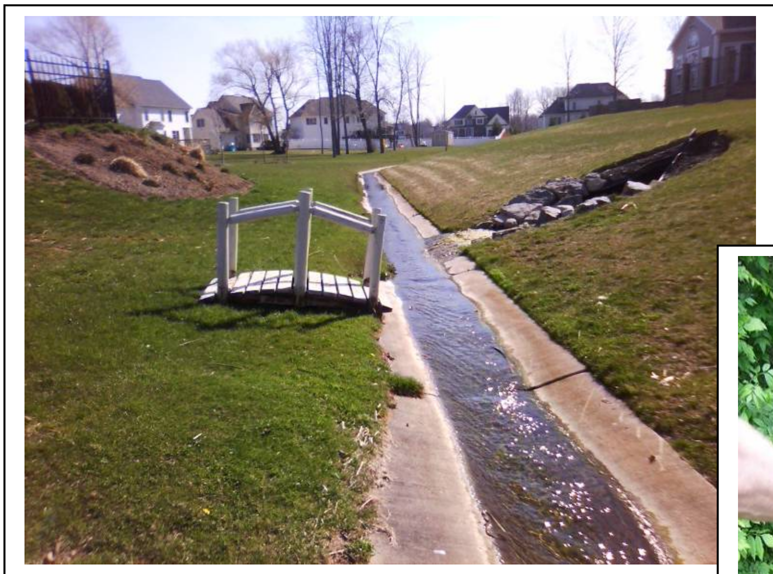
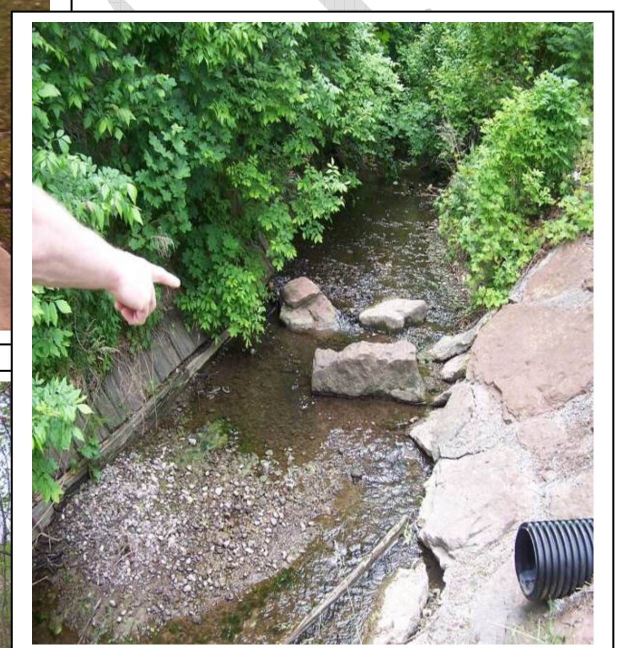
Shipbuilders Creek Stormwater Assessment and Action Plan





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Shipbuilders Creek Stormwater Assessment and Action Plan is a Pilot plan of the Monroe County Stormwater Action Plan

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List of Abbreviations

cfs	cubic feet per second (rate of water flowing)
CWP	Center for Watershed Protection
EMC	Event Mean Concentration
EPA	US Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
H.S.	High School
ICM	Impervious Cover Model
LIDAR	Light Detecting And Ranging
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
POC	Pollutant of Concern
SC	Shipbuilders Creek
TMDL	Total Maximum Daily Load
USGS	US Geological Survey
WTM	Watershed Treatment Model

Executive Summary

Shipbuilders Creek (SC) is an eight square mile watershed east of Rochester NY, originating in the town of Penfield, flowing north through the town of Webster and, discharging to the Rochester Embayment of Lake Ontario (Figure E1). SC was selected as the pilot assessment due to its water quality impairments and small size. The New York State Water Quality Section 305b Report (NYS DEC, 2004) states that SC has impaired segments and in 2008, SC was elevated to the New York State 303(d) list of impaired waters. Impairments reported in the list for Shipbuilders Creek are high dissolved oxygen demand, phosphorus, pathogens and silt/sediment with industrial, municipal, septic systems, construction and urban storm runoff as possible pollution sources. In Shipbuilders, Pollutants of Concern (POC) are phosphorus and pathogens which can often be found at significant concentrations in urban stormwater discharges.

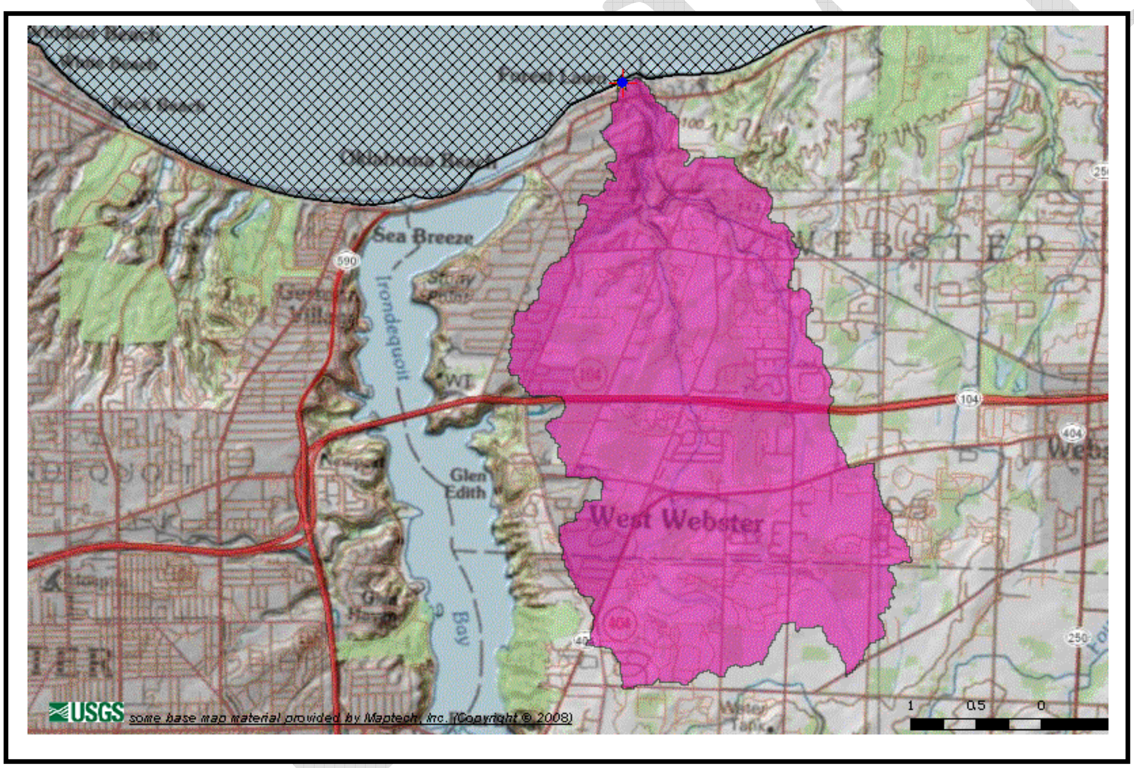

Figure E.1 Shipbuilders Creek Watershed in Monroe County

Monroe County has long been active in water quality initiatives and early in 2009, Monroe County's Stormwater Coalition (Coalition) began work on a comprehensive, county-wide Stormwater Action Plan to protect and improve the County's waters. The project received seed money from NYS Department of Environmental Conservation (NYSDEC) and technical support from the Monroe County Department of Environmental Services. A Stormwater Action Plan Committee was formed to guide the process and also developed the overriding goal to "restore, preserve, and protect" waters of Monroe County.

In addition, the Stormwater Action Plan is a step towards addressing requirements in the New York State General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4 permit). The 2010 MS4 permit states *"…if a small MS4 discharges a stormwater pollutant of concern (POC) to impaired waters…the permittee must ensure no net increase in its discharge of the listed POC to that water. By January 8, 2013, permittees must assess their progress and evaluate their Stormwater Management Program with respect to the MS4's effectiveness in ensuring no net increase…The assessment shall be done using department supported modeling of pollutant loading…"*

While full details of "no net increase" have not yet been established by NYSDEC at the time of this writing, permittees in Monroe County are moving to address the permit requirement through the Stormwater Action Plan. Due to limited funding, the Coalition is taking a stepped approach, beginning with the work of this pilot Stormwater Assessment and Action Plan (SWAAP) for Shipbuilders Creek.

The SWAAP presents recommendations for the Creek's protection, restoration and removal from the New York State 303(d) impaired waterbodies list over a 15 year timeline. In addition, the process used to develop the SWAAP can be used to assess all Monroe County streams and become the basis for the county-wide Stormwater Action Plan. The measure for success will be *no net increase* in phosphorus and pathogens delivered to Lake Ontario with the ultimate goal of a reduction of these pollutants.

1. Assessment

Many stormwater professionals report that achievable and sustainable results are best accomplished through study, planning and implementation at the subwatershed level – an area approximately 2 to 15 square miles (1,200 -10,000 acres). The SC assessment process included six steps: desktop assessment of watershed characteristics; water quality sampling; stormwater modeling; stream corridor assessment; an upland survey of "stormwater hotspots"; and a restoration inventory. Figure E.2 shows a section of stream on SC where typical streamside vegetation has been removed. Stream bank or riparian vegetation creates habitat for aquatic organisms and buffers the stream from impacts from land development such as lawn care chemicals and temperature increases.

Figure E. 2 Stream Reach with no Stream Buffer

Together, the stream and upland assessment methods allowed project staff to identify a number of pollution source control, on-site stormwater retrofits, riparian reforestation, stream restoration, discharge prevention and upland reforestation projects within the subwatersheds.

Common observations in the field included a lack of forested stream buffers, particularly in residential neighborhoods, significant stream bank erosion in the stream in the lower portion of the subwatershed, and little management of stormwater runoff from existing development.

2. Planning

The planning process included the ranking and prioritization of the Restoration Inventory. Due to the limited resources typically available for implementation, restoration projects identified in SC were prioritized based on feasibility (i.e. land ownership & accessibility), cost effectiveness, environmental benefits and ability to provide multiple benefits. Table E.1 is a prioritized project list with planning-level cost estimates.

Implementation of the prioritized projects is expected to provide a combination of added water quality treatment and, in many cases, flow attenuation that will reduce erosive storm flows and capacity problems to downstream impacted reaches.

Figure E3 shows an existing dry basin "pond" with a concrete channel for flow conveyance. The dry pond provides storage for large storm events but small events typically stay in the channel and are conveyed downstream. Upgrades to existing stormwater ponds can involve removing existing concrete channels to allow for greater infiltration and water quality treatment for small events. These types of restoration projects have been shown to have the best cost-benefit.

Table E. 1. Potential Restoration Projects, Costs and Benefits Gained

	Project Type	Reason for Prioritization	Cost
1	Build New Stormwater Ponds	• Treat large area • Reduces downstream erosion • Built on public property	$290K
2	Upgrades to Conventional Stormwater Ponds	• Reduces downstream erosion • Treats upstream developed area w/o quality treatment • Built on public property or on public easement	$850K
3	Green Infrastructure Retrofits	• Reduce the volume of runoff • Treats developed area w/o treatment • Utilizes available space	$152K
4	Stream Repairs	• Reduces sediment loads to stream • Improves fish and aquatic habitat	$58K
5	Stream Buffer Enhancement	• Improves fish and aquatic habit • Treats stormwater pollutants	$58K
6	Hotspots and Discharge Prevention	• Removes toxics and oxygen demanding pollutants • Source control efficiency	$1,715K
7	Residential Management Practices	• Involves the public in water protection programs • Source control efficiency	$232.4K

3. Recommendations

To meet the SC watershed goals and objectives a number of key actions are recommended for the watershed. These recommendations provide a framework for implementing the numerous management and restoration practices identified through field assessments as well as program and education-related recommendations identified through both desktop analyses and field assessments. Examples of recommendations are the establishment of a stakeholders group, development of a targeted education program, and implementation of small and large scale restoration projects.

Figure E.3 Candidate Site - Upgrade Conventional Stormwater Pond

4. Summary

The Shipbuilders Creek Stormwater Assessment and Action Plan is a first step in the process to improve water quality and drainage as well as restoring stream habitat and riparian areas. The Plan provides a baseline of existing conditions, a list of potential restoration practices as well as a series of recommendations for future stakeholders to consider. Planning-level cost estimates are provided for restoration that, if funded, should meet human and aquatic needs as well as address State and Federal water quality standards being imposed.

Section 1: Introduction

1.1 Setting

Shipbuilders Creek (SC) lies east of the City of Rochester NY, originating in the town of Penfield, flowing north through the town of Webster and, discharging to the Rochester Embayment of Lake Ontario (Figure 1). The SC watershed covers approximately 8.25 square miles with medium to high-density residential development in the upper reaches, a commercial area along Route 404, and open land and low density residential development in the lower reaches. Current impervious cover in the watershed is approximately 17 %. The watershed has five subwatersheds that create useful units for water quality and quantity analysis. Conducting the assessment at the subwatershed level allows for a more thorough understanding of the entire watershed and enhances the ability to craft restoration strategies based on local stream conditions.

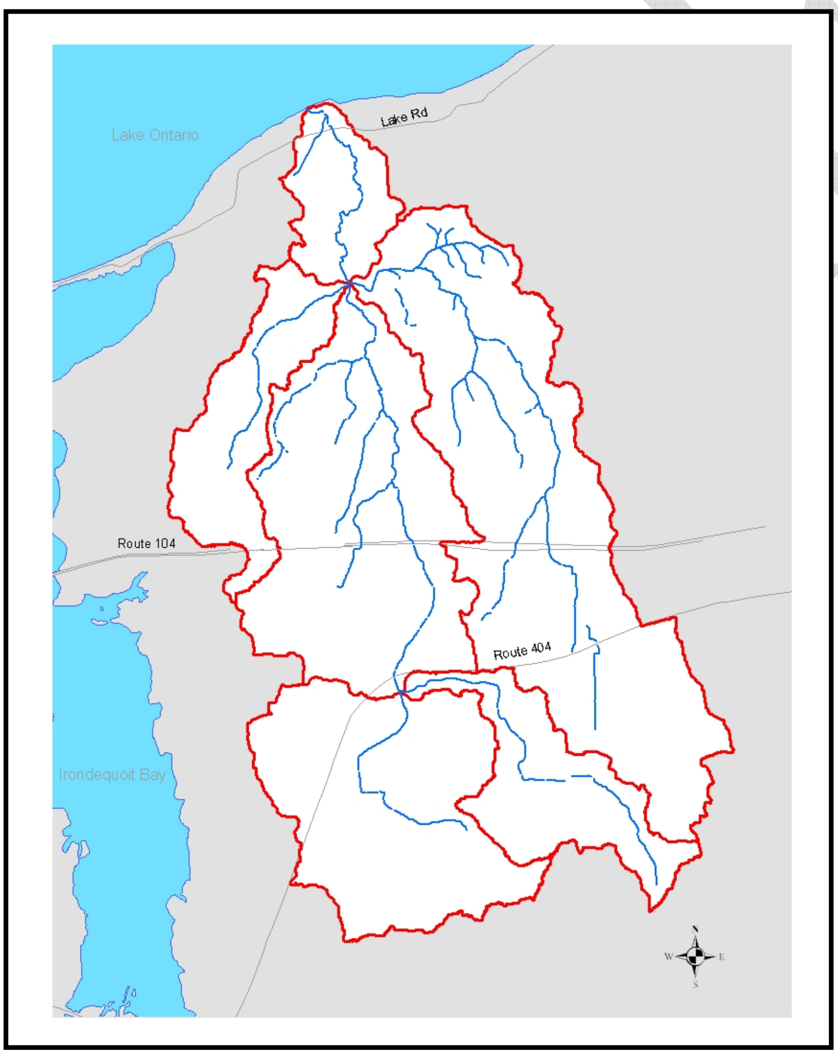

Figure 1. Shipbuilders Creek Watershed

1.2 Purpose

The Shipbuilders Creek Stormwater Assessment and Action Plan (SWAAP) summarizes the results of a rapid assessment of Shipbuilders Creek and presents recommendations for its protection, restoration and removal from the New York State 303(d) impaired waterbodies list. This project was conducted with funding and support from NYS Department of Environmental Conservation (NYSDEC), the Monroe County Department of Environmental Services and the Stormwater Coalition of Monroe County. It is intended to be a first step in a comprehensive County-Wide Stormwater Action Plan that will assess all waterbodies in Monroe County in order to meet water quality goals and reduce local drainage issues. To guide the work of the Stormwater Assessment and Action Plan, an Action Plan Committee was created, consisting of national and local experts including representatives from the Monroe County Stormwater Coalition. This Committee has provided input including drafting an overriding county-wide goal to restore, preserve, and protect our water resources for the enjoyment and benefit of present and future generations.

The New York State General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4 Permit) regulates 25 municipalities in Monroe County. A requirement for municipalities with impaired waters covered under the permit is to assess potential sources of stormwater pollutants, identify potential stormwater pollutant reduction measures, and evaluate their progress in addressing those pollutants to ensure no net increase of pollutants of concern (POCs). Shipbuilders Creek is listed as one of those impaired waters. The approach used in this SWAAP meets the MS4 Permit modeling requirements and demonstrates the steps necessary to perform that modeling on the other ten impaired waterbodies in Monroe County.

POCs in SC are phosphorus and pathogens. Examples of stormwater pollutants and the effects of watershed development on stream health include:

- *Sediments, Phosphorus, and Stream bank Erosion* -The increased volume, velocity and flow rate of stormwater from impervious surfaces increase pollutant loads and thereby, erosion of stream beds and banks.

- *Pathogens* - Wet weather concentrations of microbial pathogens such as Cryptosporidium, Ecoli, Giardia lamblia are bacteria that cause significant water quality concerns in urban streams.

- *Baseflow* - Widespread urbanization also modifies the normal or baseflow in streams by decreasing infiltration into the ground and thereby reducing the ability for groundwater to recharge the stream.

- *Habitat Degradation* - Much of SC has been relocated around development to increase the build out of parcels. In addition, several sections of the stream have been lined with concrete. These practices increase water temperature and limit aquatic habitat.

1.3 Goals and Objectives

An important element of stormwater planning is to establish goals and objectives that will improve the health of the waterbody through support and involvement of local stakeholders, biologists, planners and other experts. While this process has not been completed, several steps are being taken to insure the SWAAP reflects community goals and needs.

Proposed goals are listed here to be used as a starting point for the SC Stakeholder Task Group to consider:

1. Mitigate stormwater impacts on water quality from new and existing development.
2. Reduce regional flooding impacts through the implementation of green infrastructure (a more effective way to improve water quality and reduce drainage problems generally through more extensive management of stormwater runoff).
3. Educate and involve the public in efforts to protect water quality

1.4 Recommendations

Recommendations are a series of concrete actions that can help to achieve the subwatershed goals as well as to identify a timeline and party responsible for implementing the actions. Specific recommendations for SC will be developed by the SC Stakeholder Task Group. Preliminary recommendations are listed in Section 5 along with a proposed timeline and responsible parties as a starting point for the Task Group to consider.

1.5 Project Scope

The scope of this project included the following tasks:

1. Divide the boundaries for SC into five subwatersheds.
2. Review existing subwatershed monitoring data.
3. Conduct rapid stream and upland assessments in SC.
4. Create restoration project lists and rank projects based on established criteria.
5. Draft the SWAAP that outlines recommendations, identifies priority projects, and includes conceptual designs and a subwatershed monitoring plan.

