due to be updated.
- *Coastal Site Plan Renew:* Required if any part of subdivision is with the coastal boundary.

Salem (*www.salemct.gov*)

The Town of Salem has several positions and commissions with authorities over the management of water resources. The names of these positions and commissions and a brief description of their authority are provided here:

- Planning & Zoning Commission – Subdivision, Site Plan and Special Permit Review.
- Inland Wetlands & Conservation Commission – review applications and grant permits for activities with inland wetlands/watercourses.
- Sanitarian – septic approvals.

The following is a list of local policies and programs, administered by the Town of Salem, summarizing local mechanisms as they relate to watershed management. Some of this information is captured in Table 5.0-1.

- *Wetlands Regulations:* The Town has adopted the standard State's model wetland regulations with a 75-foot upland review area for watercourses and wetlands. The Town has also established regulations setting a minimum amount of land required should wetlands be on a site or if accessory apartments are present, as well as for Planned Residential Developments. Also, developers are required to provide alternatives for the site development and reasoning for their choice.
- *Flood Plains:* The Town has the standard State model regulations. The regulations are particular to subdivisions of five (5) acres or 50 lots.
- *Overlay Districts for Resource Protection:* The Town has a Seasonal Residential Zone and a Commercial Recreation Zone, which help to preserve the area around Gardner Lake.
- *Aquifers:* Applicants must show they are taking aquifers into account in the environmental management report that is necessary for a Planned Recreation/Residential Community.
- *Stormwater Management (includes detention and retention, road design, impervious surfaces limits, curbs and swales, parking, and maintenance):* A

broad range of stormwater regulations are in place. The town uses the 25-year storm as the design criteria. A 13% maximum limit is set for impervious area in PRDs. Treatment measures such as swales, detention basins and ponds are cited as potential measures to control stormwater runoff. Regulations are in place for control of stormwater for protection of groundwater. Control of stormwater is established for roads and parking areas; the Town favors traditional design criteria requiring use of bituminous materials and curbing.

- *Erosion and Sediment Control:* The Town uses the standard regulations based on the Erosion and Sediment Control Guidelines set forth by the State. The standards are applied to land disturbances of ½-acre or more.
- *Net Buildable/Soil Based Zoning:* Regulations have been established using net buildable area as a means for regulating development. Net Buildable Area is required for each new lot created after December 1, 2003.
- *Slopes:* Regulations are in place setting design criteria as well as recognizing the potential impact from development on steep sloped areas.
- *Watershed Approach (Regulations by Major Watersheds):* Salem has signed the Eightmile River Watershed Compact, indicating recognition of the municipality as part of a larger watershed community. In February 2006, the Town voted to endorse the proposed Eightmile River Management Plan, which includes a range of planning and zoning mechanisms to protect riparian corridors, control stormwater, control impervious surfaces, and reduce habitat fragmentation.
- *Provisions for Alternative (Cluster, Open Space) Subdivisions*: Regulations allow developer to propose alternative type development to increase residential choices and/or preserve open space and natural resources.

Waterford (*www.waterfordct.org*)

The Town of Waterford has several positions and commissions with authorities over the management of water resources. The names of these positions and commissions and a brief description of their authority are provided here:

- Planning and Zoning Commission issues – review and approval of subdivisions, site plans, Special Permits and Coastal Site Plans.

- Conservation Commission – oversees/regulates inland wetlands and watercourses permits.
- Sanitarian – serves as the agent for the Director of Health and responsible for issuing permits for the installation of wells and septic systems. Also responds to shellfish management issues.

The following is a list of local policies and programs, administered by the Town of Waterford, summarizing local mechanisms as they relate to watershed management. Some of this information is captured in Table 5.0-1.

- *Wetlands Regulations:* The town has an 100-foot upland review areas for both wetlands and watercourses.
- *Floodplains:* The town regulates development in floodplains based on the FEMA standards (require flood-proofing for commercial structures and raising floors of residential structures 1-foot above base flood elevation).
- *Overlay Districts for Resource Protection:* The town has no overlay zones to protect specific resources but they have an Open Space District, where the specified uses (permitted) are less intensive. This district does not include the Niantic River area.
- *Stormwater Management (includes detention and retention, road design, impervious surfaces limits, curbs and swales, parking, and maintenance):* Waterford has no specific requirements in their regulations but they review each application and require stormwater to be contained on site. One zone, the Special Development District (SDD) does address imperviousness. The Town of Waterford operates much of its storm sewer system under a General Permit for the discharge of stormwater to a municipal separate storm sewer system (MS4), which required the Town to complete a Stormwater Management Program Plan (SWPP). The SWPP contains implementation actions to meet the six minimum measures of the MS4 Permit.
- *Erosion and Sediment Control:* Town regulations spell out the E&S control requirements. Although they do not reference the State guidelines, they are

similar. The E&S control plans are approved at the time of site plan approval and include such considerations as construction sequence and maintenance.

- *Slopes:* Steep slopes are regulated as non-buildable areas if they are over 25%. No development is allowed on steep slopes unless it is required for access.
- *Watershed Approach (Regulations by Major Watersheds)*: The town uses the Jordan Brook Watershed Plan as guidance for developers and for development approvals on areas within that watershed, which encompasses approximately 70% of Waterford. The plan included studies of wetlands, potential build-out as a basis for recommendations.
- *Provisions for Alternative (Cluster, Open Space) Subdivisions*: The town allows Cluster Subdivisions in any residential district. The cluster allows higher development densities in exchange for preserving more sensitive portions of a development site as open space. The town uses the Minimum Buildable Area method of calculating developable area.
- *Coastal Site Plan Review*: Required if any part of subdivision is within the coastal boundary.

Joint Municipal Commissions

The Towns of East Lyme and Waterford mutually participate in two commissions dealing with the management of natural resources, including the Niantic River and its watershed. The name and function of these commissions are provided:

- *Niantic River Gateway Commission*[17] – Chapter 478a, Sections 25-109*a* through 25-109*p* Connecticut General Statutes enables the Towns of East Lyme and Waterford to form by ordinance this joint commission. The commission was empowered to give consideration and to administer standards, "to the conservation and preservation of sensitive coastal resources, scenic vistas, and unique habitat(s)" in a zone associated with the Oswegatchie Hills area.

[17] www.cga.ct.gov/2005/pub/chap428a.htm

- *Waterford/East Lyme Shellfish Commission* – This joint commission was formed by the Towns of East Lyme and Waterford to manage the shellfish beds of the Niantic River, exclusively. All harvesting, transplanting and aquaculture operations are approved through this commission.