Section 2: Watershed Characterization

Shipbuilders Creek flows north through the Towns of Penfield and Webster, discharging to Lake Ontario. The creek has an 8.25 square mile watershed with a total of 20 stream miles. Basic watershed metrics can be seen in Table 2.

Table 2. Shipbuilders Creek Subwatershed Data

Subwatershed Metric	Subwatershed A	Subwatershed B	Subwatershed C	Subwatershed D	Subwatershed E
Area (Acres)	470	1560	1805	998	490
Mapped Stream Miles	1.4	7.3	7.8	1.4	2.2
Miles of Channelized Stream	.23	0.6	1.0	1.4	1.5
# of Stormwater Treatment Facilities	5	19	20	9	6
# of Stormwater Outfalls	11	47	36	40	44
Density of Stormwater Outfalls (# per stream mile)	7.8	6.4	4.61	28.5	20
Current Impervious Cover	19%	15%	21%	24%	14%
Current Subwatershed Management Classification	Impacted	Impacted	Impacted	Impacted	Impacted
Forest Cover %	35	38	30	31	34
Jurisdiction	Entirely within the Town of Webster	Entirely within the Town of Webster	Entirely within the Town of Webster	50% Webster 50% Penfield	50% Webster 50% Penfield

The watershed has seen a transition in the past 30 years from primarily agricultural land use to a mix of residential and commercial use. A review of SC aerial photos from 1930 to current day illustrates the straightening, channelization and stream relocation to accommodate land development, all of which impact the volume and rate of flow in streams. SC watershed was originally heavily forested and transitioned to agricultural in the mid to late 1800's. Today, much of the stream and its corridor has been further straightened and channelized from suburban and urban land uses.

2.1 Watershed Data

One of the initial tasks in developing this SWAAP was to gain an understanding of the baseline, or current condition of the Shipbuilders Creek watershed. To accomplish this, the following were done:

- Reviewed existing watershed data, studies, and reports
- Analyzed extensive watershed Geographic Information System (GIS) data
- Conducted strategic water quality sampling
- Developed a baseline Watershed Treatment Model for existing and future watershed conditions

2.1.1 GIS Desktop Assessment

Subwatershed Delineation

An accurate delineation of the Shipbuilders Creek (SC) Watershed and subwatersheds was needed to perform the assessment. Previous drainage studies completed for the Towns of Penfield and Webster (MRB 2001; Costich 1981) that delineated the watershed were reviewed as well as the county's Geographic Information System (GIS) watershed map layer (data source is unknown). The USGS StreamStats online tool was also used. StreamStats is an integrated GIS application developed through a cooperative effort of the USGS and ESRI, Inc. More information on the use and application of StreamStats can be found in Appendix F. County staff evaluating these sources made adjustments creating a new delineation that was used to calculate all subwatershed characteristics (i.e., stream miles, land use, impervious cover estimates) and to break up the field assessments into reasonable partitions. Figure 2 shows subwatersheds A-E.

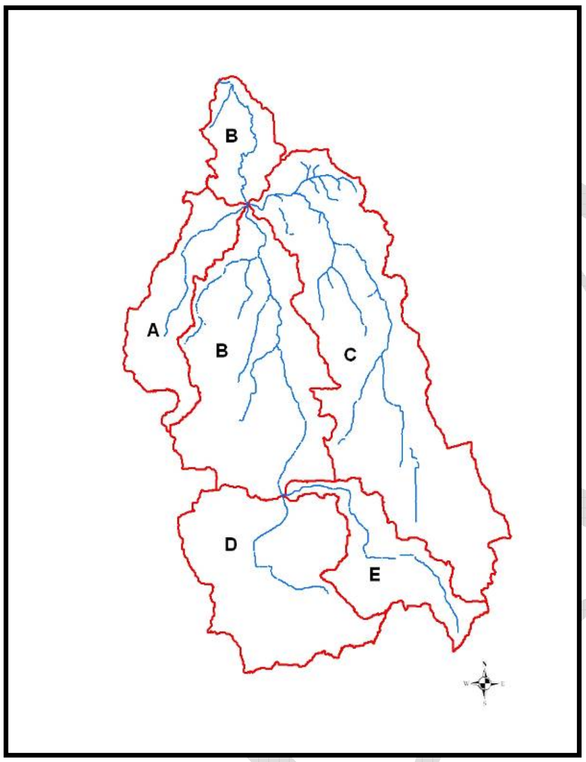

Figure 2. Delineation of Shipbuilders Creek Subwatersheds

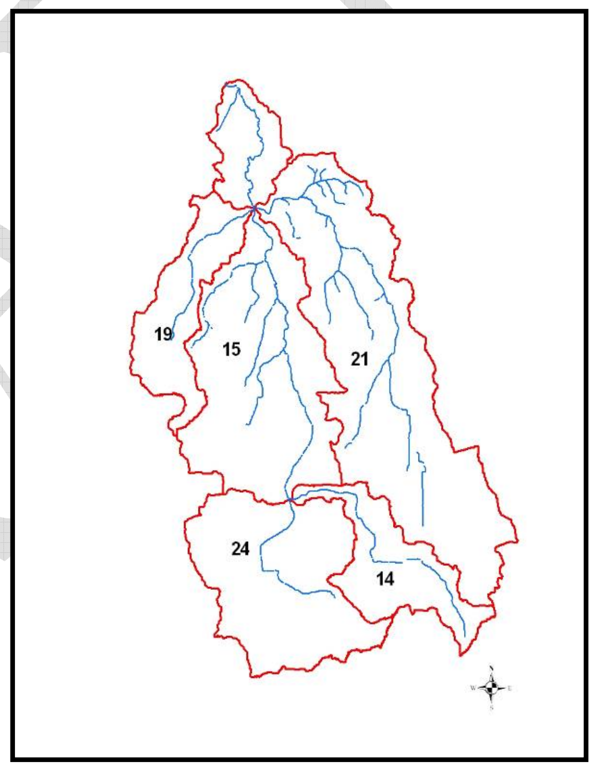

Figure 3. Subwatershed Percent Impervious Cover

Impervious Cover Analysis

Project staff estimated existing impervious cover percentages for the delineated subwatersheds (Figure 3). These estimates were determined using remotely sensed cover imagery along with IDRIS Andes software and municipal zoning maps. Methods used for impervious cover analysis are described further in Appendix C.

Impervious cover has been identified as a key indicator to explain and sometimes predict how stream conditions change in response to increasing levels of watershed development (CWP, 2005). Research has shown that the amount of impervious cover within a watershed can be directly linked to the health of its receiving stream. From this research, the Center for Watershed Protection created the "Impervious Cover Model" (ICM). The ICM is best illustrated by a simple graph with the percentage of impervious cover in a watershed plotted against stream health. The horizontal scale of the graph divides impervious cover percentage into four ranges that correspond to four levels of stream water quality. As shown in Figure 4, the model predicts that most stream quality indicators decline when watershed impervious cover exceeds ten percent, with severe degradation expected beyond 25 percent.

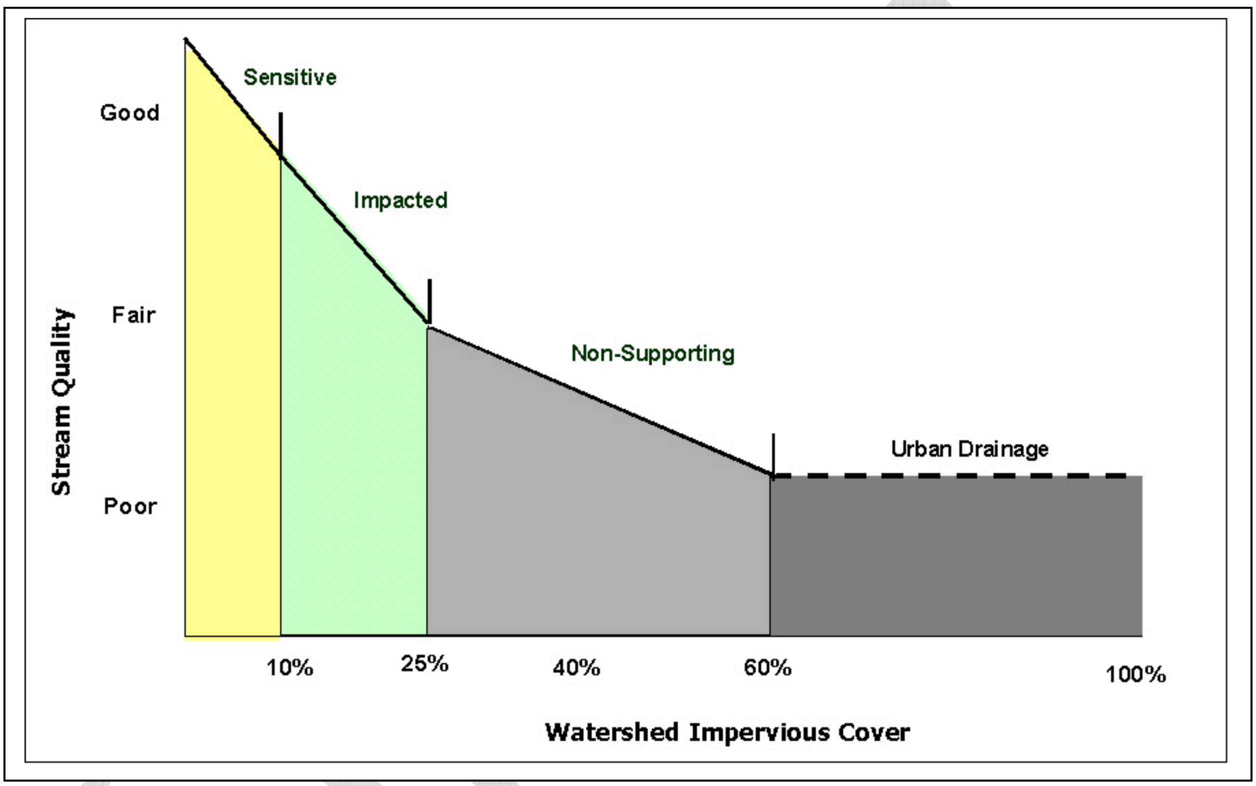

Figure 4. The Center for Watershed Protection Impervious Cover Model

Based on the desktop assessment, each of the five SC subwatersheds have between 14 and 24 percent impervious cover and fall under the Impervious Cover Model's "Impacted" range. According to the model constructs, streams in this range show clear signs of declining health with indicators such as increased summer stream temperatures, pollution tolerant aquatic organisms, and high bacteria levels. Future imperious cover in Shipbuilders Creek, based on zoning build out, is projected to be in the range of 18 to 28 percent.

Land Use

Using the current Monroe County property classification it was determined that the predominant land use in the watershed is residential, which accounts for 75 percent of the watershed (Figure 5)

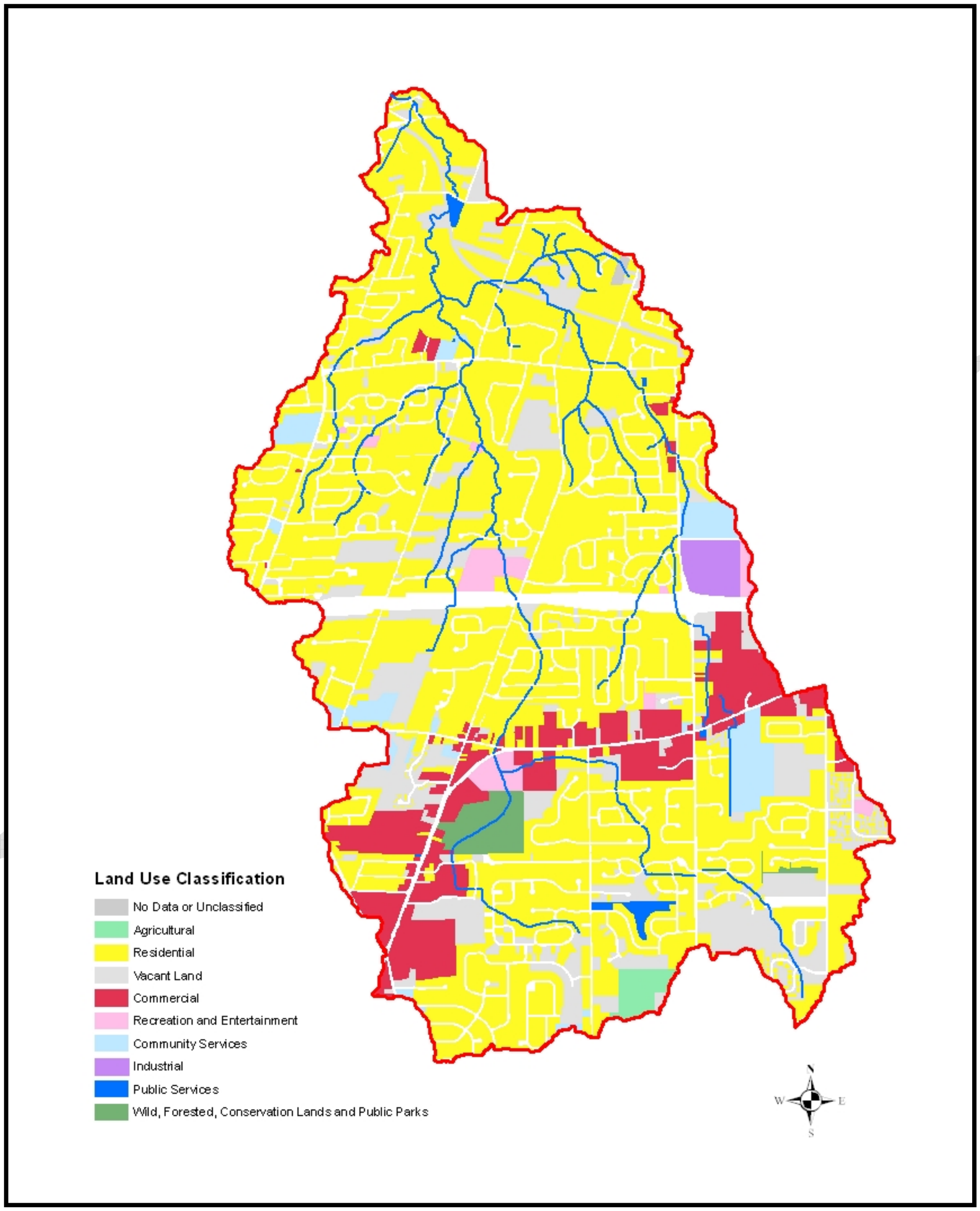

Figure 5. Shipbuilders Watershed Land-Use Classification

2.1.2 Water Quality

New York State classifies SC as Class "B" fresh surface water from the mouth to a point that the creek branches, just north of Klem Road in Webster. The remainder of the creek to its headwaters is class "C". NYSDEC states that B class waters "…best usages are primary and secondary contact recreation and fishing". C class waters best usages are for fish, shellfish, and wildlife propagation and survival "…suitable for fishing and fish propagation". The New York State Water Quality Section 305(b) Report (NYS DEC, 2004) reported SC had impaired segments and in 2008, SC was elevated to the New York State 303(d) list of impaired waters requiring the development of a TMDL. Impairments listed are high dissolved oxygen demand, phosphorus, pathogens and silt/sediment. The list notes industrial, municipal, on-site/septic systems, construction and urban/storm runoff as possible pollution sources.

Water Quality monitoring done by New York State Department of Environmental Conservation (NYS DEC) was reviewed and is reported on in the Biology portion of this subsection (Section 2.1.3). Very little other information exists on the creek's water quality. As part of this SWAAP, Monroe County Department of Environmental Services conducted strategic water sampling in 2009. This minimal sampling approach was taken to determine if meaningful data on stream health and water quality could be collected. Along with stormwater modeling, results of the 2009 sampling provide the foundation for the bulk of this Plan.

As evidenced from national studies in similar urbanizing watersheds and local watershed analysis, water quality in SC has degraded with the increase of impervious surfaces such as more roads and buildings. The conversion of forested lands to agriculture, and then to development and impervious surfaces, suggests the majority of pollution entering SC is from what is termed "nonpoint source" pollution (i.e. stormwater runoff).

2009 Sampling Results

The 2009 sampling was conducted in all five subwatersheds (Figure 6). A strategic sampling method was used that included the collection of dry (baseflow) and wet weather samples over a three month period for eight water quality parameters: Total Suspended Solids (TSS); Total Phosphorus (TP); Total Kjeldhal Nitrogen (TKN); Soluble Reactive Phosphorus (SRP); Ammonia (NH_3); Nitrate/Nitrite (NOx); Chloride (CHL); and Ecoli. All sample analysis was performed by the Monroe County Environmental Lab following approved procedures. Sampling methods included composites and grab samples and was conducted at selected road crossings to allow easy access to the stream and where possible, at locations downstream from other sampling locations to isolate sources of sediment and nutrients.

Baseflow data is useful to identify areas with potential base flow contamination. The results of baseflow sampling are presented in Table 3. In addition, a set of wet weather grab samples were collected during a rain event of 1.17 inches on July 23rd, 2009.

Automatic Sampler at Station 6, Loews

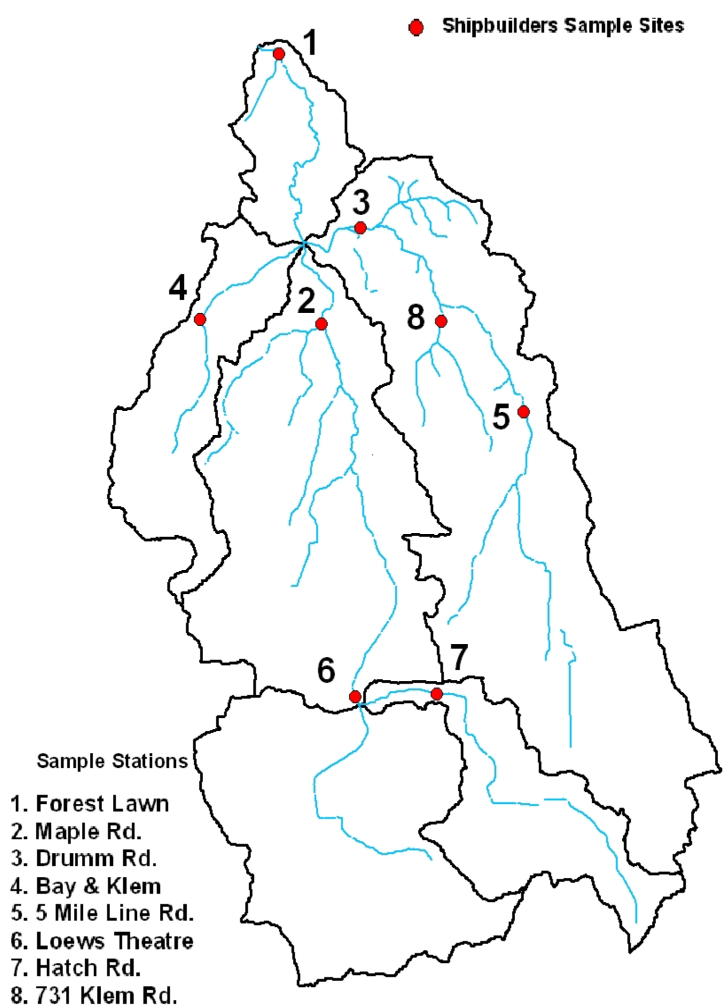

Figure 6. Shipbuilders Sampling Stations

Table 3. Baseflow Monitoring Data All values mg/L Ecoli mpn/100mL

	Station	Date	TSS	TP	NH_3	TKN	SRP	NO_X	CHL	Ecoli
Upstream	7	5/26/2009	1.4	0.025	0.017	0.443	0.010	0.143	117	179
	6	5/26/2009	1.4	0.031	0.010	0.547	0.005	0.206	165	22
	5	5/26/2009	1.0	0.020	0.013	0.336	0.008	0.345	302	179
	4	5/26/2009	3.4	0.033	0.031	0.404	0.005	0.254	228	23
	3	5/26/2009	2.0	0.049	0.048	0.599	0.018	0.666	165	128
	2	5/26/2009	2.6	0.059	0.097	0.437	0.013	0.467	191	579
Downstream	1	5/26/2009	1.6	0.023	0.010	0.137	0.009	1.020	183	308

As expected, all wet weather samples showed significant elevation in values as compared to the May baseflow results. Stations 1, 2 and 3 had the highest values for most parameters. For example, wet weather total phosphorus at station 2 was seven times higher than the baseflow value. Figures 7, 8, and 9 show comparisons between baseflow and wet weather sample results for the watershed pollutants of concern, Total Phosphorus, Total Suspended Solids and Ecoli at all stations. Appendix A provides full results from all watershed sampling.

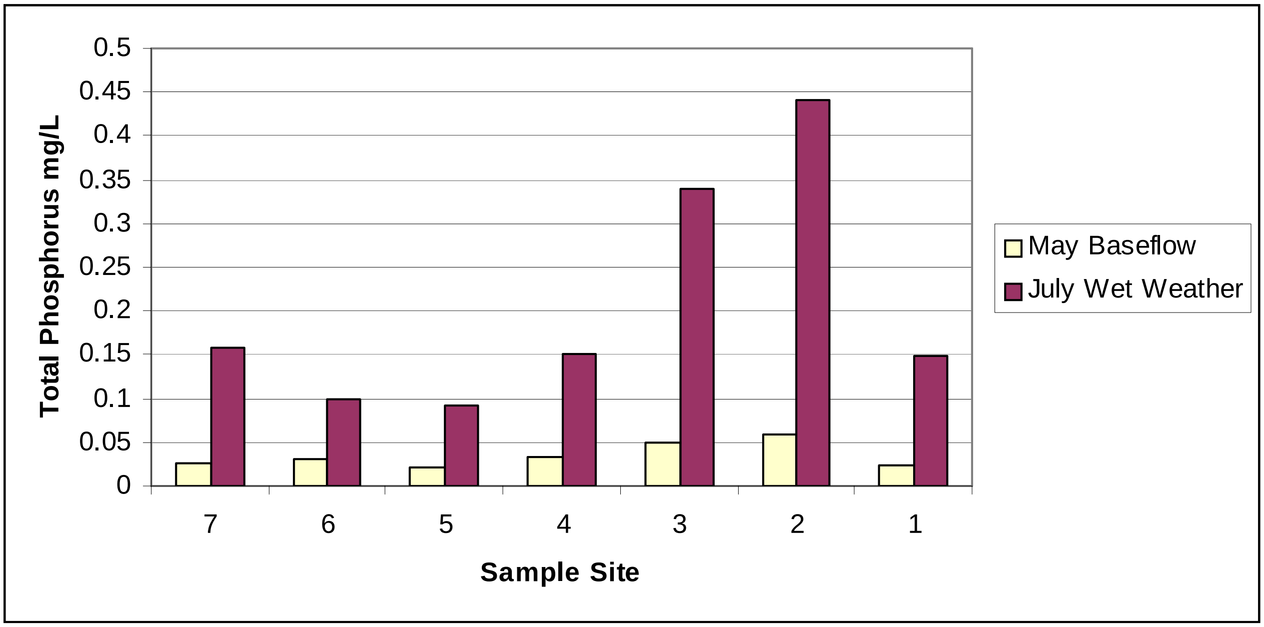

Figure 7. Comparison of baseflow and wet weather total phosphorus results

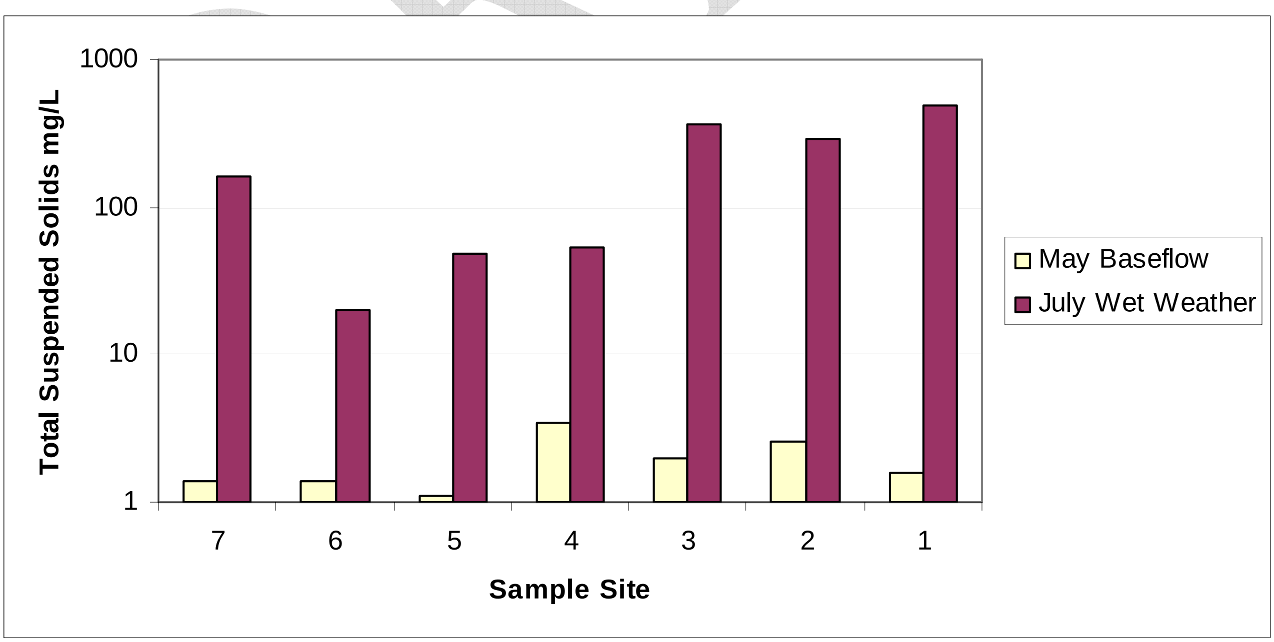

Figure 8. Comparison of baseflow and wet weather total suspended solids results

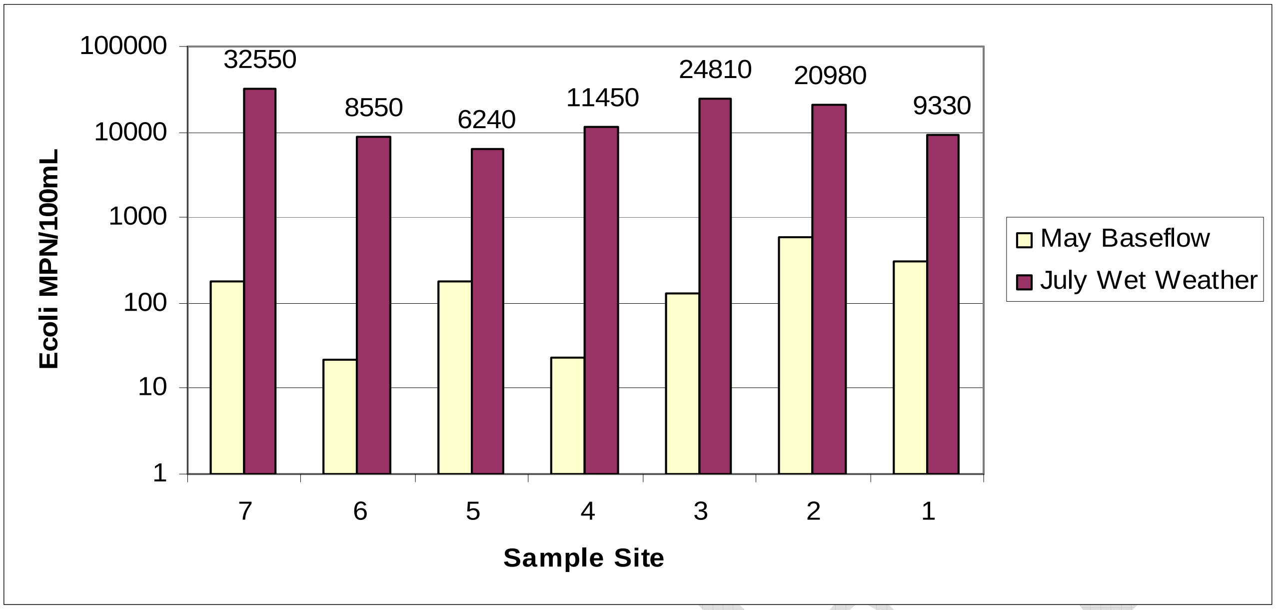

Figure 9. Comparison of baseflow and wet weather Ecoli results

Figure 10 shows the Ecoli results at all stations for the July 23rd wet weather sampling. As the creek flows north through the watershed, a general decrease in water quality occurs. A notable increase in Ecoli concentrations occurred between Stations 5 and 3 on the eastern branch of the creek. The upstream Station 5 had an Ecoli value of 6240 MPN/100mL. Compare this number to downstream Station 3 where Ecoli was 24,810 MPN/100mL. This suggested a source of sanitary waste between the two stations and in fact, this was confirmed by verbal communication with Town of Webster officials. The highest Ecoli value sampled was 198,630 mpn/100mL at Station 8, on a tributary that flows into the eastern branch between Stations 3 and 5. The same pattern can be seen were a notable increase in Ecoli concentration was also found between stations 2 and 6. Both locations will be investigated further for sources of sanitary waste.

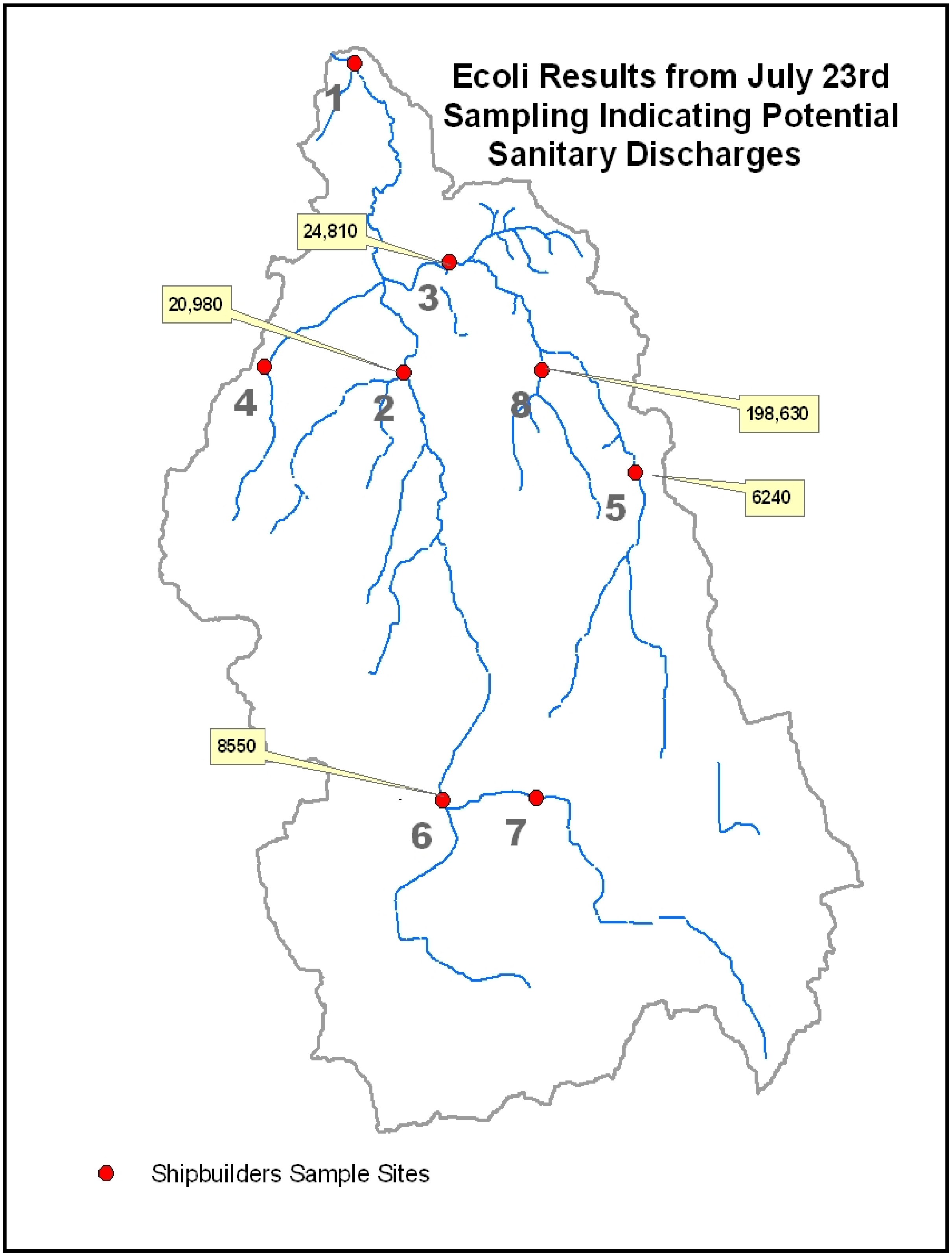

Figure 10. Ecoli Results from July 23, 2009 Rain Event (expressed in MPN/100 mL).

2.1.3 Drainage and Hydrology

Both towns of Penfield and Webster have engineer-prepared drainage plans for Shipbuilders Creek watershed (MRB Group, 2001 and Costich, 1981). Information collected from these plans note that much of the stream corridor has been modified due to urbanization that has increased storm-event flow volumes. Additional information was obtained from interviews with personnel from the two towns.

The most significant drainage problem noted in Webster's 1981 study is downstream of where Shipbuilder's two major branches converge, near a subdivision called Forest Lawn. This neighborhood has a long history of flooded homes and streets. The 1981 study evaluated a number of potential upstream stormwater detention options, most notably several along the NYS Route 104 Expressway (Figure 11), and flow diversions parallel to the stream north of Lake Road through Forest Lawn to reduce existing and future development impacts at Forest Lawn. Some of those options have been implemented by the two towns including the development of a stormwater pond in Empire Park to reduce flooding and to generally, reduce issues in the conveyance of storm flows through SC.

Penfield's drainage study of SC (MRB Group 2001), notes several locations where road cross culverts' capacity can be exceeded during large storm events which are depicted in Figure 11 as "drainage problem sites". However, few incidences of culvert overtopping have occurred due to the relatively flat topography that allows temporary storage over low-lying woods, lawns and farmland. While standing water has caused citizen complaints, interviews with town engineers note the addition of several detention ponds and modifications of existing pond discharge structures has improved the conditions here. More improvements through detention of small storm events are proposed for this upper portion of the watershed in Section 4 of this SWAAP.

Areas within the 100-year-floodplain in SC are also shown on Figure 11. The 100 year floodplain is the area that is expected to be flooded as a result of a storm with a one percent chance of occurring in any given year. These areas mainly border the stream in the northern end of the watershed. However, a large floodplain along with State and Federal Wetlands cover Empire Park.

Today, the states and federal governments support a number of regulations that protect wetlands to preserve this valuable resource. In some situations, draining treated or pervious area runoff to natural wetlands may enhance or restore some wetlands in the SC watershed (though developed areas should never be directly drained to natural wetlands which would degrade their habitat value).

To illustrate the interconnectedness of these forces on the stream, Figure 11 shows identified drainage problem locations along with proposed stormwater detention ponds identified from former drainage studies, floodplains, wetlands, and stream bank erosion sites.

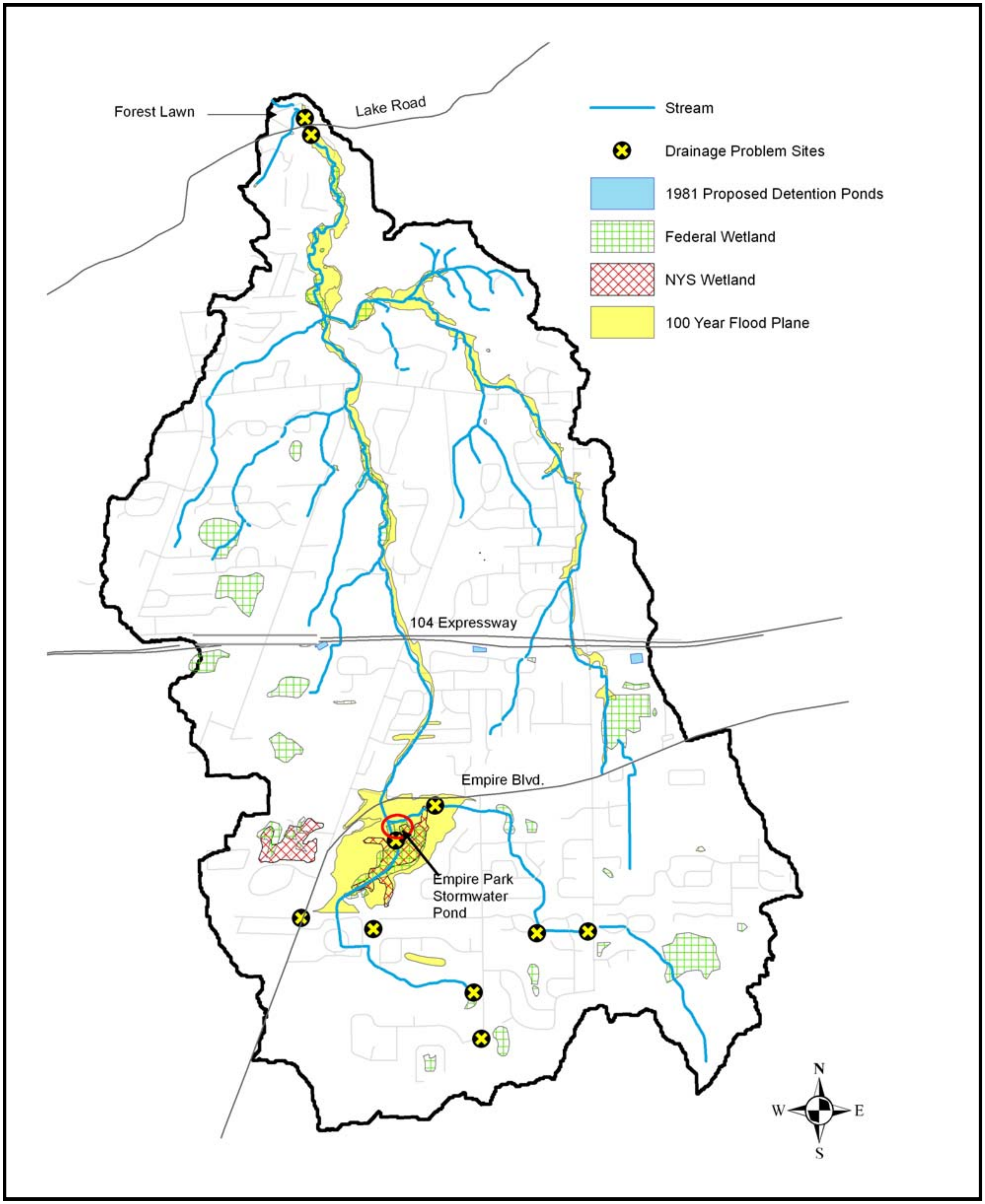

Figure 11 Shipbuilders Creek Drainage and Hydrologic Feature Areas

2.1.3 Biology

NYS Department of Environmental Conservation (NYSDEC) assessed biological indicators in Shipbuilders Creek in 1999 and 2001 by looking at benthic macroinvertebrates (aquatic insects living in the stream) and stream habitat (the material that rests at the bottom of a stream). The process of collecting, identifying and counting these insects is a widely recognized tool for assessing water quality in streams, rivers and lakes. Indicators of stream health are species diversity and population, the types of species present, and habitat quality. Macroinvertebrate species are first grouped by the degree they can tolerate pollution. Examples of pollution intolerant species are mayflies and stoneflies. Pollutant tolerant specie examples are leeches and maggots. Stream habitat is determined by measuring features thought to contribute to habitat quality such as the amount of silt in the steam bed, bank stability and the width of the riparian zone.