Regional Government

East Lyme, Montville, Salem, and Waterford participate in the SCCOG. SCCOG is the second largest of Connecticut's fifteen regional planning organizations. Member town representatives make up the actual Council. It also has as non-voting affiliate members; two federally recognized Native American Tribes. SCCOG also has liaison representation from the United States Naval Submarine Base and the United States Coast Guard Academy. Operating under the provisions of Sections 4-124i through 4-124p of the Connecticut General Statutes, the SCCOG is assigned several duties: making a plan of conservation and development for the region; assisting municipalities within the region, as well as state and other public and private agencies; and performing a variety of advisory review functions. Under federal transportation law, SCCOG functions as the region's Metropolitan Planning Organization (MPO), responsible for coordinating transportation planning in southeastern Connecticut[18].

5.2 Organizational Approaches for Watershed Management

Recommendations for altering the structure of municipal and state government to more effectively manage watersheds and water quality tend to be disregarded because of their inherent political challenges. The Niantic River Gateway Commission, however, is a unique entity in that its formation demonstrated that inter-municipal planning with the goal of managing natural resources is possible. Fulfilling the intent of the law that created the Gateway Commission would be a considerable step forward in helping protect the Niantic River and may set the stage for amending the law to broaden the scope and powers of the Commission.

[18] http://www.seccog.org/about.html

The recommendations in this plan rely heavily on local adoption and implementation for this plan to have its intended impact. Each of the four communities would have to make planning and zoning changes, enable stricter enforcement of riparian setbacks and implement stormwater management programs. With few incentives for communities to work together to adopt and implement watershed management measures, it is necessary to take advantage of those that exist. In this regard, endorsement of this watershed protection plan by 1) the Project Steering Committee and 2) all four of the towns is an important *political* step.

Although the greater proportion of this plan's implementation relies on the independent action of the four watershed communities, CTDEP support and stakeholder compliance, a watershed forum could enhance certain watershed management activities. Establishment of a watershed coalition, for instance, could be built around the mission to complete specific management activities. In contrast, it is not recommended to form a coalition created to serve primarily as an open forum to discuss watershed issues. Watershed partnerships that are formed without a clear work agenda fail. Of the wide range of actions recommended by this watershed management plan, several of them – namely information/education campaigns, stormwater management measures, water quality monitoring - can truly benefit from group cooperation and collaboration. To implement these activities, the fours towns could collaborate to acquire funding; share technical resources, equipment, and materials; conduct public and media relations; and sponsor festivals and events. A multi-jurisdictional, public/private coalition or partnership would foster such collaboration.

Recommendation: *East Lyme and Waterford should fulfill the intentions of the enabling statute of the Niantic River Gateway Commission to protect those areas identified by statute.*

Recommendation: *The four watershed communities and their respective state legislators should meet to discuss the feasibility of expanding the scope and powers of the Niantic River Gateway Commission to include Salem and Montville and to empower them to develop administrative standards to protect critical resource areas throughout the entire*

watershed. This coalition would be strengthened significantly by building a foundation supported by scientists, planners and managers and interacting directly with communities.

Recommendation: *Similar to the approach taken by the Eightmile River Wild & Scenic Study Committee, the Niantic River Watershed Protection Project Steering Committee should formally vote to endorse the final Niantic River Watershed Protection Plan. The Committee should then consider how to present it to the Boards of Selectmen in each town for the community's endorsement.*

Recommendation: *The Project Steering Committee should consider the formation of a watershed partnership or coalition. This body could be an ad hoc entity to regularly meet and collaborate on the implementation of specific aspects of the watershed plan. Or, the entity could be formed as a subcommittee of the Southeastern Connecticut Council of Governments, which may also assist in coordinating the body and implementing the plan.*

6.0 RECOMMENDED WATERSHED MANAGEMENT MEASURES FOR THE NIANTIC RIVER WATERSHED

This recommendations section of the plan begins with the identification of management goals to guide the implementation of this plan. These goals and related objectives attempt to be as specific as possible and linked to existing water quality standards. In the absence of federal or state criteria, qualitative targets are presented. This holds true for social or programmatic targets as they are measured as more qualitative indicators.

6.1 Management Goals and Objectives

Management goals and associated objectives and targets are presented in Table 6.1. These goals are derived from the watershed management issues of concern studied by this project.

Indicators and targets are derived from various sources. Indicator bacteria targets are taken from CT Water Quality Standards (CTDEP, 2002c). Nutrient targets are merely suggestions derived from literature values and national guidance (Burkholder, 2004; USEPA, 2001). Currently, there are no national and state nutrient criteria for estuaries. The USEPA has published recommended nutrient criteria for rivers and streams that could be used for the tributaries of the Niantic (USEPA, 2000). The *Connecticut Stormwater Quality Manual (CTDEP, 2004a)* provides guidance for controlling stormwater quantity to reduce impacts from peak flow on streams.

Table 6.1. Watershed Management Goals, Objectives, Indicators, and Targets

Goal	Management Objective	Indicator/Target
Support designated uses for shellfishing.	Reduce bacterial loads from stormwater outfalls, runoff, and direct discharges.	Fecal coliform: Geometric Mean less than 14/100ml; 90% of Samples less than 43/100ml (CTDEP, 2002c).
Support designated uses for primary contact recreational uses.		Enterococci: Geometric Mean less than 35/100ml; Single Sample Maximum 500/100ml
Support designated uses for aquatic life.	Reduce nutrients loading from stormwater outfalls and runoff.	Total Nitrogen: Maximum of 30% annual N loading to the Niantic River OR Inorganic Nitrogen: minimize loadings to below recommended eelgrass threshold (0.3 mg/l) (USEPA, 2000).
Protect and restore natural stream channels.	Minimize flooding impacts by improving peak and volume [stormwater] controls from impervious surfaces.	Peak flow volume and velocity: Minimized peak velocity for 1-yr, 24-hr storm events (CTDEP, 2004a).
Educate key stakeholders about watershed management issues and good housekeeping responsibilities.	Raise stakeholder awareness by implementing a watershed management information and education campaign.	*See* Section 7.1.1
Establish a sustainable coalition of partners to manage the Niantic River Watershed.	Create a coalition of watershed stakeholders to take a leadership role for the implementation of this plan.	A sustainable, engaged watershed management coalition.
Improve water quality and biological monitoring for the Niantic River and its tributaries.	Establish a comprehensive, long-term water quality monitoring program for the Niantic River Watershed.	* EPA-approved water quality and biological monitoring program. * Funded and staff water quality monitoring program.

6.2 The priority actions to address Watershed Management Strategies

Watershed management strategies must directly address the objectives listed above and strive to hit the targets associated with them. With the exception of the three last programmatic objectives, the management objectives that guide the strategic approach and implementation of this plan involve many of the same management

measures: minimize impervious surfaces, retrofit old storm sewer systems and protect and restore wetlands and riparian corridors.

Several watershed management strategies are proposed to meet these objectives. They focus on addressing the adverse effects of future development and managing problems associated with existing stormwater management systems. Together the strategies provide the framework of a comprehensive approach for the targeted management measures, which constitute the actual steps for implementation. Below is a list of the key management strategies for the Niantic River Watershed.