The advantages of benthic macroinvertebrate sampling are numerous, but the key advantage is the invertebrates are living in the stream all the time and are subjected to all changes in water quality and habitat over the course of seasonality, storm events, and changes in the land use. This technique is widely accepted and is used by NYSDEC as an indicator of water quality across the state. Benthic macroinvertebrate population data provides a useful summary of water quality throughout the watershed and when used in conjunction with targeted water quality sampling, is a good rapid approach to assess the watershed.

The NYSDEC sampling results indicated moderately impacted water quality conditions. Possible sources of pollutants identified by investigators were from municipal and/or industrial discharges. Investigators noted that sandy substrates also influenced poor habitat conditions (NYSDEC Waterbody Inventory revised, 2007).

In 2009, Monroe County staff assessed benthic macroinvertebrates at six sample locations. At each site, macroinvertebrates were sampled with a kick net and each species was identified and counted. The stream bed habitat was also assessed at each location. Results can be found in Table 5 (site locations numbers are shown on the map in Figure 6).

Table 5. Shipbuilders Creek 2009 Macroinvertebrate Sample Results

Site Name/Station#	Macroinvertebrate Population Status	Stream Habitat
Five Mile Line Rd/5	Good	Good
Bay and Klem Rd/4	Impacted	Good
Hatch Rd./7	Good	Intermediate
Maple Rd./2	Good	Intermediate
Drumm Rd./3	Impacted	Good
Loews Theatre/6	Impacted	Poor

Only intermediate and pollution tolerant macroinvertebrate species were present in Shipbuilders Creek, typical of an urban stream indicating degraded water and habitat quality.

The quality of aquatic habitat varied between each sample location. The quality of the habitat is the result of many factors with much significance given to degree of erosion and amount of plant growth along the stream bank. If severe erosion occurs upstream of the sample location, then the eroded sediment settles downstream and creates an inhospitable habitat for sensitive macroinvertbrates to live. In some cases, these habitats become anaerobic where few species survive. An example is Station 6 at Loews Theatre where the stream reach has received large amounts of sediment deposited over the stream bed. The sediment is at least a foot deep which makes this stretch of stream unsuitable habitat for benthic macroinvertbrates. In other sample locations such as Drumm Road (Station 3), the habitat was suitable for macroinvertebrates, but the population was tolerant of poor water quality, most likely indicating an upstream pollution source.

Stream temperature was measured at several locations in SC (Table 6). Temperature is important because it governs the kinds of aquatic life that can live in a stream. Fish, insects, zooplankton, phytoplankton, and other aquatic species all have a preferred temperature range. If temperatures get too far above or below this preferred range, the number of individuals of the species decreases until finally there are none. Most aquatic organisms begin to feel stress at stream temperatures above 68° Fahrenheit (20° Celsius).

Table 6. Shipbuilders Creek Temperatures June 25-August 17 in Fahrenheit°

	Site 1 Forest Lawn	**Site 2 Maple**	**Site 3 Drumm**	**Site 4 Bay+Klem**	**Site 5 Five Mile**	**Site 6 Loews**	**Site 7 Hatch**
Mean	65.8	66.4	66.1	70.8	67.7	68.8	68.1
Max	73.8	75.2	73.8	83.7	78.0	80.8	77.3

Potential causes of these elevated temperatures are lack of tree cover along the stream bank to provide shade and in the case of site 4, Bay & Klem, a small pond upstream of our sample site. This pond would absorb sunlight during warm summer days which elevates the downstream temperature.

2.1.4 Geology and Soils

Monroe County and Shipbuilders Creek (SC) are in the Erie-Ontario Lake Plain region of Western New York with soils dominated by deep glacial and lacustrine deposits. Ridge Road is located and named from the raised, geologic feature of a former glacial lake shoreline that runs three to four miles south of Lake Ontario's current shoreline. This dividing ridge noticeably separates soil types. The makeup of watershed soils is important from a restoration perspective, as it relates to the potential for infiltration of stormwater. Infiltrating stormwater reduces stormwater runoff volumes and peak flows.

SC watershed has generally well drained soils that are defined hydrologically as "A" and "B" (where most rainwater soaks in), north of this ridge. Soils here are lacustrine deposits (from prehistoric lakes) of silt and very fine sand and, coarser glacial laid deposits. South of the ridge, the watershed soils are smaller particle sizes of clays and fine textured subsoil that are somewhat poorly drained. These soils infiltrate rainwater much slower and are defined as "C" and "D" soils (Figure 12). South of the ridge, the Creek slopes are flat to moderate and increase along some segments to the north nearing the Lake.

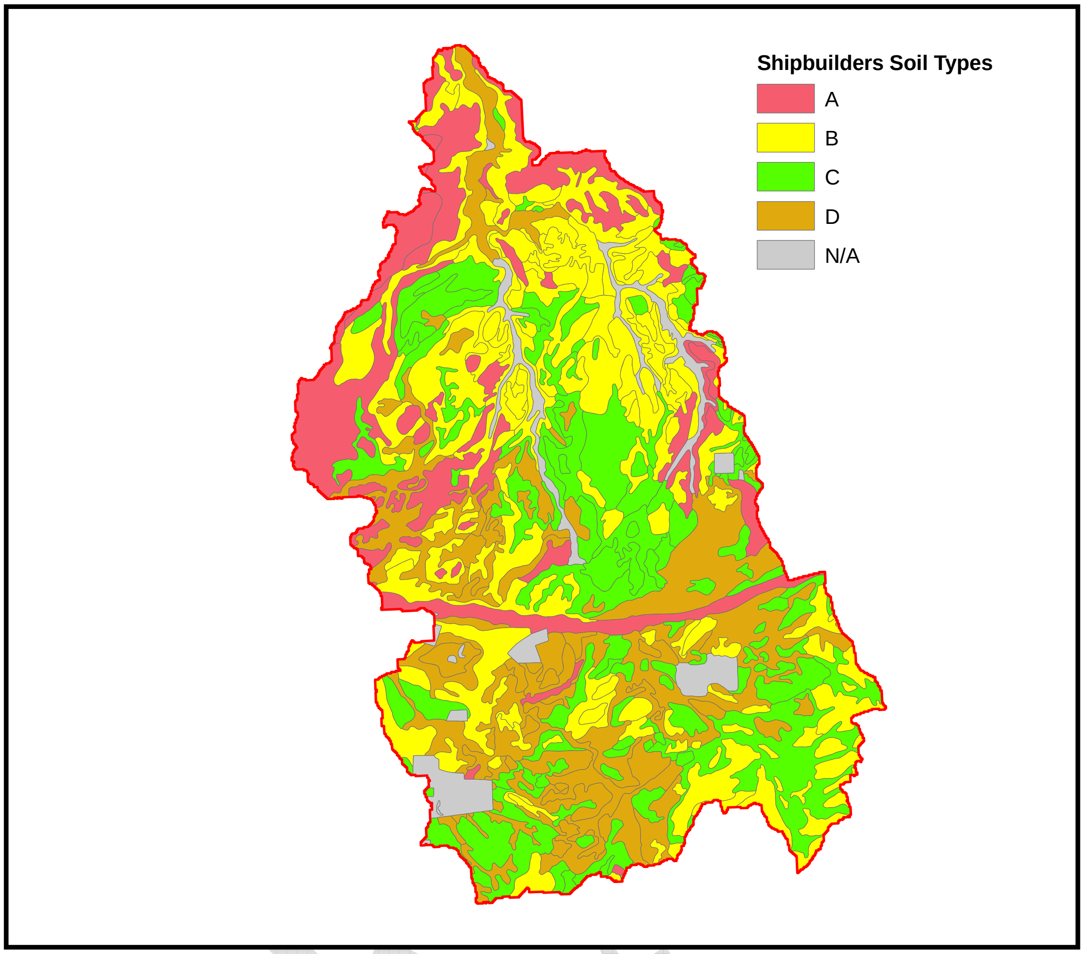

Figure 12. Shipbuilders Creek Hydrologic Soil Types

2.1.5 Watershed Treatment Model for Pollutant Loads

The Watershed Treatment Model (WTM) was used to estimate existing and future nutrient and total suspended solid loads within the Shipbuilders Creek watershed. This information was used, in part, to target specific subwatersheds for more detailed and intensive field assessments.

The WTM, (Caraco, 2002), is a spreadsheet model used to:

- Estimate pollutant loading under current watershed conditions
- Determine the effects of current management practices
- Estimate potential load reductions associated with implementation of structural and non-structural management practices
- Evaluate the effects of future development

The model has two basic components: Pollutant Sources and Treatment Options. The Pollutant Sources component of the WTM estimates the load from primary land uses (residential, commercial, forest land) and secondary sources (i.e. active construction, managed turf, channel erosion, illicit connections) in a watershed without treatment measures in place. The Treatment Options component of the model estimates the potential reduction in this uncontrolled load if various treatment measures (both structural and nonstructural) are used. A more detailed description of the WTM is in Appendix D.

The following caveats should be considered while reviewing the use of the WTM:

- The WTM is a planning level model primarily for urban/suburban applications. There are many simplifying assumptions made by the WTM, and the model results are not calibrated. Therefore, the results of the model simulations should be compared on a relative basis rather than used as absolute values.
- The application of existing treatment practices in the Shipbuilders watershed is based on GIS data, best professional judgment, and default values associated with the WTM.

The WTM land use primary source estimates are based on area calculations from Monroe County's GIS parcel layer. Each parcel has an attribute showing the property class description as well as lot size. The WTM impervious cover estimates were determined by the Monroe County GIS Division using the 2005 Monroe County Land Cover Model and aerial imagery. The WTM estimates were adjusted where reasonable, using best professional judgment, to align more closely with the directly measured values generated from the county impervious cover layers.

Inputs for primary and secondary pollutant sources in the watershed provided the foundation of the model. These included metrics such as residential housing density and commercial, industrial and rural watershed acreage. A review of the resultant pollutant loads from the land use was representative of the watershed characteristics. About 75 percent of the land use in the watershed is residential with the resultant pollutant loads counted under the "Urban Land" heading in Table 7 (along with commercial and industrial land uses). The relatively small pollutant loads from active construction are reflective of the current slow construction period. A secondary source input asks for the fraction of illicit connections of sanitary waste to storm sewers in the watershed. Actual numbers were available since Monroe County surveyed outfalls for illicit discharges in 2005 as required under their MS4 permits.

GIS data was available for sewer systems in the watershed and once the length of sanitary sewer miles was tallied, WTM default values for sanitary sewer overflows (SSOs) were used and thought to be representative based on increased wet weather flow volumes recorded at the treatment plants. Loads reflect that there are no combined sewers in the watershed and very little agricultural land (which was lumped into the "Rural Land" category along with parks and vacant parcels). While the northern end of this watershed has large wooded lots, Table 7 shows no results for the land use category "Forest". In order to depict this land use correctly, the model allowed users to modify these large lots with lower values of impervious and turf areas therefore, representing the wooded areas of these parcels.

The model inputs for existing stormwater management practices required some research to complete. For structural stormwater management practices, staff reviewed aerial photos with storm sewer overlays to determine where developed areas were discharging to stormwater management practices, the type of the practice, area draining to the practice, and percent of impervious cover within the drainage area. While this was time consuming, good GIS data made it possible.

Table 7. Existing Stormwater Loads

	Total Nitrogen	Total Phosphorus	Total Suspended Solids	Fecal Coliform	Runoff Volume
Pollutant Source	**lb/year**	**lb/year**	**lb/year**	**billion/year**	**(acre-feet/year)**
Urban Land	26,036	5,370.96	533,038	920,507	48,497
Active Construction	154	31	104,774	0	88
Sanitary Sewer Overflows	386	64	2,572	291,960	0
Channel Erosion	1,096	1,041	273,888	0	0
Rural Land	2,704	411	58,780	22,924	35
Livestock	420	48	0	1,600	0
Illicit Connections	398	96	2,846	256,238	0
Septic Systems	818	136	5,450	32,906	0
Open Water	192	8	2,325	0	0
Total Load	32,204	7,206	983,673	1,526,135	48,620

Section 3. Assessment Results and Restoration Inventory

County staff conducted a physical stream corridor assessment, upland survey and restoration inventory in Shipbuilders Creek Watershed. A Prioritized list of restoration projects and estimates of water quality improvements that would occur if they were implemented are summarized at the end of this section.

The stream and subwatershed assessments were conducted using steps (with minor modifications) developed by the Center for Watershed Protection (CWP, 2004 a & b): the Stream Corridor Assessment, Upland Survey and Restoration Inventory. Together, these protocols allowed project staff to rapidly identify a number of pollution source control measures, on-site stormwater retrofits, riparian reforestation, stream restoration, hotspot and discharge prevention and upland reforestation projects within the subwatersheds. Field crews consisted of county staff from the Department of Environmental Services. Examples of the field forms used are provided in Appendix E.

3.1 Stream Corridor Assessment

Forty two stream reaches were identified and inspected along 23 miles of stream. Table 8 shows the number of identified impacts in each subwatershed for the 6 categories assessed during the stream corridor assessment.

Table 8. Stream Corridor and Riparian Impacts by Subwatershed

	A	B	C	D	E
Impacted Buffers	1	7	10	3	5
Stream Bank Erosion	3	18	13	2	7
Channel Modification	3	2	4	2	2
Stream Crossings	4	25	30	5	7
Stormwater Outfalls	11	47	36	40	44
Trash & Debris	0	2	4	0	0

3.1.1 Impacted Stream Buffers

Streamside buffers stabilize banks, create habitat, and remove pollutants. The vegetative species found in a stream buffer vary with a mature forest representing the optimal condition. Development in a watershed often results in encroachment, tree clearing and mowing of the buffer. These changes interrupt the continuity of the stream buffer corridor and undermine its many benefits. The stream buffer survey evaluated stream corridor lengths greater than 100 feet long that lacked at least a 25 feet wide, naturally-vegetated riparian buffer on one or both sides of stream.

Each assessed reach was given a score for reforestation potential ranging from 1-5. A score of 5 indicated that the impacted area was on public land where the riparian area does not appear to be used for any specific purpose with plenty of area available for planting. A score of 1 indicated limited restoration potential with the impacted area on private land where road, building encroachment or other features significantly limit available area for planting. There were 25 impacted reaches identified with 16 having scores of 3-5 (greatest potential for restoration). Figure 13 shows an impacted buffer in subwatershed C.

Figure 13. Impacted Buffer at Webster Schroeder High School with High Restoration Potential

3.1.2 Stream Bank Erosion

Stream erosion reflects the natural process of channel migration and adjustment, whereby streams continuously meander, widen and narrow in an attempt to reach a stable equilibrium. The balance between sediment load and discharge can be disrupted by development in the watershed. Severe erosion occurs when the velocity of flowing water in the stream exceeds stability thresholds for the stream materials (such as soils and rock). Research has shown a linear relationship between development in a watershed and bank instability leading to rapid and excessive bank erosion as the stream adjusts to the changing hydrologic conditions.

The erosion assessment inventoried reaches with slope failures, bank sloughing, downcutting (where streams erode deeper, more unstable channels) and widening in areas noticeably worse than the average erosive condition of the survey reach. Trimble(1997) estimated that more than half the sediment loads from highly developed watersheds were derived from eroded stream banks.

Erosion severity was measured on a scale from 1-5 with a score of 5 indicating active downcutting, tall banks on both sides of the stream, eroding at a fast rate with erosion contributing a significant amount of sediment to the stream, or an obvious threat to property or infrastructure. Only 23 of the 42 erosion sites were ranked as suitable for restoration due to available access to the sites. Of the 23 suitable for restoration, 19 had a severity score of 3 or higher making them priority candidates for restoration/stabilization. Figure 14 shows an example of active stream bank erosion in subwatershed C.

Figure 14. Active Stream Bank Erosion in Subwatershed C

3.1.3 Channel Modification

Stream segments have often been modified to safely convey high flows, restore a stable channel, restrict channel migration, or realign channels around property or infrastructure. The basic engineering approach is to design a channel, often with concrete lining or pipes, that has less roughness, greater slope, and an expanded cross-sectional area to pass flood waters quickly and efficiently. Segments of stream that have channelized, concrete-lined or reinforced sections greater than 50 feet in length are inventoried.

As with erosion and buffers, channel modification was measured for severity and restoration potential. The highest level of severity indicates a long section (>500 ft) with very shallow channel water and no natural sediments present in the channel. Figure 15 is an example of a stream reach on Shipbuilders with a severity score of 5. Thirteen reaches were identified with channel modification with 8 of those having severity rankings of 3 or higher. All 14 are candidates for restoration.

Figure 15: Channelized Stream Segment in Subwatershed E with Severity Score of 5

3.1.4 Stream Crossings

Development increases the number of stream crossings which interrupt the stream corridor. These crossings can alter local steam hydrology, impact bank stability and prevent fish migration. All engineered structures that cross the stream, such as roadways, bridges, railroad crossings and other overhead utilities are assessed.

Stream crossings are important to assess as they relate to stream impacts and flooding potential. They can also be good candidates for upstream storage retrofits. Of the 71 road stream intersections in the watershed, 23 were evaluated. Of those, 2 were candidates for upstream storage, 4 for stream repair and 2 for fish barrier removal.

3.1.5 Stormwater Outfalls

Stormwater outfalls along streams are widespread and consist of open channels or closed pipes that discharge stormwater runoff into streams. In developed watersheds stormwater is typically collected in a storm drain system and conveyed through an outfall. As impervious cover in a watershed increases, the density of outfalls per stream mile increases. In some cases, this causes increased flooding, peak flows and stream erosion. All pipes and channels that discharge stormwater to the stream are assessed.

In 2008 all municipal outfalls in the watershed were inspected to comply with the Municipal Separate Stormwater Sewer System Permit (NYSDEC, 2008 MS4). Outfall density was also included as a parameter in the Watershed Treatment Model and is shown in Table 2.

3.1.6 Trash and Debris

Despite decades of anti-litter campaigns, trash still finds its way into streams and flood plains either from direct dumping or by transport through the storm drain system. The presence of trash and debris can degrade resident perceptions about stream quality, reduce community amenities, contribute pollutants and create blockages at outfalls or other locations in the stream. Areas of significant trash and debris accumulation greater than average levels observed across a survey reach are inventoried.

Six locations were identified as trash and debris hotspots. Materials found ranged from yard waste, pet waste, paper, plastic and automotive products. All locations have high potential for restoration by volunteer clean-ups, education, or removal by municipal staff. Figure 16 shows a trash hotspot in a commercial area of subwatershed D.