- Mitigating the impacts of increased/increasing impervious surfaces from development.
- Enforcing state-of-the-art stormwater management practices for all development (both during and post-construction).
- Implementing municipal Stormwater Management Program Plans according to the General Permits for MS4s (CTDEP, 2004d), including retrofits for existing stormwater drainages and outfalls on the river.
- Requiring developers to incorporate low-impact site preparation and development techniques.
- Elevating the importance of homeowners' and business' "housekeeping" responsibilities.
- Protecting existing and restoring degraded vegetative and riparian buffers ("critical areas") where needed.

There are several ways in which to act on these management strategies. The toolbox of planning and zoning techniques available to all municipalities includes dozens of possible measures that can be applied to watershed protection goals. A comprehensive look at the toolbox is included in matrix form in Appendix F, which outlines possible protection tools, their assessed protection value, and their ease of implementation in Connecticut. The matrix was developed based on the 24 watershed protection issues (or threats) identified by the Eight Mile River Watershed Study. (Eight Mile Wild & Scenic Study Committee, 2005) Not all of the issues are directly relevant to water quality

protection and in many cases ease of implementation and protection value would vary by municipality; hence the table is provided as a reference but not a directive. The toolbox was referenced in this study during evaluation of priority recommendations, but other inputs were also used to focus on the most effective tools for water quality protection and enhancement, in terms of "bang for the buck".

What would bring about the greatest change, on the ground, for water quality protection, of all the tools available? The most immediate and valuable tools are believed to be those that are relatively easy to implement in Connecticut and that also have a good to excellent protection value (positive impact). For this study, recommended measures concentrate on developable land; areas that will not be preserved through acquisition or preservation. Each town has the discretion to pursue land preservation as a way to avoid development, but the focus of this study is to guide municipalities under the most prevalent "threat" scenario (development) in order to mitigate water quality impacts where/when they occur.

Sections 6.2.1 through 6.2.6 lists the priority actions, or goals, with recommendations for the most effective management actions. While preferred actions would be ones that are relatively easy for towns to implement, it would be fruitless to select easy measures if they were not effective for water quality protection. Fortunately, most of the actions considered by this study to be strongest in terms of bang for the buck <u>are</u> also relatively "easy", in the sense that they are authorized by law, have good precedents, and/or involve voluntary measures. These measures also work no matter what the zoning, or type of development; they can be applied to any part of town under any land use scenario.

6.2.1 <u>Mitigating the Impacts of Increased/Increasing Impervious Surfaces from Development</u>

- Protect existing wetlands, vernal pools and watercourses to maximum extent practicable (*i.e.* no alteration of areas with good existing functions and values)

- Protect or establish a vegetated buffer beyond wetland and watercourse boundaries (50-foot minimum width within which no alteration or vegetative removal is permitted in areas with existing established vegetation)
- Encourage and enforce non-structural, non-piped stormwater handling techniques wherever possible (*e.g.* surface flows, vegetative filter strips)
- Encourage porous pavements and other non-impervious solutions in all developments or redevelopment projects
- Require mitigation for any and all wetland/riparian impacts, to re-establish vegetative filtration zones in appropriately placed locations (even if upland locations are the only options)
- Encourage site development practices that provide for allowable densities with the minimum footprint
- Utilize design review to evaluate options for minimizing water quality impacts, no matter what type of development proposal is submitted, no matter what zoning
- Support and carry out municipal best management practices including regular street cleaning and maintenance/repair of municipal stormwater facilities
- Lot coverage/impervious surface restrictions
- Development restrictions on steep slopes (slope restrictions) or steep slope overlay zone establishing design criteria
- Education for developers, town staff and the public

6.2.2 Enforcing State-of-the-art Stormwater Management Practices for All Development (Both During and Post-construction)

- Codify & enforce use of the *Connecticut Stormwater Quality Manual* (CTDEP, 2004a) (stormwater management guidelines) and best management practices (BMPs) in all new developments or redevelopments (recommend implementation for control of both peak flow and volume for stormwater controls along with BMPs for water quality).

- Codify & enforce use of the *Connecticut Guidelines for Erosion and Sedimentation Control* in all new developments or redevelopments (CTDEP, 2002a)
- Embrace stormwater BMPs for all municipal roadway construction and other municipal projects
- Codify and enforce use of best site development practices, including construction staging and soil stabilization techniques
- Educate developers and town staff

6.2.3 Implementing Municipal Stormwater Management Program Plans (SWMPPs) According to the General Permits for MS4s (CTDEP, 2004d)

- Create a stormwater management utility for MS4s in order fund control measures
- Target resources to implement minimum control measures as outlined in the SWMPPs

6.2.4 Steering Developers Toward and/or Regulating Low-impact Site Design

- Utilize design review to evaluate options for minimizing water quality impacts, no matter what type of development proposal is submitted or zoning designation
- Codify and enforce use of best site development practices, including construction staging and soil stabilization techniques
- Develop incentive-based programs for developers to maximize protection and use of vegetative buffers (defined here as vegetative strips positioned to capture runoff from development positioned between the development and receiving wetlands/waters or stormwater conveyance structures)
- Codify and enforce lot coverage/impervious surface restrictions
- Develop slope restrictions or steep slope overlay zone establishing design criteria

6.2.5 Elevating the Importance of Homeowners' and Business' "Housekeeping" Practices

- Educate homeowners and targeted businesses (potentially businesses on large sites)
- Establish and/or enforce annual septic pump-out requirements and inspections

6.2.6 Restoring Vegetative and Riparian Buffers Where Needed

- Modify or enforce wetland regulations to require mitigation for any and all wetland/riparian impacts, with emphasis on re-establishing vegetated buffers (water quality filtration zones) in appropriately placed locations
- Use of incentive-based program(s) for developers to restore or establish vegetative buffers as part of site development
- Partner with the ConnDOT on state roadway projects in the Watershed to request Transportation Enhancement funding (available for habitat/ecological restoration projects under SAFTEA-LU)
- Educate developers, town staff, and the public

7.0 IMPLEMENTATION PROGRAM

Five components constitute the implementation program for this plan: *Organizational Structure, Information and Education, Schedule, Financial Strategy and Monitoring Program.* These components are necessary to take action and implement the suggested management measures. Much of this information comes from the Draft USEPA *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (October 2005) and the USEPA *Getting in Step: A Guide for Conducting Watershed Outreach Campaigns* (December 2003).

7.1 Organizational Structure

Section 5.0 of this plan discussed the organizational issues associated with implementing this watershed plan. It also made recommendations on how to overcome some of the institutional barriers to executing a watershed approach for managing nonpoint source pollution in the Niantic Watershed. Above and beyond the default option that each of the four municipalities must act independently to implement the recommended management measures of this plan, there must be a point person or group of people responsible for monitoring plan implementation. There are several possible approaches to meeting this need, two popular ones are listed here:

- Hire or appoint a "watershed coordinator" for the Niantic River Watershed. This position (equal to 1 full-time employee) would be dedicated to implementing this plan, *i.e.* conducting the inter-jurisdictional coordination, grant-writing and evaluation of plan implementation.
- Maintain the current project steering committee, but shift its responsibilities from planning to implementation. Its focus would be to refine the recommendations of this plan and implement them. This group may eventually be the core of a watershed partnership or coalition.

7.2 Information and Education Component

Developing and executing strategies to reach out to the variety of watershed stakeholders and raise their level of understanding about the *Niantic River Watershed Protection Plan* constitute the first component of implementation. All the management measures in this plan rely on certain groups of individuals that must be included in the watershed management process. Inclusion of these people begins by educating them about watershed issues and the proposed measures to address them.

When possible, outreach activities should build off existing efforts. Because a considerable amount of watershed educational research and development on national, state and local levels exists, there is little need to "start from scratch". For more information and additional help on I/E activities, visit http://www.epa.gov/owow/watershed/outreach/documents/getnstep.pdf.

Informational materials about the Niantic River, coastal watershed management in Connecticut and stormwater management are readily available, current and applicable to the Niantic River. Several of these resources are listed in here:

- *"The Niantic River…and what you can do to protect it"* – An educational brochure published by the Waterford – East Lyme Shellfish Commission in 2001.
- *Save the River, Save the Hills* holds regular information meetings and invites researchers and managers to come and speak about the Niantic. It also holds an annual kayak regatta.
- *Jordan Cove Watershed Demonstration Project* – This nationally-recognized project generated abundant press and educational materials that could be modified for the Niantic River Watershed.
- *Town of Waterford Stormwater Management Program Plan* – documents several current and proposed stormwater education efforts. Other towns adopt similar efforts or share the costs of implementation with Waterford.

Building off these important milestones to educate people in the Niantic River region, this plan, as recommended by the USEPA (USEPA, 2005a) proposes an Information and Education program consisting of six steps:

1. Define Information and Education goals and objectives.
2. Identify and analyze the target audiences.
3. Create the messages for each audience.
4. Package the message to various audiences.
5. Deliver the messages.
6. Evaluate the Information and Education program.

For each step, the plan proposes elements that may be considered a starting point for implementation. These are proposed elements; however it is expected that municipal staff, working along with other watershed partners, will have to customize these elements for implementation.

Step 1: Information and Education Goals and Objectives

The overarching goal of this Information and Education component is:

To increase the involvement of individuals and organizations in the protection of the Niantic River and its watershed.

Specific Information and Education goals and objectives are listed below. Some of these goals and objectives are broader than the others, some overlap, and in some cases, it may be necessary to raise awareness about a specific water quality issue. In other cases, a water quality issue may be commonly understood; therefore, the goal may be to educate people about what to do to reduce the issue. As plan implementation proceeds and Information and Education objectives are met, they will have to be updated to reflect progress and new challenges.

GOAL: Increase stakeholder awareness about the link between shellfish closures and sources of bacterial pollution in the Niantic River.

Objective 1: Within six months, complete a public outreach campaign for shoreline neighborhoods in East Lyme and Waterford about potential sources of bacterial pollution.

Objective 2: Every year implement stormwater management education and outreach measures throughout the watershed. For reference, towns could copy components of Waterford's Stormwater Management Program Plan. These components include good housekeeping tips for homeowners (*e.g.* lawn care, pet waste, wildlife), stormdrain stenciling, and household hazardous waste cleanups

Objective 3: In the Winter of 2006, hold a workshop for town elected officials and department staff to learn about the formation and implementation of a stormwater utility district.

GOAL: Increase stakeholders' level of knowledge about nutrient loading and the health of the Niantic River Estuary

Objective 1: Within six months, complete a training for relevant municipal staff and the development community about the fate and transport of nitrogen in the watershed and how best to control it through the development process in order to promote the management of nitrogen-loading in the watershed.

Objective 2: Before Spring 2007, arrange a training session for municipal staff, interested volunteers and other watershed stakeholders about monitoring water quality for nitrogen in order to create interest and knowledge for a citizen - based water quality monitoring program.

GOAL: Educate stakeholders about the watershed management approach and the Niantic River watershed.

Objective 1: Within two months of due completion, publish an executive summary of the watershed protection plan in local papers and municipal communications in order to raise awareness about the plan.

Objective 2: Within six months, hold town meetings to endorse the watershed protection plan as an advisory document to guide future land use decisions in all four watershed communities.

GOAL: Educate land use decision makers about the value of vegetated riparian buffers in the protection of water quality.

Objective 1: Within one year (included with other workshops/trainings) promote the protection of riparian buffers for the benefit of water quality and habitat protection.

Step 2: Target Audiences

Part of the Committee's or Partnership's challenge in implementing an Information and Education campaign is to identify the target audiences. Table 7.2-1 presents examples of target audiences based on watershed issues and/or management objectives.

Table 7.2-1. Watershed Issues/Objectives and I/E Target Audience

Issue / Management Objective	Potential Target Audience
General watershed education	Schoolchildren and their parents; garden clubs, neighborhood associations; fair and festival audiences
Stormwater management	Local DPW and engineering staff; planning and zoning officials; local and state transportation staff; developers/homebuilders
Proper fertilizer and home chemical use	Homeowners; garden clubs
Riparian corridor protection	Local DPW and engineering staff; planning and zoning officials; local and state transportation staff; developers/homebuilders

Step 3: Create the Messages for each Audience

Message for Bacterial Pollution/Shellfish Closures

Message for Nutrient Loading

Message for Watershed Approach

Message for Riparian Buffers

Step 4: Package the Message to Various Audiences

Once the message has been agreed upon, it is important to package it appropriately for different audiences. There are four obvious ways to package a message for watershed-related information: 1) work with the media to package, 2) develop effective print materials, 3) hold events and presentations, 4) leverage existing resources by sharing materials and cooperative efforts.

Step 5: Deliver the Message

Delivery of the message demands that the actual "messenger" be considered and appropriately selected. Below is a list of common delivery mechanism used for information and education campaigns:

- Mailing lists
- Phone calls
- Interviews
- Focus groups
- Presentations to boards, commissions, trade groups, neighborhood associations, library groups, garden clubs, *etc.*

Step 6: Evaluation of Information and Education Component

Before embarking on any facet of an information and education campaign it is critical to define the "measures of success" the group will use to determine if it

has met its Information and Education goals. Indicators, or milestones, are an excellent way to establish how success will be measured from the beginning. Indicators must be clear, realistic, and practical. For an outreach campaign, a group may consider *programmatic* or *social* indicators (Table 7.2-2):

Table 7.2-2. I/E Indicators of Success

Type of Indicator	Example Indicator	Method of Measurement
Programmatic	Number of brochures mailed	Mailing lists
Programmatic	Number of participants	Attendance lists
Social	Number of follow-up phone calls	Phone records
Social	Increased awareness of watershed issues	Pre- and post- surveys, interviews, focus groups
Social	Number of landowners requesting assistance for management practice installation	Phone records, site visits
Social	Number of landowners aware of technical and financial assistance for watershed management measures	Pre- and post- surveys, interviews

7.3 Schedule

The implementation schedule (Table 7.3-1) provides a timeframe for taking action on the plan's recommendations. For each measure, a responsible entity is identified and a presentation of the relative cost of implementation.