Figure 16. Trash and Debris in Subwatershed D

3.2 Upland Survey

Urban subwatershed restoration has traditionally focused on the stream corridor, with less attention paid to upland areas where neighborhoods and businesses are located. These upland areas, however, are important in subwatershed restoration, since they contribute storm water pollutants to the stream. The upland survey is designed to assess these areas for behaviors that can potentially influence water quality and to identify potential restoration projects. It provides a quick but thorough characterization of major source areas contributing to the stream, options that control them through source controls, pervious area management, and improved municipal maintenance. The upland land survey was conducted following the concepts of the Center for Watershed Protections Unified Subwatershed and Site Reconnaissance Inventory (CWP 2004). There were three components used to complete the survey:

1. *Neighborhood Source Assessment* — a profile of pollution source areas, stewardship behaviors, and restoration opportunities within individual neighborhoods that looks specifically at yards and lawns, rooftops, driveways and sidewalks, curbs, and common areas.

2. *Hotspot Site Investigation* — a ranking of the potential severity of each commercial, industrial, municipal or transport-related hotspot found within a subwatershed that looks specifically at vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure.

3. *Pervious Area Assessment* — an evaluation of the potential to reforest turf areas or restore natural areas at all open parcels within a subwatershed looking specifically at vegetative cover, potential impacts, and site constraints.

Before conducting field work for the upland assessment, county staff reviewed GIS data such as aerial photos, parcel data and storm sewer locations. This helped to identify neighborhoods constructed before stormwater regulations were in-place, potential hotspots and the location of large impervious surfaces. These areas all represent potential restoration projects that were then verified with field surveys. Data was gathered and entered into GIS maps.

3.2.1 Neighborhood Source Assessment

The neighborhood source assessment was conducted to evaluate stormwater pollution source areas, stewardship behaviors, and restoration opportunities within individual residential areas. The assessment looks specifically at yards and lawns, rooftops, driveways and sidewalks, curbs and common areas.

Prior to going out in the field, potential residential locations were identified through aerial photograph interpretation. Distinct neighborhood units were delineated using land-use data and digital orthophotos. Neighborhood units in the watershed included blocks with similar single-family residential housing density, physically defined communities, and apartment or town home complexes. Individual yards account for about 70% of the turf cover in urban subwatersheds, and usually the majority of total pervious cover. Yards tend to be intensively managed, and can be a potentially significant source of nutrients, pesticides, sediment, and runoff.

A desktop assessment was conducted to delineate twenty five neighborhoods. Individual neighborhoods were grouped together that shared similar characteristics such as lot size, road widths, setbacks and house types.

One location that provides an example of how a neighborhood assessment can be helpful is the Hills Pond neighborhood in Webster. It is a 40 acre subdivision with 93 single family residential homes built in 1992. The neighborhood has approximately 21% impervious cover with all impervious surfaces directly connected to the stream via an aging storm pond. This includes rooftops, driveways and street surfaces which equals approximately 8.5 acres of impervious surface.

Treating the runoff from a neighborhood like Hills Ponds presents a challenge. In addition to retrofitting the existing pond, more could be done with education and outreach to encourage homeowners to disconnect downspouts and install rain barrels and or rain gardens through a future community-wide education effort.

3.2.2 Hotspot Site Investigation

Stormwater hotspots are defined as commercial, municipal, industrial, institutional or transport related operations that produce higher levels of stormwater pollutants and/or present a higher than normal risk for spills, leaks or illicit discharges. Using the watershed parcel records and the parcel property class description, 132 potential hotspots were identified in the SC watershed. A majority of these are clustered along the Empire Blvd./Route 404 corridor. This distribution can be seen in Figure 17. Hotspots can be placed into five categories; commercial, industrial, institutional, municipal and transportation related (Figure 18). In SC, 77 percent of the potential hotspots fall in the commercial category.

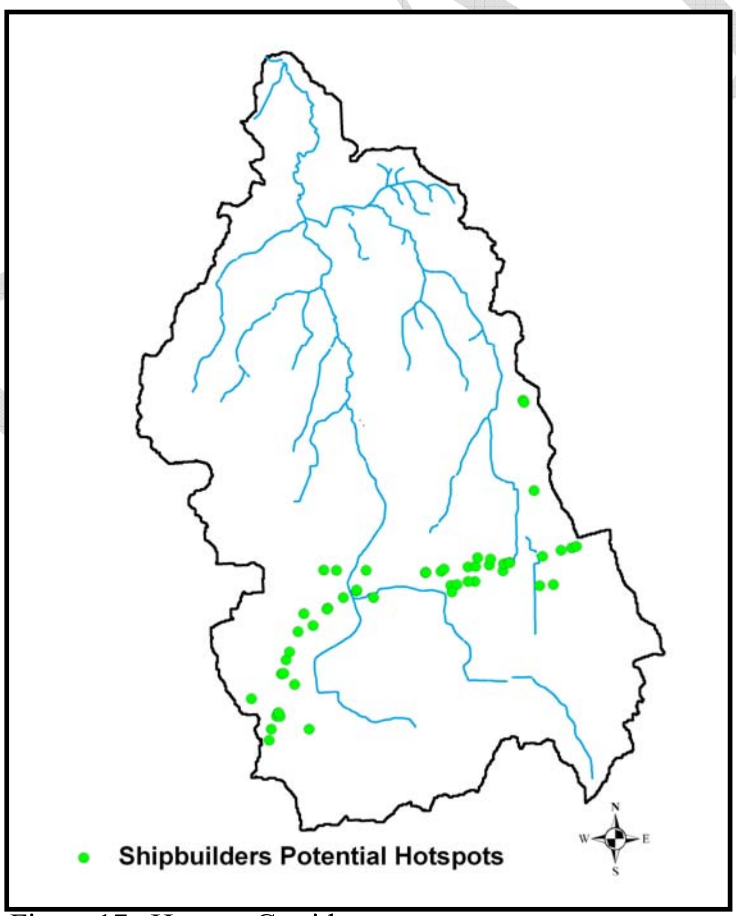

Figure 17: Hotspot Corridor

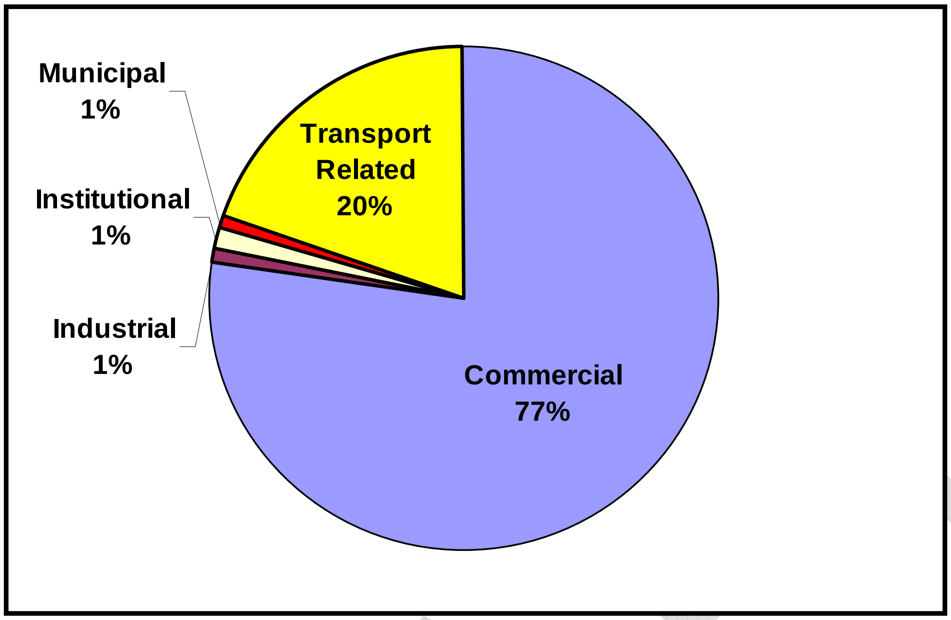

Figure 18: Shipbuilders Creek Watershed Hotspot Distribution

Commercial hotspots typically experience a great deal of vehicle inputs, generate waste of wash water, handle fuel or repair vehicles, or store products outside. Each type of commercial hotspot can generate its own blend of pollutants which can include nutrients, hydrocarbons, metals, trash or pesticides (CWP, 2005). Figure 19 gives a further breakdown of hotspot types in the SC watershed based on the specific property class description. Figure 20 illustrates a used cooking grease storage bin that has spilled on the ground located less than 20 feet from the stream.

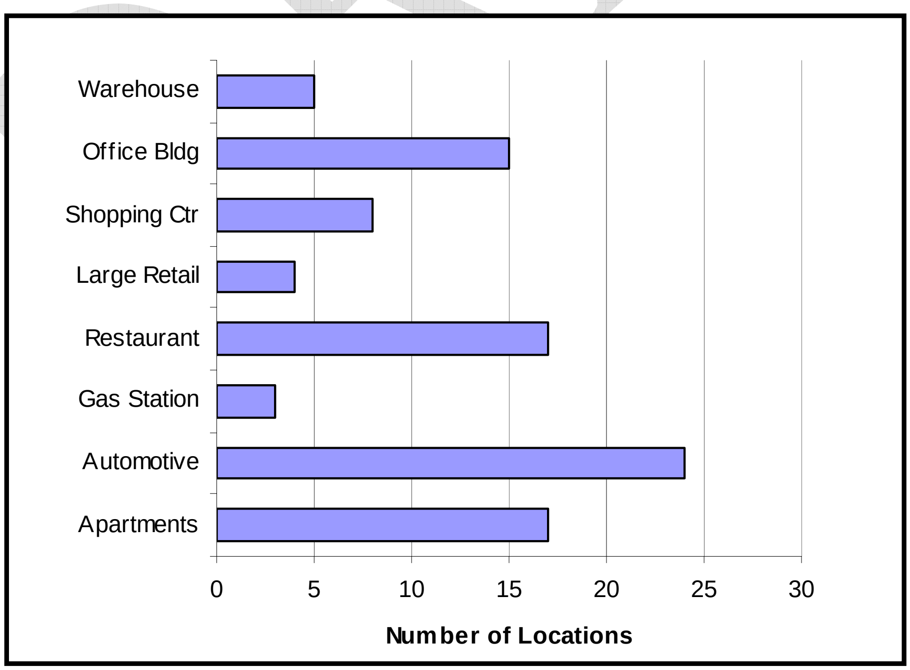

Figure 19: Shipbuilders Creek Watershed Hotspot Types

Figure 20: Grease dumpster spill in subwatershed D

Using the identified hotspot parcels, a windshield survey was conducted along the Empire Blvd corridor. Observations were made for several categories of pollution generating activities; vehicle operations, outdoor material storage, waste management, physical condition of the building and grounds, turf landscape areas and stormwater infrastructure. Facilities were scored in each of these categories as to whether they were generating stormwater pollutants. Twenty-five sites were given a status of either potential, confirmed or severe hotspot. Of those, seven locations were confirmed hotpots and two were found to be severe. These nine locations could be considered to be the most likely to pose an immediate threat to water quality. Six of the nine were automotive related and one was a construction company. The other two were mixed retail establishments. Potential remedies are education and outreach as well as enforcement of the municipal illicit discharge ordinance.

3.2.3 Pervious Area Assessment

The pervious area assessment was conducted to evaluate natural remnants and large pervious areas outside the stream corridor. During the upland survey County staff looked specifically at existing vegetative cover, potential impacts, and site constraints at each location. The potential to reforest turf areas or restore natural area remnants and open parcels via soil amendments, planting, invasive plant species removal, and trash clean-up were evaluated.

Prior to going out to the field, sites with significant turf cover and publicly-owned sites were identified in the office using aerial photos and land use mapping information.

3.3 Restoration Inventory

The third step, following the stream corridor and upland assessments, was developing a list of locations for potential stormwater retrofit projects and stream repairs. This was done using findings from the field assessments and by analysis of aerial photos and other mapping resources.

Retrofit Assessment

Stormwater retrofits improve water quality and reduce water quantity problems by providing stormwater treatment, storage and runoff reduction in locations where practices previously did not exist or were ineffective. They are installed to capture, infiltrate and treat stormwater runoff before it is delivered to receiving waters. Retrofits are the primary practice used to restore streams since they can remove pollutants, promote more natural hydrology, improve stormwater conveyance capacity, and minimize stream channel erosion.

Stormwater treatment, storage and runoff reduction fall into two categories: Large practices - those that treat drainage areas ranging from five to 500 acres such as ponds and wetlands and, Small practices – those that normally treat less than five acres of contributing drainage area, and frequently less than one acre such as bioretention and infiltration practices (CWP, 2007).

Candidate sites were initially identified using orthophotos, local input, and information gathered during the field assessments. Priority candidate sites in the watershed generally had one or more of the following characteristics:

- Located upstream of potential stream restoration projects
- Located at uncontrolled hotspots
- Have a large amount of impervious cover in the drainage area
- Have existing drainage infrastructure or existing stormwater practices
- On publicly-owned or operated lands
- Could serve as a demonstration project.

Retrofit objectives were set early in the planning process to target the specific pollutants impacting the watershed as well as improve existing drainage issues. Both small and large retrofit practices have great potential of increasing water quality treatment, recharge, and mitigation of known localized channel erosion areas. These practices became the focus of recommended projects for the SC watershed.

The target volume and flow rate controls for retrofits are:

- *Recharge*(R)*:* targets rainfall events that contribute much of the annual groundwater recharge at a site but create little or no runoff from undeveloped areas with pervious surfaces. Infiltrating this volume helps restore baseflows to streams, helping to restore habitat.

- *Water Quality*(WQv): targets rainfall events that deliver the majority of the stormwater pollutants during the course of a year. The water retrofit goal is to capture and treat the 90 percent storm, as defined by the local rainfall frequency spectrum. This criterion optimizes runoff capture resulting in high load reduction for many stormwater pollutants. The rainfall depth associated with the 90 percent storm for the Rochester NY area is 0.8 inches.

- *Channel Protection* (Cpv): targets storms that generate bankfull or near bankfull flows that cause stream channel enlargement. Channel protection storage generally exceeds the water quality storage volume by 20 to 40 percent in most regions of the country.

- *Overbank Floods* (Qp10): targets large and infrequent storm events that spill over to the floodplain and cause damage to infrastructure and streamside property.

Using both field investigation and mapping tools, potential stormwater retrofit projects were identified and inventoried to meet SC restoration objectives. The full list of high priority projects are provided in Appendix H and are estimated to be built over a 15 year timeline. Once stakeholders provide input on the SWAAP and projects are chosen, concept plan designs will be prepared.

Stream Repair Assessment

Stream repair projects stabilize eroding stream banks, remove concrete-lined or piped sections, re-establish aquatic habitat, and reduce pollution sources. In areas where the stream is set away from urban property lines, natural materials and "soft" techniques are used. Soft techniques include the use of natural materials such as rocks, logs, and native vegetation to:

- Reduce pressure on eroded banks
- Prevent down-cutting of the streambed
- Restore the natural meander pattern found in stable streams (such as an S-curve or a sine curve)

Long-term protection is provided by reforestation of the stream buffer zone. In areas where the stream is closer to the street and in dense urban areas, "hard" solutions such as riprap and rock walls may be used to protect and reinforce stream banks

3.3.1 Restoration Project Types

A variety of project types are proposed to meet SC restoration objectives, funding limits and available space. The highest ranking stormwater restorations are three new ponds, four channel storage conveyance projects, one rain garden and one bioretention project. Other high ranking projects involve converting existing flood control ponds to stormwater ponds. Some 56 existing ponds were located and mapped. All but three of those ponds are constructed for stormwater management (where stormwater is routed to control the discharge rate and in some cases for treatment of pollutants). The most notable pond is in the Town of Webster's Empire Park which is considered a regional stormwater pond since it captures and treats a large upstream area (versus a single neighborhood or commercial parcel). At the time of this writing the pond is undergoing a retrofit through a joint effort between the towns of Penfield and Webster. The pond was built in the early 90's as recommended in the 1981 Town of Webster Drainage Study (Costich 1981) to mitigate downstream flooding.

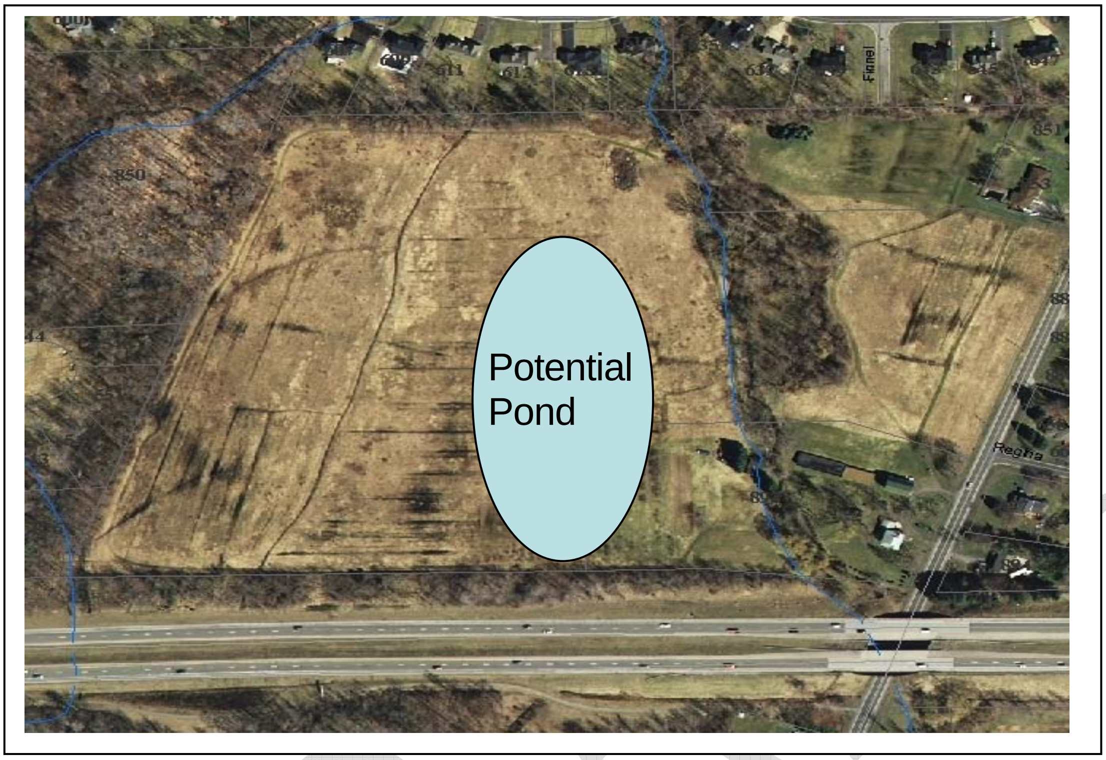

Figure 21: Finn Park in Webster, Potential Site for Stormwater Pond

There are seven restoration project types that were considered:

1. Construction of New Stormwater Management Ponds

New stormwater management ponds provide flood and water quality controls with significant benefits depending on location in the watershed. Figure 21 shows the location of a potential future pond that could be built adjacent to the main stem of SC in the northern portion of the watershed. The pond would receive high flows from the creek through a constructed channel that connects the creek to the pond at the south end and, another channel at the north end that discharges “treated” water back to the creek.

2. Retrofit Conventional Flood Control Ponds

Retrofit practices modify existing ponds adding features to treat stormwater pollutants in addition to their existing function of flood control. There are 52 mapped ponds that provide flood control features, four are recreational ponds. Dual functioning ponds control runoff from small, more frequent storms, which account for up to 90 percent of the annual rainfall events. They are landscaped to enhance pollutant removal, aesthetics, improve native habitat and to reduce facility maintenance requirements. An example of a proposed conversion of a conventional flood control pond is shown in Figure 22.

To promote pollutant removal, a dual functioning pond is designed to:

- Maximize the flow path through the pond,
- Slow the flow of stormwater through the pond,
- Improve how plants use stormwater to increase absorption and evapotranspiration,
- Filter and trap common runoff pollutants,
- Promote soil saturation/groundwater recharge.