Table 7.3-1. Implementation Schedule

Measures	Responsible Entity	Relative Cost/Effort
Year 1		
Stormwater Management		
1. Stormwater Utility Establishment (ordinance adoption) and Administration	Board of Selectmen; Municipal departments: Planning, Zoning, DPW and Engineering	Staff time (1/2 FTE) funded by utility for SW coordinator
2. SWMPP Implementation	Municipal DPW and Engineering	$3.75 - $6.00 per citizen per year (Reese, --)
3. Stormwater Retrofits	Municipal departments: DPW and Engineering	$30 – 45K per retrofit
4. Low impact development/stormwater management alternatives	Municipal departments: Planning, Zoning, and Engineering	
Riparian Buffers		
5. Adopt a riparian buffer overlay zoning district based on delineation of perennial and associated wetlands (100 feet for larger streams; 50 feet for smaller, head water streams)	Municipalities (Selectmen, planning and zoning)	Begin with WVA maps, hire consultant or work with UCONN Cooperative Extension
6. Restore degraded riparian buffers including regarding and revegetation	Municipalities, CTDEP, NRCS, NOAA	Staff time, $5 – 100K per project, size dependent
7. Adopt management standards for existing buffers near developments, roadways and other developed areas, including demarcation	State and local transportation staff, DPWs, engineering.	Signage, training, educational materials
8. Incorporate buffer education into other watershed and NEMO training and workshops	NEMO, municipal boards and commissions	Gathering materials
Year 1		
Watershed and Land Use Planning		
9. Use drainage maps (impervious surface, priority indices) in the development review process	Planning and zoning boards and commissions	Policy change – plan adoption
10. Limit rezoning that will result in more impervious surface and/or less wetlands in critical drainage bases.	Planning and zoning staff, boards, and commissions	Ordinance change, staff time
11. Cluster and/or conservation subdivision ordinances	Montville - Planning and zoning staff, boards, and commissions	Ordinance change, staff time

Measures	Responsible Entity	Relative Cost/Effort
12. Include riparian protections and low impervious surface requirement in all development zones	Planning and zoning staff, boards, and commissions	Ordinance change, staff time
13. Hire a watershed planner/coordinator	CTDEP, SCCOG, municipalities	1 FTE ($35 – 50K annual salary)
Low Impact Development/Better Site Design		
14. LID techniques in priority areas	Planning and zoning staff, boards, and commissions	Ordinance change, staff time
15. Zoning ordinance changes to include LID techniques	Planning and zoning staff, boards, and commissions	Ordinance change, staff time
16. Hold a follow-up contractors/builders workshop	Contractors, builders, engineers	Staff time, workshop expenses
Watershed Education		
17. Continue homeowner education and outreach through presentations, events and mailings	CTDEP, NEMO, municipalities, Save the River, Save the Hills	Program funding, volunteer time, staff time
18. Expand NEMO offerings throughout watershed building over past and recent efforts	NEMO, municipalities	Staff time, workshop funding
Land Conservation		
19. Set watershed land preservation goals and targets based on available (undeveloped) land and priority watershed areas	CTDEP OLISP, municipal land trusts, private land trusts, TPL, TNC, Friends of Oswegatchie	Staff time, GIS work
20. Protect acres of priority watershed areas every year (based on goals/targets)	Municipal land trusts, private land trusts, TPL, TNC	$750,000 to $1.5 million per year
Year 1		
Stream Restoration		
21. Conduct assessments of tributaries to establish stream restoration priority locations and needs	CTDEP WPLR Fish and Wildlife, USDA NRCS, NOAA Fisheries, NOAA Restoration Program, landowners	Staff time, GIS analysis (begin with WVA analysis)
22. Recruit landowners to participate in stream restoration projects (perhaps begin on publicly-owned land)	NRCS, NOAA, landowners	Staff time, cost-share project ($25 – $200K per project, size dependent)

Measures	Responsible Entity	Relative Cost/Effort
Long-term Water Quality and Biological Monitoring		
23. Develop monitoring plan and quality assurance program plan	USEPA; CTDEP; Save the River, Save the Hills; UCONN	Staff time, start-up funds
Years 2-6		
Stormwater Management		
1. Stormwater Retrofits	Municipal departments: DPW and Engineering	$30 – 45K per retrofit
Riparian Buffers		
2. Continue restoration and educational efforts		
3. Continue educational efforts		
Watershed/Land Use Planning		
4. Continue zoning revisions and plan updates based on ordinance amendments	Municipal planning and zoning	Staff time
5. Continue support for watershed planner/coordinator	State, regional, and/or local support	Salary
Better Site Design		
6. Additional workshops and trainings	NEMO, private sector	Staff time, expenses
Watershed Education		
7. Continue homeowner education	NEMO, Save the River, Save the Hills, CTDEP	Staff time, expenses
Years 2-6		
Land Conservation		
8. Protect acres of priority watershed areas every year (based on goals/targets)	Municipal land trusts, private land trusts, TPL, TNC	$750,000 to $1.5 million per year
Stream Restoration		
9. Continue working with landowners to participate in stream restoration projects	NRCS, NOAA, landowners	Staff time, cost-share project ($25 – $200K per project, size dependent)

7.4 Financial Strategy

Securing funding to support the implementation of the recommendations made in this watershed management plan may be the most challenging task to the individuals and organizations responsible for moving the plan forward. However, to effectively protect the Niantic River Watershed, funding must be generated to support management activities. There are many diverse sources of funding available for watershed management and protection activities. There are several important factors to consider prior to searching for and acquiring funding:

- *Strength in numbers* – Coalitions and partnerships stand a better chance in locating funding sources and acquiring funding. Several groups standing behind common goals are more powerful and more influential. Representatives from East Lyme, Montville, Salem, and Waterford teaming with members of *Save the River, Save the Hills*, and staff from CTDEP, USGS, UCONN make a powerful coalition for discussing issues pertaining to the Niantic and seeking funding from diverse sources to address them.

- *Prepare for competition* – Most funding sources require an application to participate in a competitive award process. It is critical that watershed stakeholders be careful and strategic about where and how they apply for financial assistance. For example, it is advantageous to approach a funding source that has specific interests in the watershed or region.

- *Be multi-talented* – The watershed coalition or partnership should have members with a variety of backgrounds, interests and professional experiences. To acquire funding, it is important to show that the coalition/partnership has the vision, capacity and technical capability to get the project done.

- *Start somewhere* – It is easy for watershed groups, especially newly-formed ones, to be overwhelmed by the amount of work it takes to acquire funding. However, there is a beginning to the process and it usually takes shape by pursuing one or two funding opportunities.

- *Use what you already have* – With a little creative thinking, watershed groups can identify and contact locally-based financial and technical resources. These

"homegrown" resources can be used as leverage for more funding and support. For example, county officials and department staff (*e.g.* public works, planning, transportation) have knowledge and access to information related to environmental management. Local business and organizations (*e.g.* churches, Boys and Girls Clubs, Girl Scouts of America) are usually willing to support projects that will benefit their community. In both instances, local politicians and businesses usually have the "political capital" to get projects moving.

- *Ask for free advice and in-kind services* – If you need a video, ask the local television station for script and production assistance. If you need monitoring assistance, work with your local water department and your local school system. Do not forget that saying thank you in public, it will go a long way towards getting additional help next time.

Tip: no one gives money to a group without a plan for how to use it. Financial assistance can come from unusual places and innovative sources once the group has a solid plan.[19]

The Internet has made it possible to search for, contact and apply to hundreds of funding sources to implement this watershed management plan. These sources include funding opportunities from federal, state, local and private sources. To start the process, identify as many as four or five potential sources. Make sure that they are different types of sources so that you diversify your opportunities (*e.g.* find one federal, two state, and two private grant sources to apply to).

In order to identify these initial opportunities in an efficient manner, the USEPA has developed *Guidebook of Financial Tools: Paying for Sustainable Environmental Systems*, which is available for download at www.epa.gov/efinpage/guidbkpdf.htm. It was developed by USEPA's Environmental Financial Advisory Board and the Agency's network of university-based Environmental Finance Centers. It should be a helpful guide along the road to acquiring funding for environmental projects (USEPA, 2005a).

[19] This tip comes from a 1999 edition of Know Your Watershed, an information clearinghouse for watershed coordinators. Know Your Watershed is now available online at http://www.ctic.purdue.edu/KYW/.

The USEPA and other federal government agencies offer several, easily-accessible guides to funding sources that can be accessed through the Internet. A good place to start is USEPA's website for funding nonpoint source pollution management projects (http://www.epa.gov/owow/nps/funding.html). USEPA has also produced the *Catalog of Federal Funding Sources for Watershed Protection.* This catalog is an interactive website that helps match watershed project needs with funding sources. See the website for more information: www.epa.gov/watershedfunding. For a far-reaching funding search, the federal government maintains a large database of the expansive list of federal funding sources. The Catalog of Federal Domestic Assistance (www.cfda.gov) provides access to the database of all federal programs available (USEPA, 2005a).

Another online resource that watershed groups and stakeholders may access is available through the River Network. This membership organization serves the watershed organizations of the United States with technical and organizational assistance so they can achieve their goals. One of the many services they offer is a directory of organizations that fund watershed management projects. The *Directory of Funding Sources for Grassroots River and Watershed Conservation Groups* lists private, corporate, and federal funding sources (www.rivernetwork.org).

Some of the more popular sources of watershed funding are listed in Table 7.4-1. It is important to keep in mind that funding levels and application opportunities are subject to change. Therefore, it is important to contact a representative from each agency or organization early in the process in order to better understand current opportunities and guidance for accessing them.

Table 7.4-1. Watershed Management Funding Organizations and Opportunities*

FUNDING SOURCE	PROGRAM DESCRIPTION	MATCH REQUIREMENT	ELIGIBILITY	CONTACT INFORMATION
FEDERAL/STATE				
SECTION 319	The CTDEP provides financial support to regional and municipal government and non-government organizations. CTDEP administers a competitive 319 grant program that receives approximately 30-40 applications annually for new projects, and typically funds 20-25 projects targeting both priority watersheds and statewide issues.	40% non-federal match	Phase I and II permitted areas and confined animal feeding operations generally not eligible.	CT Nonpoint Source Management http://dep.state.ct.us/wtr/nps/index.htm Stan Zaremba at 860-424-3730 stanley.zaremba@po.state.ct.us
SECTION 6217	Section 6217 of the CZARA of 1990 requires the State of Connecticut to implement specific management measures to control NPS pollution in coastal waters. Management measures are economically achievable measures that reflect the best available technology for reducing pollutants.	NA	Technical assistance is available to all CT communities within the coastal zone.	CT CNP http://dep.state.ct.us/olisp/coastalnonpoint/index.htm
CT CLEAN WATER FUND	Provides grants and low-interest loans for the construction of municipal wastewater facilities and implementation of nonpoint source pollution control, river restoration, estuary protection and public access projects.	NA – 20% or 50% grant + remainder on loan.	Municipalities and water pollution control authorities	http://dep.state.ct.us/wtr/cwa/cwfund.htm
HAZARD MITIGATION GRANT PROGRAM	Provides financial assistance to state and local governments for projects that reduce or eliminate the long-term risk to human life and property from the effects of natural hazards.	75% Federal 25% Local	State and Local Governments	CT BWPLR http://dep.state.ct.us/wtr/index.htm

FUNDING SOURCE	PROGRAM DESCRIPTION	MATCH REQUIREMENT	ELIGIBILITY	CONTACT INFORMATION
SAFETEA-LU	SAFETEA-LU authorizes the Federal surface transportation programs for highways, highway safety, and transit for the 5-year period 2005-2009. It provides funding for transportation enhancements including; wetland mitigation, highway runoff pollution control, and roadside landscaping.	80% Federal 20% Local	Local Governments, profit and non-profit entities, and colleges and universities	USDOT Federal Highway Administration http://www.fhwa.dot.gov/safetealu/
ENVIRONMENTAL QUALITY INCENTIVE PROGRAM (EQIP)	Provides technical assistance, cost-sharing, financial incentives, and producer education related to soil, water, air, wildlife and other related natural resource concerns.	40% property owner cost share	CT Landowners	NRCS – Connecticut http://www.nrcs.usda.gov/programs/
SECTION 206 - AQUATIC ECOSYSTEM RESTORATION	Provides funding to improve, protect, and restore aquatic ecosystems including streambank restoration and planning and construction activities.	35% non-federal match	Local governments	http://www.sam.usace.army.mil
CONGRESSIONAL APPROPRIATION - DIRECT FEDERAL FUNDING	Supports projects of national significance.	Congressman Rob Simmons (860-886-0139) Sen. Chris Dodd (800-334-5341) Sen. Joseph Lieberman (800-225-5605)		
STATE APPROPRIATION - DIRECT STATE FUNDING	Supports projects of state significance.	Rep. Ed Jutila (Ed.Jutila@cga.ct.gov) - 37th District – East Lyme & Salem, Rep. Elizabeth Ritter (Elizabeth.Ritter@cga.ct.gov) – 38th District – Montville & Waterford Sen. Andrea Stillman (Stillman@senatedems.ct.gov) – 20th Senate District		