For further information on retrofitting conventional flood control ponds, see Appendix I.

Figure 22: Proposed upgrades of conventional flood control pond in Baytown (Walmart) Plaza – Empire Blvd.

3. Green Infrastructure Retrofits

Green Infrastructure is being supported by NYSDEC and partner organizations as a more effective way to capture, treat and improve stormwater runoff. These practices capture runoff from small areas of impervious surface and infiltrate, evapotranspire, and reuse stormwater (ie. to water lawns or gardens) to maintain or restore natural site hydrology. In this way, green infrastructure practices help to reduce stress on stormwater pipes and channels and lessen the impacts of development on streams. Benefits of green infrastructure include:

- Reduce stormwater pollution levels. Once runoff is infiltrated into soils, plants and microbes can naturally filter and break down many common pollutants found in stormwater runoff..

- Moderate erosive flow energy in stream channels. The infiltration of a portion of stormwater runoff can lower stream velocity which results in less erosion to stream channels. This leads to reduced suspended solids in the stream, stable stream banks and better aquatic habitat.

- Recharge of the groundwater table needed to maintain normal dry weather base flow in a stream which is a critical element to maintain a diverse aquatic habitat.

Figure 23: Proposed Cul-de-sac Rain Garden (Ironwood Cir/Sequoia Dr.)

Figures 23 – 25 are examples of potential green infrastructure practices that could be installed in the Shipbuilders Creek watershed. For further details and examples of these practices, see Appendix I.

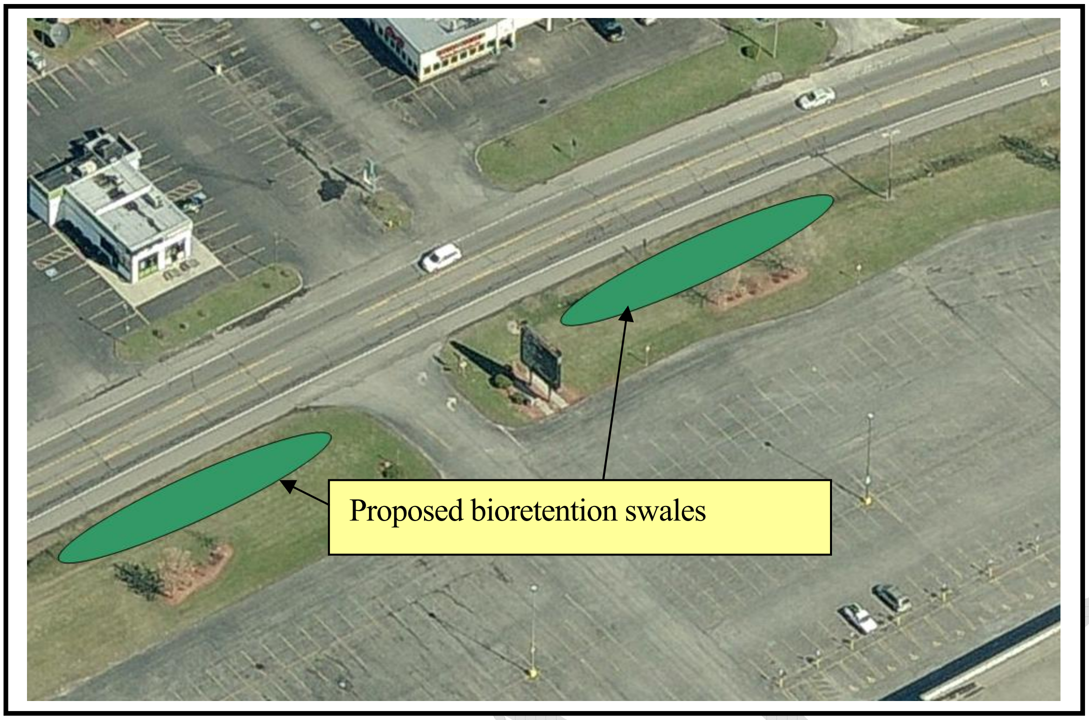

Figure 24: Proposed Vegetated Bioretention Swale at Lowes Theatre

Figure 25: Proposed Impervious Cover Reduction at Lowes Theatre

4. Stream Repairs

Stream repairs include physical modifications to stream channels, banks, and in-stream habitat to repair and improve degraded or unstable conditions. The project objectives are to reduce stream bank erosion, protect threatened infrastructure such as adjacent homes or roads, and recover biological diversity of a naturalized stream. Figure 15 shows a high priority candidate restoration site near the Bryden Park subdivision.

5. Stream Buffer Enhancements

A stream buffer is a vegetated corridor of trees, shrubs and other native vegetation planted adjacent to the stream to protect the stream from the effects of the surrounding landscape. Replanting streamside vegetation with native shrubs, trees and plants insulate streams from a wide range of land use stressors such as stormwater runoff pollution. Figure 13 shows a high priority restoration site at Webster Schroeder High School.

6. Hotspot and Discharge Prevention

Hotspot and Discharge Prevention is used to prevent the entry of sewage and other pollutants into the stream. These discharges may be caused by illicit sanitary sewage connections to a stormwater systems, industrial and commercial pollutant discharges, failing sewage lines, vehicle transport or spills. Hotspot and Discharge Prevention entails the use of techniques to find, fix and prevent these illicit discharges; including conducting a survey of all known stormwater outfalls to identify suspicious discharges for further investigation. Water sampling in SC showed high Ecoli levels as described in Section 2.1.2 and shown in Figure 11 of this SWAAP.

7. Residential Management Practices

The last of the project types proposed for restoring Shipbuilders Creek is actually a number of practices that rely on changing the day-to-day habits of watershed residents in ways that result in reductions in pollutant discharges. These practices include better management and reduced use of lawn chemicals, proper disposal of pet wastes, and understanding and applying the message "only rain down the drain" (no dumping or discharging wash waters, oils, paints and other chemicals down catch basins or stormwater conveyances).

3.3.2 Potential Restoration Projects

Prioritization of Projects

The goal of identifying potential restoration and retrofit projects is to ultimately work with local partners and funders to implement them. Due to the limited resources expected to be available for implementation, restoration projects identified in SC were evaluated based on a set of criteria to identify priority projects to pursue for implementation. The ranking system used was fairly quantitative where potential projects were assigned points based on the following rationale:

1. Feasibility Projects on public land were ranked higher because it is typically easier to implement restoration projects on public land where issues regarding property rights or privacy are avoided. Ease of access to the project area was also considered under this criterion by adding one point. Points awarded based on land ownership were as follows:

- Public lands were given three points in this category.
- Projects with stormwater easements on commercial property or covered by a homeowners association were given two points since they are considered to be less attached to mowing yards.
- Residential properties with stormwater easements were given one point.
- Projects on private property where no easement existed were not considered.

2. Multiple Benefits Many restoration projects can be designed to meet more than one subwatershed objective. The projects selected met at least two of the objectives identified for the Shipbuilders Creek subwatersheds (see section 1.3 for objectives). One point was added for each expected benefit a project would deliver.

3. Environmental Benefit Environmental benefit was quantified by making an estimate of the area treated by proposed stormwater retrofits, or by estimating the length of stream restored or re-planted for stream restoration and riparian reforestation projects.

Watershed Acreage treated (for new and existing pond retrofits):

1. Large areas, greater than 40 acres were given three points.
2. Medium areas were those ranging from 10-39 acres were given two points.
3. Small areas were less than 10 acres and were given 1 point.

For Stream dechannelization and buffers:

1. Long lengths, greater than 100 feet were given three points.
2. Medium lengths were those ranging from 50-99 feet were given two points.
3. Small lengths were less than 50 feet and were given 1 point.

4. Cost Effectiveness The cost of stormwater restoration projects varies greatly, from several hundred to hundreds of thousands of dollars. Most projects were prioritized because they were simple projects that could be implemented by municipal staff, or were relatively inexpensive retrofits such as bioretention. Figure 26 illustrates the cost effectiveness of several stormwater practices and provides the basis for this criteria ranking. Points awarded based on cost per cubic foot of stormwater treated were as follows:

1. Highly cost effective projects were those ranging from $1 to $11 and were given three points.
2. Median cost effective projects were those ranging from $12 to $25 and were given two points.
3. Low cost effective projects were those ranging from $26 and $100 and were given one point.
4. All other project types were not ranked – excluding for example green roofs.

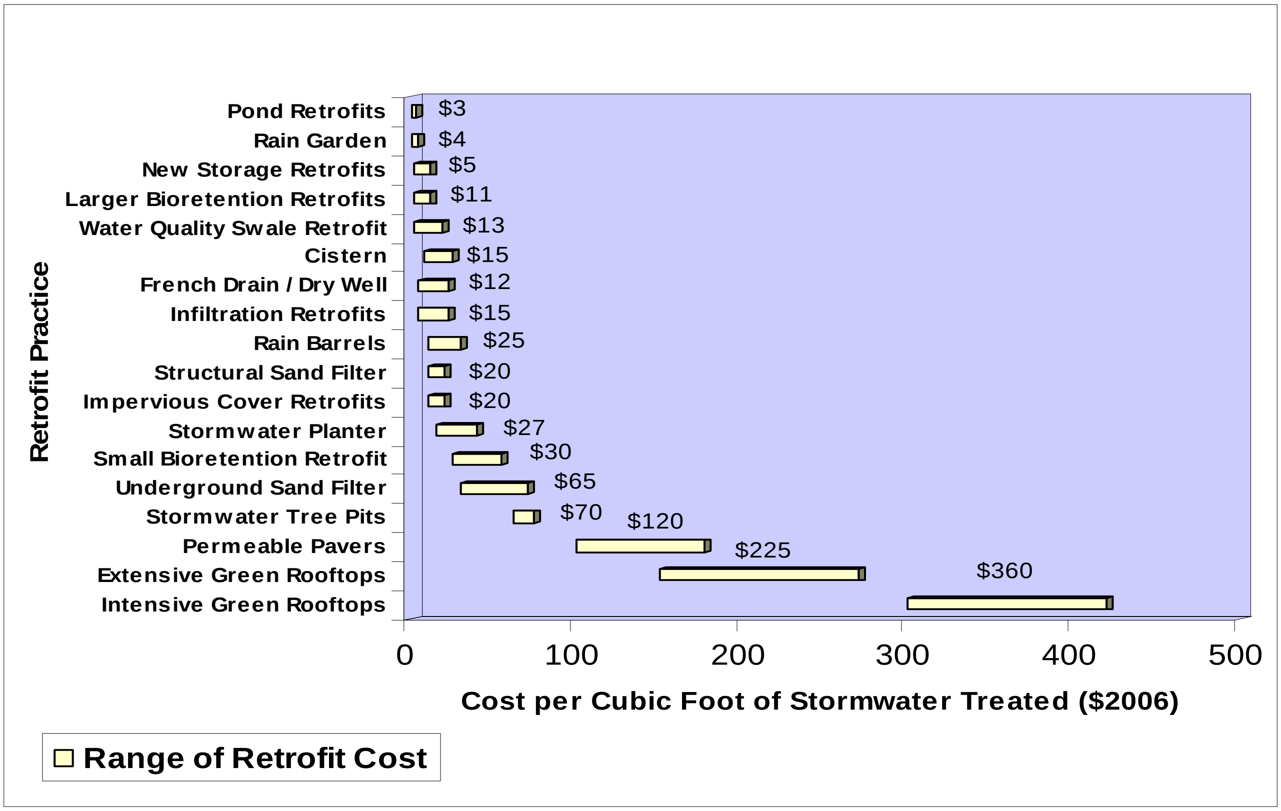

Figure 26. Range of Stormwater Retrofit Costs (Center for Watershed Protection)

Project List

The projects listed in Table 10 are those that were ranked the highest using the numeric criteria described in the previous section and considering a 15 year build-out timeline. A full listing of all potential restoration projects is provided in Appendix H. Additional criteria such as barriers due to State and Federal Stream and Wetland permit restrictions has been suggested and should be added along with weighting factors from the stakeholder meetings. Project types are numerically listed in Table 10 according to the seven categories described in section 3.3.1.

Table 10. Potential Restoration Projects

Project Name/ Project Location	Project Type	Area Treated (acres)	Stream Length Restored (ft)	Reason for Prioritization	Planning-Level Cost Estimate
Finn Park/ Gravel Rd. Webster	New Stormwater Pond	295	NA	• Treats large area • Downstream erosion • Upstream developed area w/o treatment • Public property	$180,000
Penfield Property -S. side of State Road/1345 Shoecraft Rd. Penfield	New Stormwater Pond	6	NA	• Downstream erosion • Upstream developed area w/o treatment • Public property	$60,000
Bauman Farm low berm/Hatch Rd. Penfield	New Stormwater Pond	7	NA	• Downstream erosion • Localized drainage issues • Available space	$50,000
Bryden Park/Five Mile Line Rd. Penfield	Upgrade of Conventional Flood Control Pond	67	NA	• Treats large area • Localized drainage issues • Available space	$60,000
Lowes Home Imp. Ctr. (S. side entrance)/Five Mile Line Rd., Webster	Upgrade of Conventional Flood Control Pond	15	NA	• Downstream erosion • Localized drainage issues • Available space	$30,000
St. Ann's Home/Webster	Upgrade of Conventional Flood Control Pond	32	NA	• Treats large area • Downstream erosion • Upstream developed area w/o treatment	$30,000
Hegedorn's Property at Lowes/Webster	Upgrade of Conventional Flood Control Pond	20	NA	• Downstream erosion • Upstream developed area w/o treatment	$60,000
Val Car Subd/ Webster	Upgrade of Conventional Flood Control Pond	51	NA	• Treats large area • Public property	$100,000
Bishops Lane/off Hatch Rd. Webster	Upgrade of Conventional Flood Control Pond	26	NA	• Public property • Downstream erosion • Localized drainage issues	$100,000
Preston Park Subd./ 607 Hosta Circle Webster	Upgrade of Conventional Flood Control Pond	50	NA	• Treats large area • Downstream erosion • Upstream developed area w/o treatment	$100,000
Heritage Park Dr./N. Side Ridge Rd. Webster	Upgrade of Conventional Flood Control Pond	17	NA	• Public property • Downstream erosion	$60,000
Wood Harbor Estates/Galleon Dr. Webster	Upgrade of Conventional Flood Control Pond	10	NA	• Downstream erosion • Upstream developed area w/o treatment • Public property	$60,000
Wood Harbor Estates Resub/Webster	Upgrade of Conventional Flood Control Pond	8	NA	• Downstream erosion • Public property	$60,000

Table 10. Potential Restoration Projects (continued)

Project Name/ Project Location	Project Type (s)[1]/ Description	Area Treated (acres)	Stream Length Restored (ft)	Reason for Prioritization	Planning-Level Cost Estimate
Baytown Plaza (Walmart)/Penfield	Upgrade of Conventional Flood Control Pond	60	NA	• Treats large area • Upstream developed area w/o treatment	$100,000
NYS Rt 104 pond/Webster	Upgrade of Conventional Flood Control Pond	70	NA	• Public property • Treats large area • Downstream erosion • Upstream developed area w/o treatment	$30,000
Silverwoods Subd./off Hatch Rd., Penfield	Upgrade of Conventional Flood Control Pond	65	NA	• Public property • Treats large area	$30,000
Watersong Subd./Penfield	Upgrade of Conventional Flood Control Pond	21	NA	• Public property • Localized drainage issues	$30,000
Webster Thomas H.S.	Green Infrastructure Retrofit	0.5	NA	• Downstream erosion • Upstream developed area w/o treatment • Public Land • Education opportunity	$30,000
755 Ridge Road Holtz Auto Dealer	Green Infrastructure Retrofit	1.5	NA	• Adjacent to stream • Available space • Hot spot	$20,000
Webster Schroeder Middle School - East Tributary	Green Infrastructure Retrofit	3	NA	• developed area w/o treatment • public land • reduces runoff volume	$15,000
Webster Schroeder Middle School - West Tributary	Green Infrastructure Retrofit	3	NA	• developed area w/o treatment • public land • reduces runoff volume	$15,000
BJs/Lowes	Green Infrastructure Retrofit	3	NA	• Localized drainage issues • Upstream developed area w/o treatment • Available space	$15,000
NYS Rt 104	Green Infrastructure Retrofit	3	NA	• Downstream erosion • Upstream developed area w/o treatment • Public property	$15,000
Multiple Residential Neighborhoods	Green Infrastructure Retrofit	3	NA	• Reduces runoff volume & pollutants	$20,000

Table 10. Potential Restoration Projects (continued)

Project Name/ Project Location	Project Type (s)[1]/ Description	Area Treated (acres)	Stream Length Restored (ft)	Reason for Prioritization	Planning-Level Cost Estimate
Multiple institutional and commercial properties	Green Infrastructure Retrofit	15	NA	• Reduces runoff volume & pollutants	0 (through SPDES)
Multiple institutional and commercial properties	Green Infrastructure Retrofit	20	NA	• Reduces runoff volume & pollutants	$22,000
821 Lindsey Circle/ Webster	Stream Repairs	NA	50	• Severe erosion	$2500
575 Drumm Road/Webster	Stream Repairs	NA	50	• Severe erosion	$2500
595 Vosburg Rd Sewer Pump Sta../Webster	Stream Repairs	NA	50	• Severe erosion	$2500
475 Klem Road/Webster	Stream Repairs	NA	50	• Severe erosion	$2500
616 Old Woods Rd. (off Drumm Rd.)/Webster	Stream Repairs	NA	50	• Severe erosion	$2500
Webster Thomas HS, File Mile Line Road/Webster	Stream Repairs Stream Buffer Enhancement	NA	800	• Public property • w/ available space • Education opportunity • Severe erosion • Impacted Stream Buffer	$15000
Bryden Park/Five Mile Line Rd. Penfield	Stream Repairs Stream Buffer Enhancement	NA	800	• Education opportunity • Severe erosion • Impacted Stream Buffer	$15000
Daniel's Creek, 59 Seabury Blvd.	Stream Repairs Stream Buffer Enhancement	NA	550	• Homeowners Association property w/ available space • Education opportunity • Downstream erosion	$14000
Rosebud Trail/Penfield	Stream Repairs Stream Buffer Enhancement	NA	550	• Severely impacted egment	$14000
Montgomery Glen Dr. off Hatch Rd (not yet developed)	Stream Repairs Stream Buffer Enhancement	NA	900	• Education opportunity • Downstream erosion	$16000
Sugarcreek trail off Hatch Rd	Stream Repairs Stream Buffer Enhancement	NA	900	• Homeowners Association property w/ available space • Education opportunity • Downstream erosion	$16000
Lowes Theatre	Stream Repairs Stream Buffer Enhancement	NA	450	• Commercial property • Downstream erosion	$13000

Table 10. Potential Restoration Projects (continued)					
Project Name/ Project Location	**Project Type (s)[1]/ Description**	**Area Treated (acres)**	**Stream Length Restored (ft)**	**Reason for Prioritization**	**Planning-Level Cost Estimate**
Multiple Businesses along Empire Blvd.	Hotspot and Discharge Prevention	148	NA	• Hotspot discharge removal	$5,000
Multiple Streets in watershed	Hotspot and Discharge Prevention	30	NA	• Good cost-benefit ratio	$90,000
Multiple locations	Hotspot and Discharge Prevention	NA	NA	• Source Control	$20,000
Multiple locations	Hotspot and Discharge Prevention	NA	NA	• Source Control	$1,600,000
Multiple Residential Neighborhoods	Residential Management Practices	1000	NA	• Addresses pollutants delivered from largest land use in watershed	$10,000
Multiple Residential Neighborhoods	Residential Management Practices	14	NA	• Addresses pollutants delivered from largest land use in watershed • Reduces runoff volume	$15,400
Multiple Residential Lots	Residential Management Practices	NA	NA	• Source control	$207,000

3.4 Watershed Treatment Model Results

As described in section 2.1.5, the Watershed Treatment Model (WTM) was used to estimate existing and future loads of stormwater pollutants delivered to Shipbuilders Creek. To create these estimates, the model requires inputs for the level of watershed development (acres of residential, commercial, rural, roads etc), existing stormwater management practices, and proposed restoration efforts. Restoration practices proposed in Table 10 were added to the model and the predicted pollutant loads and corresponding reductions are shown in Table 11.