GRANT PROGRAMS			
NATIONAL FISH AND WILDLIFE FOUNDATION (NFWF)	Awards challenge grants for natural resource conservation projects.		NFWF http:/www.nfwf.org
ENVIRONMENTAL EDUCATION GRANTS	Supports environmental education projects that enhance the public's awareness, knowledge, and skills to make informed decisions that affect environmental quality.		http://www.epa.gov/enviroed/grants.html
WATERSHED PROTECTION AND FLOOD PREVENTION PROGRAM	Program provides technical and financial assistance to address resource and related economic problems on a watershed basis.		CT BWPLR Flood Management Section (860) 424-3706
WATER QUALITY COOPERATIVE AGREEMENTS	Support the creation of unique and new approaches to meeting sanitary sewer, and combined sewer outflows, biosolids, and pretreatment requirements, as well as enhancing state capabilities.		http://www.epa.gov/owm/cwfinance/waterquality.htm
WATERSHED ASSISTANCE GRANTS	Supports organizational development and capacity building for watershed partnerships with diverse membership.		http://www.epa.gov/owow/watershed/funding.html
NOAA AND NATIONAL FISH AND WILDLIFE: FIVE-STAR RESTORATION PROGRAM	Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community.		http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners/nfwf.html
U.S. FISH AND WILDLIFE SERVICE (USFWS) COOPERATIVE ENDANGERED SPECIES CONSERVATION FUND	Assists in the development of programs for the conservation of endangered and threatened species. There are four program areas; Conservation Grants, Habitat Conservation Planning Assistance Grants, Habitat Conservation Plan Land Acquisition Grants, and Recovery Land Acquisition Grants.	States and territories that have entered into cooperative agreements with the USFWS	http://www.fws.gov/endangered/grants/index.html
URBAN AND COMMUNITY FORESTRY CHALLENGE COST-SHARE GRANT PROGRAM	Grant awards are based on recommendations by The National Urban and Community Forestry Advisory Council.		http://www.treelink.org/nucfac/ccs_info.htm
PRIVATE FOUNDATION GRANTS AND AWARDS	Private foundations are potential sources of funding to support watershed management activities. Many private foundations post grant guidelines on websites. Two online resources for researching sources of potential funding are provided in the contact information.		www.rivernetwork.org

OTHER	
MEMBERSHIP DRIVES	Membership drives can provide a stable source of income to support watershed management programs.
DONATIONS	Donations can be a major source of revenue for supporting watershed activities, and can be received in a variety of ways including: individual donations, family foundations, community foundations, corporations, federated funds, and church and civic groups.
USER FEES, TAXES, AND ASSESSMENTS	Taxes are used to fund activities that do not provide a specific benefit, but provide a more general benefit to the community; the user may not be able to avoid paying the tax. Assessments must show a benefit to the property owned by the user. There are various forms of taxes and assessments. It is important to note that, while taxes can create a solid funding base that can be used to fund annual capital and operating costs, there is often political pressure to keep taxes low and intensify competition for these resources.
RATES AND CHARGES	Alabama law authorizes some public utilities to collect rates and charges for the services they provide. Because watershed management programs provide benefits to water and wastewater systems by protecting water supply sources and providing receiving water for wastewater effluent, water and wastewater utility systems often provide funding for watershed management programs.
STORMWATER UTILITY DISTRICTS	A stormwater utility district is a legal construction that allows municipalities to designated management districts where storm sewers are maintained in order to the quality of local waters. Once the district is established, the municipality may assess a fee to all property owners within the district to maintain the storm sewer system.
IMPACT FEES	Impact fees, which also are known as capital contribution or facilities fees or system development charges, among other names, typically are collected from developers or property owners at the time of building permit issuance to pay for capital improvements that provide capacity to serve new growth.
SPECIAL ASSESSMENTS	Special assessments are created for the specific purpose of financing capital improvements, such as provisions, to serve a specific area. Once the special assessment has been created, special assessment bonds can be issued, which are secured by liens on the properties benefited by the improvements.
SALES TAX/LOCAL OPTION SALES TAX	Local governments, both cities and counties, have the authority to add additional taxes. Local governments can use tax revenues to provide funding for a variety of projects and activities.

PROPERTY TAX	These taxes generally support a significant portion of a county's or municipality's non-public enterprise activities. However, the revenues from property taxes also can be used for public enterprise projects, and to pay debt service on general obligation bonds issued to finance system improvements.
EXCISE TAXES	These taxes require special legislation, and the funds generated through the tax are limited to specific uses. Examples include the lodging, food, and beverage tax, which generate funds for promotion of tourism; and the gas tax, which generates revenues for transportation–related activities.
Bonds and Loans	Bonds and loans can be used to finance capital improvements. These programs are appropriate for local governments and utilities that need to make improvements to improve and protect water resources. The cost of the improvements is borrowed through the issuance of bonds or a loan. Associated with the issuance of a bond or loan must be a source of funding for the payment of the resulting debt service on the loan or bonds.
Investment Income	Some organizations have elected to establish their own foundations or endowment funds to provide long-term funding stability. Endowment funds can be established and managed by a single organization-specific foundation or an organization may elect to have a community foundation to hold and administer its endowment. With an endowment fund, the principal or actual cash raised is invested. The organization may elect to tap into the principal under certain established circumstances.
EMERGING OPPORTUNITIES FOR PROGRAM SUPPORT	
Water Quality Trading	Trading allows regulated entities to purchase credits for pollutant reductions in the watershed or a specified part of the watershed to meet or exceed regulatory or voluntary goals. There are a number of variations for water quality credit trading frameworks. Credits can be traded, or bought and sold, between point sources only, between NPSs only, or between point sources and NPSs.
PowerTree Carbon Company, LLC	Consortium of conservation groups and electric power generators in the southeast whose goal is to restore strategically located tracts of hardwood forests to increase carbon sequestration and other ecological functions. Power generators are credited for the carbon storage of the restored forests and conservation groups gain large tracts of protected forests which provide additional benefits such as; increased value for passive human use, wildlife habitat, maintenance of native species diversity, soil conservation and water quality buffering functions. Additional program and contact information is available online at: http://www.powertreecarboncompany.com/

Mitigation and Conservation Banking	Mitigation and Conservation banks are created by property owners who restore and/or preserve their land in its natural condition. Such banks have been developed by public, nonprofit, and private entities. In exchange for preserving the land, the "bankers" get permission from appropriate state and federal agencies to sell mitigation banking credits to developers wanting to mitigate the impacts of proposed development. By purchasing the mitigation bank credits, the developer avoids having to mitigate the impacts of their development on site. Public and nonprofit mitigation banks may use the funds generated from the sale of the credits to fund the purchase of additional land for preservation and/or for the restoration of the lands to a natural state.
OPTIONS OFTEN OVERLOOKED OR UNNOTICED	
Public and Private Partnerships	Having both public and private stakeholders at the table when pursuing funding for the implementation of management strategies is vital. Public entities have advantages associated with public financing, and the involvement of these entities can bring key decision-makers to the table. Private entities sometimes can contribute significant financial support, needed expertise, and voluntary labor.
Redirection of Existing Programs and Funding	For priority projects, one way to fund programs is to change the priorities or focus of existing activities to help achieve the objectives of the watershed management plan. This could entail reducing funding for other activities and making such resources available to fund the watershed management program.

One of the key questions to arise when pursuing funding for watershed projects is: *how much money will we need to make this project happen?* For some watershed groups, this question can be a real challenge. If the group has members who are technically and financially savvy they may be able to develop a project cost estimate on their own, with very little outside help. If the group does not have members who can provide this critical service they must search outside of the group for help. This type of assistance is available from several sources, online and through environmental agencies.

The Environmental Finance Center (EFC) at Boise State University in Idaho is an excellent resource for watershed organizations of all sizes and missions. They perform direct financial services (*e.g.* training) and have developed financial tools that can help stakeholders figure out what level of funding they may need and where to search for it. Some of the tools they developed are limited in scope to the Pacific Northwest. However, the *Plan2Fund*™ and *A Guidebook of Financial Tools* are readily accessible on-line.

Plan2Fund™ is a software package that can be downloaded from the EFC and installed (for free) on a local computer. The program helps organizations determine the amount of outside funding necessary to achieve the goals and objectives of their watershed management plan. The computer program asks the user to estimate implementation costs for their goals and objectives, evaluate local funding options and identify gaps in funding. With the output from *Plan2Fund*™, users can then search EFC's Directory of Watershed Resources database for federal, state and private funding sources based on identified funding needs. For more information, visit the EFC's "Tools & Services" Website at: http://sspa.boisestate.edu/efc/services.htm (Accessed on May 11, 2006).

It is also important to keep in mind that many of the public and private agencies have other resources besides money to offer. All of the federal and state agencies mentioned in this section and throughout the plan have experts on staff who can assist watershed groups with technical questions that will help scope a project. Private organizations are also valuable resources for financial and project management advice.

When creating a budget for a watershed project ask questions of agency or organization staff to refine your funding request or application.

7.5 Monitoring

- Of utmost important to a monitoring strategy for the Niantic River Watershed is the establishment of a repository for baseline water quality data for the river and its tributaries. Next, track the implementation of the management strategies. Monitoring must provide useful data that measures the performance of the prescribed activity. This information ultimately functions as a report of progress (or lack thereof) and should inform future planning and management decisions.

7.5.1 Existing Monitoring

There are several ongoing water quality and biological monitoring efforts concerning the Niantic River and its tributaries (Table 7.5-1). These efforts are integrated into several different studies and programs, of which several are associated with regulatory requirements (*i.e.* conditions of a permit). There is no central repository for this data, although there is a considerable degree of data-sharing between agencies and organizations.

Table 7.5-1. Existing Monitoring Activities

Program/Agency/Organization	Monitoring Scope	Monitoring Frequency
CT DA/BA Sanitary Surveys for East Lyme and Waterford	Water quality – bacteria	Triennially, 12-year rotation
CTDEP Rapid Bioassessment in Wadeable Streams and Rivers by Volunteer Monitors Program (RBV)	Macroinvertebrates, physical data	Annually in the fall
Millstone Environmental Laboratory Studies	Physical, chemical, biological	Weekly
USGS investigations on the Niantic	Physical, chemical	Research-specific
UCONN Avery Point Marine Sciences Research	Physical, chemical, biological	Research-specific

Program/Agency/Organization	Monitoring Scope	Monitoring Frequency
Save the River, Save the Hills Volunteer Monitoring	Physical, chemical	Seasonally
Stormwater Best Management Practices Performance Monitoring – Private entities	Physical, chemical	Permit-specific
Southeastern Connecticut Water Authority Source Water Monitoring	Physical, chemical, biological	Daily, weekly
Municipal Environmental Planning/Wetlands Monitoring	Physical, chemical, biological	Unknown

7.5.2 Monitoring Objectives

A monitoring program in the watershed should be developed according to objectives that will satisfy watershed management needs. These objectives can be as broad or specific as they need to be so long as they identify the underlying purpose for conducting a monitoring program. Some possible monitoring objectives for the watershed coalition or partnership are:

- Develop a baseline of water quality and biological integrity of the tributaries of the Niantic River.
- Build future monitoring efforts from current efforts.
- Continue monitoring and assessment of water quality and aquatic integrity of the Niantic River.
- Evaluate monitoring data against performance measures (*e.g.* indicators, targets) to evaluate the effectiveness of the watershed protection plan.
- Monitor impervious surface cover/land use on watershed and local basin basis.
- Monitor net loss of wetlands and riparian corridors/streamside forests.

7.5.3 Proposed Monitoring Approach

A monitoring plan should be developed to meet each of the objectives listed in Section 7.7, outlining the monitoring locations, types of monitoring, and parameters. The monitoring plan should also be reviewed periodically to determine if it is meeting the objectives. In addition, watershed objectives may change over time as additional information is learned about the health of the watershed. Thus, the monitoring plan also should be reviewed in light of new information and any changed watershed plan objectives.

Monitoring efforts should track the effectiveness of the management measures, when implemented, to improve (or protect) water quality (Table 7.5-2). The Niantic River is in need of water quality *restoration* at present. Levels of indicator bacteria and nitrogen should be tracked to measure management performance. These measures would hold true for the mainstem of the Niantic as well as its freshwater tributaries. More importantly to the tributaries and low order streams are the buffer and stream channel condition targets.

Table 7.5-2. Management Objective and Indicator Measures

Management Objective	Indicator/Target	Measure
Reduce bacterial loads from stormwater outfalls and runoff.	Fecal coliform: Geometric Mean less than 14/100ml; 90% of Samples less than 43/100ml (CTDEP, 2002c)	Decrease in fecal coliform counts in samples
	Enterococci: Geometric Mean less than 35/100ml; Single Sample Maximum 500/100ml	Decrease of enterococci counts in samples
Reduce nutrients loading from stormwater outfalls and runoff.	Total Nitrogen: Maximum of 30% annual N loading to the Niantic River OR Inorganic Nitrogen: minimize loadings to below recommended eelgrass threshold (0.3 mg/l) (USEPA, 2000).	Decrease in total nitrogen loadings
Minimize flooding impacts by improving peak and volume [stormwater] controls from impervious surfaces.	Peak flow volume and velocity: Minimized peak velocity for 1-yr, 24-hr storm events (CTDEP, 2004a).	Peak flow volume of outfalls to tributaries less than 400 cfs.

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