Table 11. Stormwater Loads w/Restoration Practices

	Total Nitrogen	**Total Phosphorus**	**Total Suspended Solids**	**Fecal Coliform**	**Runoff Volume**
Pollutant Source	**lb/year**	**lb/year**	**lb/year**	**billion/year**	**(acre-feet/year)**
Urban Land	22,239	4,535	414,975	743,089	48,339
Active Construction	89	18	60,290	0	88
Sanitary Sewer Overflows	357	59	2,379	270,063	0
Channel Erosion	1,074	1,020	268,464	0	0
Rural Land	2,704	411	58,780	22,924	35
Livestock	420	48	0	1,600	0
Illicit Connections	0	0	0	0	0
Septic Systems	635	106	4234	25,886	0
Open Water	192	8	2,325	0	0
Total Load w/Practices	**27,710**	**6,205**	**811,448**	**1,066,053**	**48,463**
Existing Load (from Table 7)	32,204	7,206	983,673	1,526,135	48,620
Percent Reduction with Restoration	**14%**	**14%**	**18%**	**30%**	**~0**

At the time this writing, NYS had not yet prepared a Total Maximum Daily Load Analysis for SC so it is not known whether the reductions shown here would be adequate for a future TMDL. As previously noted, Shipbuilders Creek impairments are high dissolved oxygen (DO) demand, phosphorus, pathogens and silt/sediment. Measures to address each of these are discussed separately below:

To lower dissolved oxygen demand through restoration efforts, general actions would include reducing the amount of organic material such as leaf litter and sanitary waste from entering the stream. Planting trees along the stream would serve to increase shade over the stream and reduce summer water temperature. While these actions are proposed here, few simple models can predict their results accurately (dissolved oxygen values are not represented in the WTM loads).

Phosphorus is a nutrient that is most typically a concern in freshwater ponds and lakes as the primary cause of weeds and algae growth. A guidance level concentration given by NYSDEC is 20 micrograms per liter of water for "still" bodies of water (ponds and lakes). There is no NYS guidance to date on the limit a flowing stream can assimilate without causing impairment. All wet weather flows sampled in Shipbuilders Creek exceeded the 20 micrograms limit by large amounts (see Figure 7). A restoration proposal is to increase awareness of the impacts of excess lawn fertilizers through enhanced education efforts that will ultimately lead to behavior changes. The model assumes that 90 percent of watershed residents will hear the lawn care message. Of that 90%, the model estimates that between 10 and 50 percent of residents will change their actual fertilizer use. The education program objectives are to have residents reduce fertilizer usage, switch to zero phosphorus fertilizer or use no fertilizer at all. The resultant estimate of benefit is a reduction of 491 pounds of phosphorus and a 25,000 pound reduction in nitrogen.

Pathogens in urban streams are generally considered to be a group of fecal coliform bacteria delivered to streams from a variety of sources. Sampling for the presence of these bacteria was done during the assessment of Shipbuilders Creek (see Ecoli sampling results shown in Figure 11). Determining the source of bacteria (humans, pets, birds, or wildlife) can be done by DNA analysis which was beyond the scope of this study. An example of DNA testing for Ecoli bacteria can be seen in the Lower Boise watershed study (Doran, 2002). Of the total identifiable bacteria throughout the watershed, 17 percent came from human sources, 22 percent from pets, 35 percent from avian populations, 15 percent from wildlife, and 11 percent from livestock. The SC watershed has essentially no livestock, though, concerns for the proper disposal of pet waste is part of the Stormwater Coalition of Monroe County's current water quality educational program. No additional actions for pet waste are proposed beyond the current program. Septic systems are often a source of bacteria in watersheds and the WTM estimates the benefit of an enhanced septic system education and upgrade program. Such a program would involve expanded outreach in the form of educational brochures and workshops as well as increasing inspections, system upgrades and retirement of septic systems. The WTM estimates a 39 percent reduction in fecal coliform would be realized from these actions.

Silt/sediment (referred to as total suspended solids or TSS) is the last impairment listed for Shipbuilders Creek. Several restoration proposals will provide sediment reductions including: upgrades to conventional flood control ponds (100,000 pounds of sediment removed annually); small improvements in the current construction inspection program (40,000 pound reduction); and repairs to eroding stream channels (6,000 pound reduction).

Section 4. Recommendations

While goals and recommendations for restoring SC need to be adopted by the stakeholders that live and work there, environmental regulations may direct certain actions be undertaken by local government to meet water quality standards. The first step listed below is to enlist participation of these stakeholders. The draft goal and recommendations, if implemented, should meet water quality standards expected to be imposed and provide noticeable improvements to the Creek in function and water quality.

4.1 Shipbuilders Creek Draft Watershed Goal

The watershed assessment and planning effort began with the goal to: *improve water quality in SC and its tributaries by reducing the volume and concentration of polluted stormwater runoff that enters the stream. The goal can best be met by improving and installing infrastructure capable of infiltrating and treating polluted stormwater, restoring natural aquatic habitat and, getting residents and business owners actively involved in pollution prevention practices.* This goal is consistent with the Stormwater Action Planning objective of identifying major stormwater quantity and quality issues throughout the County that provides a framework for a capitol improvement program to address these issues.

4.2 Draft Recommendations

When project goals and the assessment findings are considered, it becomes possible for project staff to establish a series of recommendations for future actions. Specific recommendations were developed for the SC subwatersheds with input from local stakeholders, observations made during the stream and subwatershed assessments and best professional judgment from the project staff. These recommendations are divided into short, mid and long-term recommendations. Short-term recommendations should occur with the next year and include those deemed most important or imminent to protecting the health of the subwatershed. Mid-term recommendations should occur within one to three years and long-term recommendations may take longer than three years to implement.

Short-Term Recommendations

1S. Establish a watershed stakeholders group. A stakeholders group consisting of local residents and municipal officials should be established to consider the Assessment and Action Plan and to guide future activities to ensure they reflect local interests.

2S. Develop a public education campaign that improves watershed awareness and targets municipal officials, developers, business owners and residents.

3S. Implement small-scale priority restoration projects in SC. Of the small-scale priority restoration projects identified in SC, the short-term goal should be to implement two projects. Small-scale projects can be performed with a low-tech engineering approach and utilize volunteer labor for installation of portions of the projects such as plantings.

Mid-Term Recommendations

1M. Directly contact landowners of potential restoration sites to discuss possible project implementation. Coalition should work with other local partners to contact landowners of priority restoration projects identified in SC to solicit their interest in implementation. This will likely involve several phone calls or meetings and may necessitate obtaining additional information about the site (e.g., site plans, utility locations), working with local consulting firms to estimate costs, presenting ideas to local homeowners associations (HOAs), and educating the landowners about watershed issues and the benefits of restoration.

2M. Establish a program to conduct regular sampling for macroinvertebrates. Utilize the already established monitoring stations to continue to monitor the long-term health of the bug community on an annual or bi-annual basis. Selecting a few key water quality parameters based on the previous results will provide a multi-faceted approach that will help to identify the sources of any observed patterns of decline. This program will be particularly important to monitor the effects of new development on stream health in SC.

3M. Conduct an annual State of the State of Shipbuilders Creek Watershed meeting for local partners. Invitees would include local governments, developers, businesses and watershed residents. The purpose of the meeting is to interact and talk about the latest work being done in the SC watershed and to generate interest in implementing priority projects.

4M. Modify relevant local codes and ordinances to allow and encourage use of Better Site Design techniques. Working with the Stormwater Coalition of Monroe County, the towns of Webster and Penfield should begin to make changes to their codes and ordinances to reflect the concepts of better site design and green infrastructure practices. A good starting point may be to present the recommendations to local planning commissions or similar entity to get their buy-in and facilitate the process.

5M. Implement large-scale priority restoration projects in SC. Of the proposed large-scale priority restoration projects identified in SC, a mid-term goal should be to implement two projects. Large-scale projects require a greater degree of design and engineering, are typically more expensive and may include multiple components such as stormwater retrofits, stream restoration and riparian plantings.

6M. Establish a program to monitor watershed restoration and protection efforts. It is important to measure and track both the short and long-term health of the streams in Shipbuilders Creek, and the success of restoration efforts. As restoration projects are implemented in SC, a monitoring plan should be developed for each project. Specifically, opportunities to measure the effectiveness of innovative restoration projects, such as bioretention or downspout disconnection, should be explored.

7M. Establish a restoration committee to seek funding for implementation of stormwater restorations and stream restoration projects. This committee should have a goal of obtaining funding for two large-scale and two small-scale restoration projects in SC each year. Specific tasks include identifying potential funding mechanisms, submitting proposals for funding and/or soliciting potential funders.

Long-Term Recommendations

1L. Adopt a stormwater ordinance that requires new development to incorporate better site design principles including infiltration and recharge of stormwater runoff. Revisions have been adoption to the NYS Stormwater Management Design Manual. The manual emphasizes innovative stormwater treatment practices termed “Green Infrastructure”. There is a five-step process for stormwater site planning and practice selection in the SWPPP; site planning to preserve natural features and reduce impervious cover, calculation of the sites water quality volume, incorporation of runoff reduction techniques by applying green infrastructure, the use of standard treatment practices where applicable, and finally design of volume and peak discharge control practices. The goal is to encourage on-site stormwater management and increased groundwater infiltration as a means to minimize stormwater discharge and limit the amount of surface pollutants entering New York streams. It is recommended that Webster and Penfield adopt the NY State regulations in a stormwater ordinance to encourage the use of practices that provide infiltration and recharge of stormwater.

4.3 Long Term Monitoring

Monitoring is an essential component of watershed planning for documenting project success, tracking stream health over time, and testing the effectiveness of innovative restoration practices. The Center for Watershed Protection proposes a strategy for long term monitoring that will be proposed for Shipbuilders Creek Watershed. Three ways to monitor project success include:

1. Track the number and location of restoration projects and subwatershed recommendations that have been implemented.
2. Conduct post-construction monitoring of structural restoration practices to ensure that they are functioning properly.
3. Measure the effect of restoration efforts on stream health.

The Center recommends establishing a long-term monitoring program that utilizes the above three methods to track project success. The first component, tracking the number and location of restoration projects and recommendations that have been implemented, can be done using a simple spreadsheet, or may be integrated with a Geographic Information System (GIS) to add a spatial element. Basic information about each project should be included in the spreadsheet, and the information should be updated on an annual basis.

The second component, conducting post-construction monitoring of restoration practices to ensure they are functioning properly, should be required with implementation of structural restoration practices such as stormwater treatment practices or stream restoration projects. A maintenance and inspection plan should be developed during the early stages of the project to prevent practice failure and allow a periodic check to ensure the practice is functioning properly. Practices that do not require regular maintenance should, at a minimum, be inspected on an annual basis.

The third component of a long-term monitoring plan is to measure the effect of restoration practices on stream health. This can be done at both the site and the subwatershed scale; however, detecting change is more easily accomplished at an individual site. For example, it may be difficult at the subwatershed level to distinguish between actual change due to restoration efforts versus changes due to climatic variation and weather patterns. Given these considerations, it is recommended that water quality and biological monitoring in SC be approached in the following three ways:

1. Track long-term water quality and stream health using macroinvertebrates. Macroinvertebrates are indicators of stream health whose life cycle places them in a stream for a period often of six to twelve months and therefore reflect the conditions in the stream over a longer period of time compared to a water quality sample. Macroinvertebrate sampling should be conducted on an annual or bi-annual basis in the Shipbuilders Creek Watershed at the already established sampling stations to continue to track long-term health in the watershed. At a minimum, several key water quality parameters should also be selected based on previous macroinvertebrates results and monitored with the macroinvertebrates to provide clues to the sources of any observed decline in bug communities.

2. Track improvements in water quality from implementation of restoration projects at either the site level or reach level. This monitoring could be useful for testing the pollutant removal effectiveness of innovative practices such as bioretention or sand filters. For example, volunteers could conduct storm event monitoring of inflow water quality versus outflow water quality for a newly installed bioretention facility. Another example is to monitor the effect of downspout disconnection in a single headwater neighborhood (implemented through a targeted door-to-door outreach effort) by monitoring the streamflow at the neighborhood outlet both before and after downspout disconnection occurs.

3. Track the effects of an individual development project at the reach level to determine the impact of either an innovative or traditional development. Ideally, this would include water quality and biological monitoring, although intensive water quality monitoring including storm events may be cost prohibitive. This effort would be best achieved by applying a paired watershed study approach, which would require monitoring a control reach within SC as well. It is important that the control reach does not have any development within its drainage area.

A paired watershed study is one of the best ways to document change in nonpoint source (NPS) pollution. (CWP, 2004) The following caveats apply to a paired watershed study:

- Anticipated (or modeled) change should be greater than 20% for the parameter of interest or detecting change over background noise will be very difficult.
- A control watershed (reach) must be used in order to select out background noise due to variations in weather, climate etc.
- Monitoring must occur both pre- and post-restoration efforts

4.4 Recommendations for Future Watershed Assessments

Shipbuilders Creek watershed was selected for detailed assessment from the list of 303(d) watersheds in Monroe County. Due to its relatively small size (5,000 acres) and homogenous land use (80% residential) it was felt that the watershed was a good first choice to demonstrate the rapid assessment and restoration process. In addition, municipal officials from the Towns of Penfield and Webster expressed interest in the study as a way to assess the waterbody and facilitate its restoration and possible removal from the 303(d) list.

A second assessment will be conducted on the Little Black Creek watershed, another priority waterbody in Monroe County. Little Black Creek watershed is more than twice the size of SC with a more varied land use including extensive commercial and industrial areas. Lessons learned from the SC assessment will be applied to this future assessment in an effort to streamline the rapid assessment process for future use. Recommendations and lessons learned are summarized in Table 12.

Table 12. Recommendations for Future Assessments

Activity	Recommendation
Stakeholder Involvement	Work with watershed stakeholders earlier in the process to help identify potential problems in the watershed. This will help in both the stream corridor and upland surveys and provide a better foundation for future retrofits
Hydrologic Modeling	Although flow meters were used with the auto samplers, the flow data proved not to be as useful as was hoped. The hydrologic component will be an important part of future assessments. Site selection for flow monitoring is important. Installation of stations for flow measurements are recommended as well as occasional manual discharge measurements. The development of a local hydrologic modeling tool will also be useful.
Sampling	Rely less on composite samples and more on grab samples in an effort to locate specific pollution hotspots

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Appendix A Stream Sampling Data from 2009 Monroe County Sampling

Table A1. Wet Weather Grab Sample	All values mg/L	Ecoli mpn/100mL								
	Station	**Date**	**TSS**	**TP**	**NH3L**	**TKN**	**OPL**	**NOXL**	**CHL**	**Ecoli**
Upstream	**7**	7/23/2009	162	0.157	0.1043	0.691	0.0234	0.3281	29.9	32550
	6	7/23/2009	20	0.098	0.094	0.689	0.0201	0.2775	44.2	8550
	5	7/23/2009	48	0.093	0.1274	0.521	0.0173	0.275	33.1	6240
	4	7/23/2009	54	0.15	0.1576	0.637	0.0284	0.3852	32.3	11450
	3	7/23/2009	368	0.339	0.114	1.52	0.0296	0.466	93.7	24810
	2	7/23/2009	294	0.441	0.0748	2.33	0.0354	0.3723	47.8	20980
Downstream	**1**	7/23/2009	484	0.149	0.0563	0.656	0.0418	0.4292	65	9330
	731 Klem	7/23/2009	182	0.536	0.156	2.42	0.0615	0.511	30.9	198,630

Table A2. McEwen Rainfall	
Date	Amount
3/26/09	0.28
4/1/09	0.23
5/7/09	0.44
5/26/09	Baseflow
5/27/09	0.13
5/28/09	2.92
6/9/09	0.27
6/11/09	0.19
6/12/09	0.21
6/17/09	1.15
6/18/09	0.8
6/20/09	1.17
6/21/09	0.11
7/23/09	1.17

Table A2. Event Mean Concentrations All values mg/L							
Station	**TSS**	**TP**	**NH3L**	**TKN**	**OPL**	**NOXL**	**CHL**
1	41.5	0.092	0.020	0.562	0.021	0.389	67.22
2	39.4	0.099	0.028	0.611	0.023	0.465	65.57
3	27.35	0.092	0.032	0.781	0.007	0.684	133.75
5	27.94	0.069	0.028	0.525	0.012	0.380	104.34

Table A4. Mean Temperatures June 25-August 17							
	Forest Lawn	**Maple**	**Drumm**	**Bay/ Klem**	**5 Mile**	**Hatch**	**Loews**
Celsius	18.76	19.12	18.95	21.53	19.84	20.06	20.45
Max	23.24	24.01	23.24	28.7	25.56	25.17	27.12
Fahrenheit	65.76	66.42	66.11	70.75	67.71	68.1	68.81
Max	73.83	75.22	73.82	83.6	78	77.3	80.82

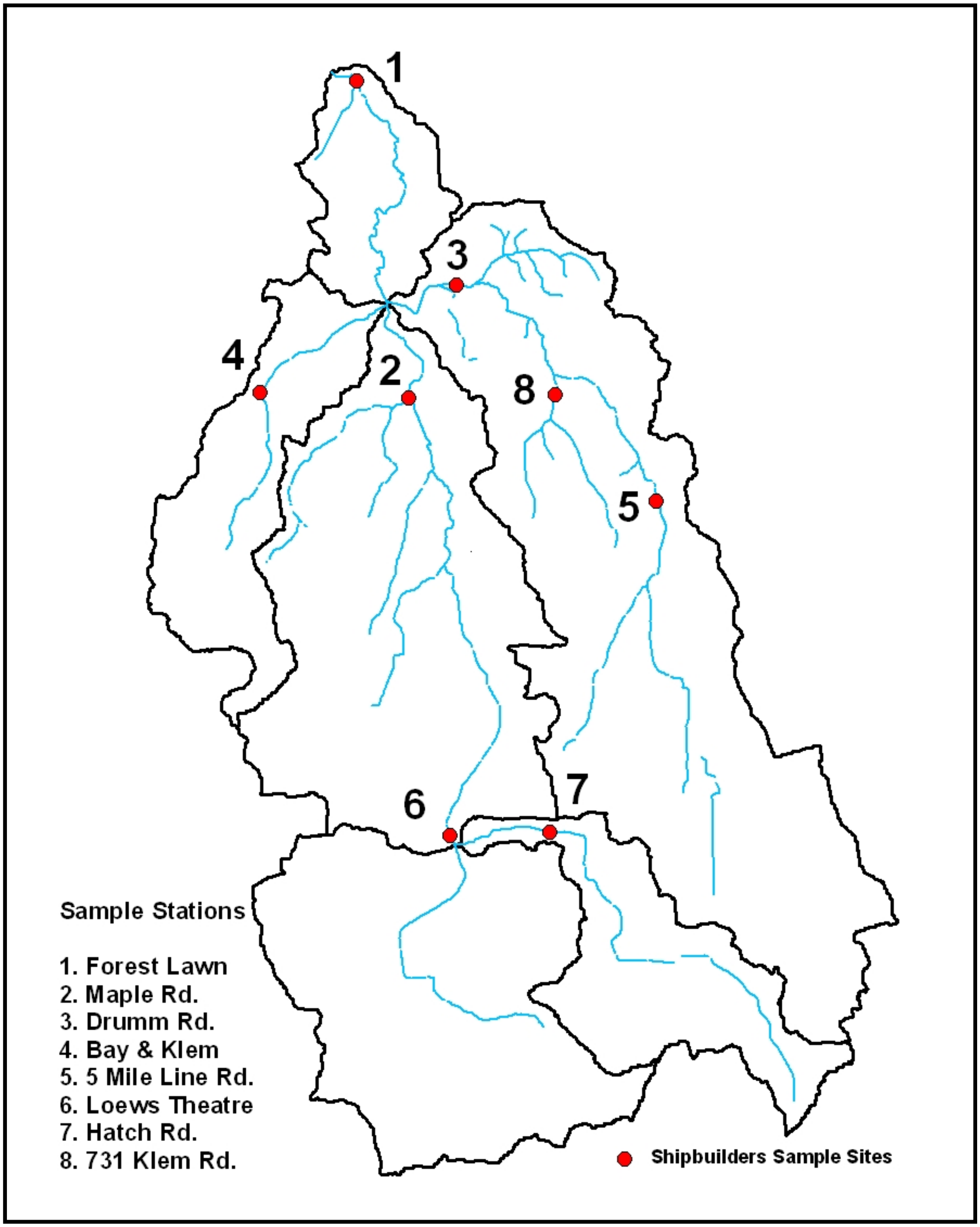
1
3
4
2
8
5
6
7
Sample Stations
1. Forest Lawn
2. Maple Rd.
3. Drumm Rd.
4. Bay & Klem
5. 5 Mile Line Rd.
6. Loews Theatre
7. Hatch Rd.
8. 731 Klem Rd.
Shipbuilders Sample Sites

Figure A 1

Appendix B. The Center for Watershed Protection Impervious Cover Model

Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores).

Taking all the research together, it is possible to construct a simple urban stream classification scheme based on impervious cover and stream quality. This simple classification system contains three stream categories, based on the percentage of impervious cover. Figure B1 illustrates this simple, yet powerful model that predicts the existing and future quality of streams based on the measurable change in impervious cover.

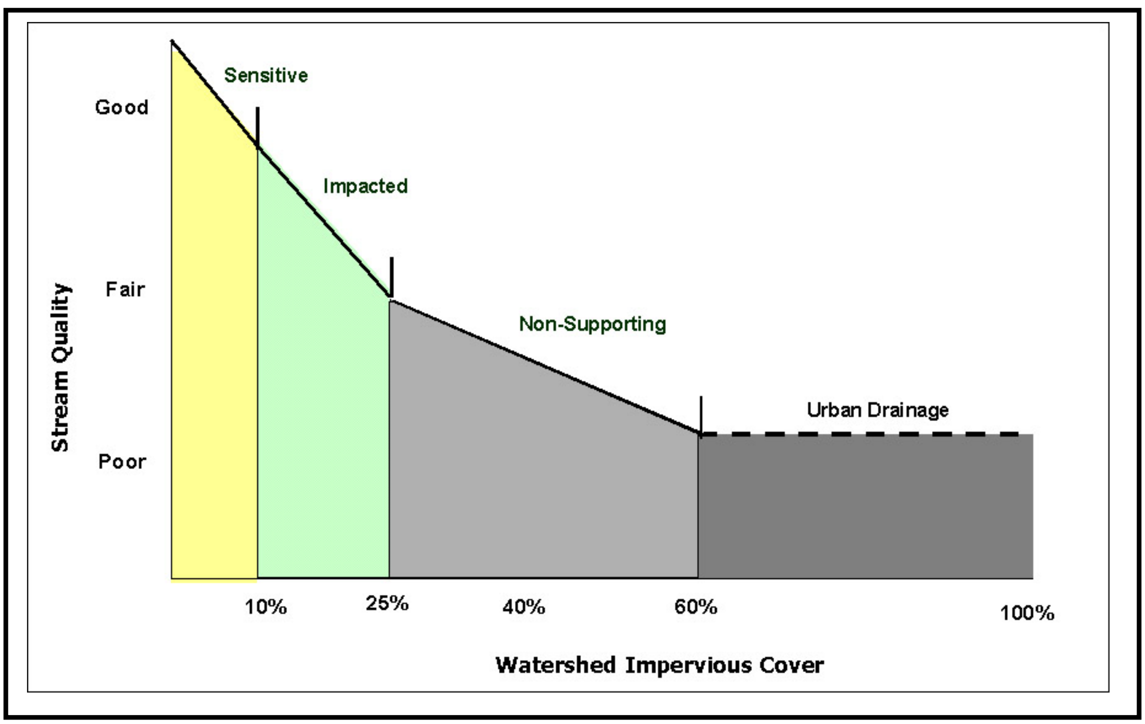

Figure B1

The model classifies streams into one of three categories: sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams. These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however these streams are often expected to recover.

Impacted Streams. Streams in this category possess a watershed impervious cover ranging from 11 to 25 percent, and show clear signs of degradation due to watershed urbanization. The elevated storm flows begin to alter stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.

Non-Supporting Streams. Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become conduits for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Water quality is consistently rated as fair to poor, and water recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, even if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

Although the impervious cover model is supported by research, its assumptions and limitations need to be clearly understood. There are some technical issues involved in its development which are discussed below:

Limitations of the Impervious Cover Model

1. Scale effect. The impervious cover model should generally only be applied to smaller urban streams from first to third order. This limitation reflects the fact that most of the research has been conducted at the catchment or subwatershed level (0.2 to 10 square mile area), and that the influence of impervious cover is strongest at these spatial scales. In larger watersheds and basins, other land uses, pollution sources and disturbances often dominate the quality and dynamics of streams and rivers.

2. Reference condition. The simple model predicts **potential** rather than **actual** stream quality. Thus, the reference condition for a sensitive stream is a high quality, non-impacted stream within a given ecoregion or sub-ecoregion. It can and should be expected that some individual stream reaches or segments will depart from the predictions of the impervious cover model. For example, physical and biological monitoring may find poor quality in a stream classified as sensitive or good diversity in a non-supporting one. Rather than being a shortcoming, these "outliers" may help watershed managers better understand local watershed and stream dynamics. For example, an "outlier" stream may be a result of past human disturbance, such as grazing, channelization, acid mine drainage, agricultural drainage, poor forestry practices, or irrigation return flows.

3. Statistical variability. Individual impervious cover/stream quality indicator relationships tend to exhibit a considerable amount of scatter, although they do show a general trend downward as impervious cover increases. Thus, the impervious cover model is not intended to predict the precise score of an individual stream quality indicator for a given level of impervious cover. Instead, the model attempts to predict the average behavior of a group of stream indicators over a range of impervious cover. In addition, the impervious cover thresholds defined by the model are not sharp breakpoints, but instead reflect the expected transition of a composite of individual stream indicators.

4. Measuring and projecting impervious cover. Given the central importance of impervious cover to the model, it is very important that it be accurately measured and projected. Yet comparatively relatively little attention has been paid to standardizing techniques for measuring existing impervious cover, or forecasting future impervious cover. Some investigators define impervious cover as "effective impervious area" (i.e., impervious area not directly connected to a stream or drainage system) which may be lower than total impervious cover under certain suburban or exurban development patterns (Sutherland, 1995).

5. Regional adaptability. To date, much research used to develop the model has been performed in the mid-Atlantic and Puget Sound eco-regions. In particular, very little research has been conducted in western, midwestern, or mountainous streams. Further research is needed to determine if the impervious cover model applies in these ecoregions and terrains.

6. Defining thresholds for non-supporting streams. Most research has focused on the transition from sensitive streams to impacted ones. Much less is known about the nature of the transition from impacted streams to non-supporting ones. The impervious cover model projects the transition occurs around 25% impervious cover for small urban streams, but more sampling is needed to firmly establish this threshold.

7. Influence of BMPs in extending thresholds. Urban BMPs may be able to shift the impervious cover thresholds higher. The ability of the current generation of urban BMPs to shift these thresholds however, appears to be very modest according to several lines of evidence. First, a handful of the impervious cover/stream indicator research studies were conducted in localities that had some kind of requirements for urban best management practices; yet no significant improvement in stream quality was detected. Second, Maxted and Shaver (1996) and Jones, *et al.* (1996) could not detect an improvement in bioassessment scores in streams served by stormwater ponds.

8. Influence of riparian cover in extending thresholds. Conserving or restoring an intact and forested riparian zone along urban streams appears to extend the impervious cover threshold to a modest degree. For example, Steedman (1988) found that forested riparian stream zones in Ontario had higher habitat and diversity scores for the same degree of urbanization than streams that lacked an intact riparian zone. Horner, *et al.* (1996) also found evidence of a similar relationship. This is not surprising, given the integral role the riparian zone plays in the ecology and morphology of headwater streams. Indeed, the value of conserving and restoring riparian forests to protect stream ecosystems is increasingly being recognized as a critical management tool in rural and agricultural landscapes as well (CBP, 1995).

9. Potential for stream restoration. Streams classified by their potential for restoration (also known as restorable streams) offer opportunities for real improvement in water quality, stability, or biodiversity and hydrologic regimes through the use of stream restoration, urban retrofit and other restoration techniques.

10. Pervious areas. An implicit assumption of the impervious cover model is that pervious areas in the urban landscape do not matter much, and have little direct influence on stream quality. Yet urban pervious areas are highly disturbed, and possess few of the qualities associated with similar pervious cover types situated in non-urban areas. For example, it has recently been estimated that high input turf can comprise up to half the total pervious area in suburban areas (Schueler, 1995a). These lawns receive high inputs of fertilizers, pesticides and irrigation, and their surface soils are highly compacted.

Although strong links between high input turf and stream quality have yet to be convincingly demonstrated, watershed planners should not neglect the management of pervious areas. Pervious areas also provide opportunities to capture and store runoff generated from impervious areas. Examples include directing rooftop runoff over yards, the use of swales and filter strips, and grading impervious areas to pockets of pervious area. When pervious and impervious areas are integrated closely together, it is possible to sharply reduce the "effective" impervious area in the landscape (Southerland, 1995).

While there are some limitations to the application of the urban stream impervious cover model, impervious cover still provides us with one of the best tools for evaluating the health of a subwatershed. Impervious cover serves not only as an indicator of urban stream quality but also as a valuable management tool in reducing the cumulative impacts of development within subwatersheds.

Appendix C: Impervious Cover Calculation Methods

The impervious surface cover model was developed using remotely sensed data from a supervised classification. This model was created for the 2005 New York State Orthoimagery Program's Imagery and only in the areas where four band coverage were available. The image dataset was resampled to a resolution of 12ft per pixel to complete the processing time. This dataset was completed in 2008 and took over 6 months to complete and calculate accuracy. The software used for the model was IDRISI Andes.

Remote Sensing Classification Methods Used

For the baseline of the project three methods of classification were used. The first being an unsupervised classification, which will give an analysis of the type of issues that are going to be observed. The two methods of supervised classification that were used were K. Nearest Neighbor and Multi-Layer Perception (MLP) Analysis. These supervised classifications, while give similar results, give different means of reporting the error.

The phase of the classification process that took the most time is the training site phase. This phase took two interns, working part time, over two months to complete and modify. The two interns created 1231 different training sites. The sites were created with a two digit code which represented a different cover type. For each of the different cover types there could be nine different classifications that were needed to classify the whole group correctly. An example of this is a code was needed to represent a difference between concrete and asphalt and another to distinguish the Genesee River from Lake Ontario. In the case of the Impervious Surface Cover Type 11 different codes were needed.

Table B 1. Classification Codes for Each Cover Type

BCode Series	BCover Type
1X	Water
2X	Tree/Forest
3X	Wetland
4X And 8X	Impervious Surface
5X	Lawn Grass
6X	Agriculture
7X	Bare Earth

After each run of the analysis, we compared the error matrix result from the MLP Analysis to determine which cover types were causing the majority of the errors. Errors within a larger group were not corrected but when the error crossed into another group were attempted to be corrected. In some cases the cause of the error was not able to be corrected, i.e. shadows from buildings resulting in water classification, or poorly maintained asphalt matching the dolomite quarries within the region.

Statistical Analysis of the Model

As stated above, each time we ran the MLP Analysis we received an error matrix to aid in the statistical analysis of the data's accuracy. This was only one part of the three part statistical analysis that was preformed on the data. Part two entailed comparing over 360 random points to "ground truth." Part three entailed using a small area and manually digitizing the different cover types and then running an error matrix,

The ground truthing of these points mainly consisted of comparing the sensed point and the Pictometry Imagery at the same location. Of the 360 different ground truth locations 208 of the sites matched, Impervious Surfaces were correctly classified only 40% of the time. For this analysis the overall accuracy was 52%. This Statistical Analysis was not significant enough to give full account of the accuracy.

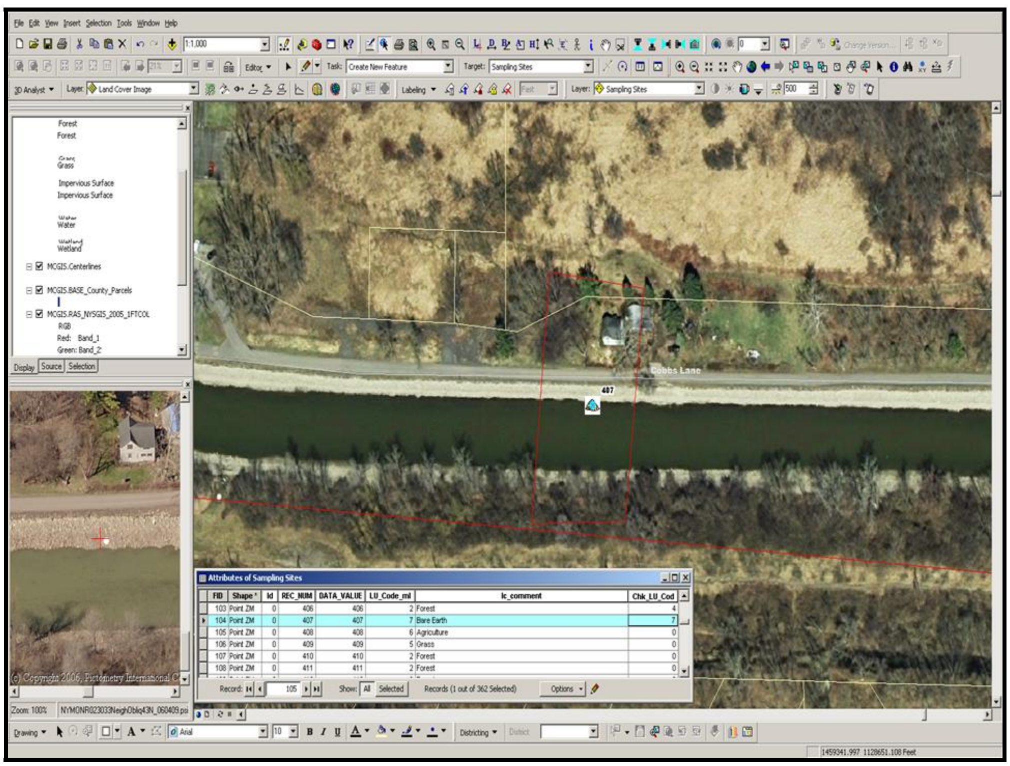

Figure C 1 -ArcGIS and the Random Sampling Analysis Interface

After the random sampling analysis, we moved onto a The Area that was studied is 45 hectares in size. This analysis, while much more time consuming and less random, does provide a better representation of the error.
The site that was chosen was in the town of Brighton. The site had all the different cover types represented and allowed for a rough sample of the area. The overall results using an error matrix showed a 71% average accuracy. Below are the two screenshots of the area digitized and from the remote sensing. As you can see the error is predominately around the agriculture and grass cover types and the bare earth and impervious cover types. Other errors occur from stray pixel classifications. This is an issue with some modeling but when you query out the single pixels you can reduce the error.

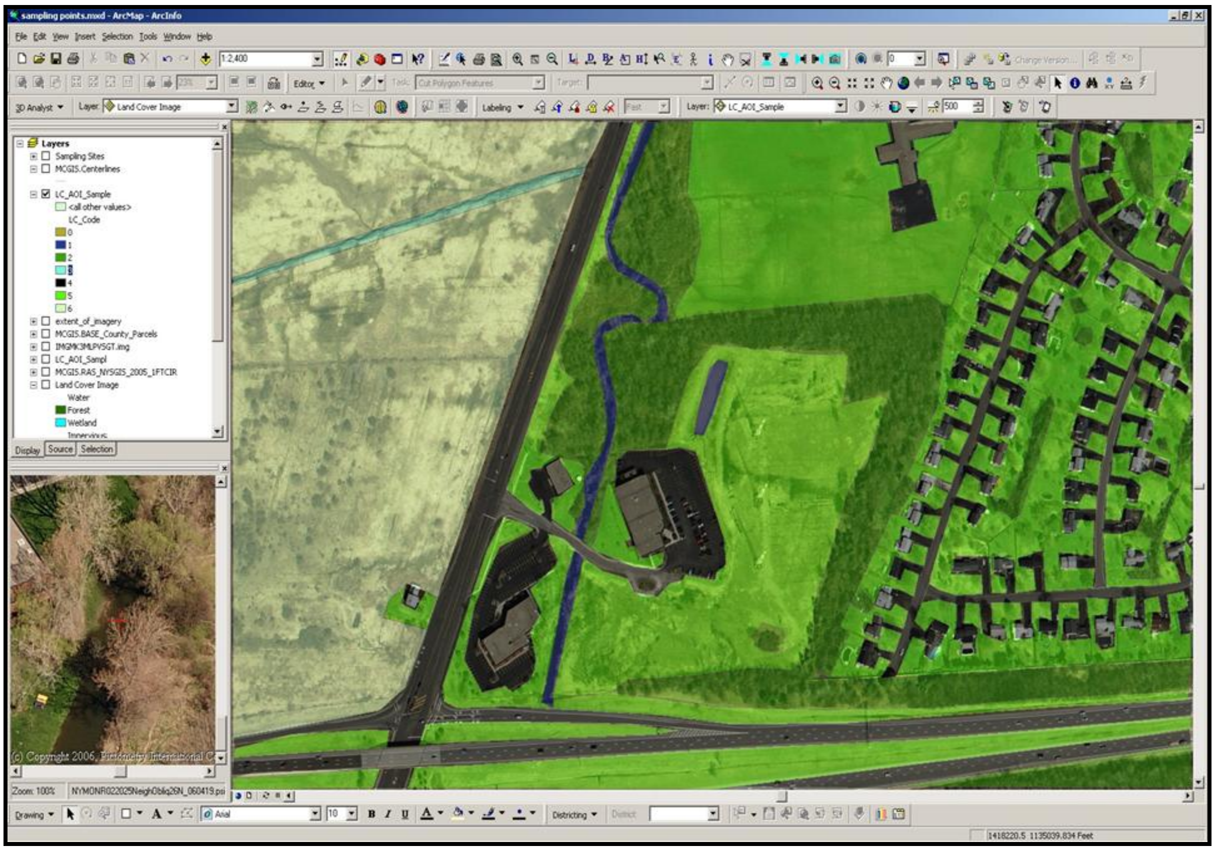

Figure C 2 -ArcGIS Showing the Digitized Cover Map

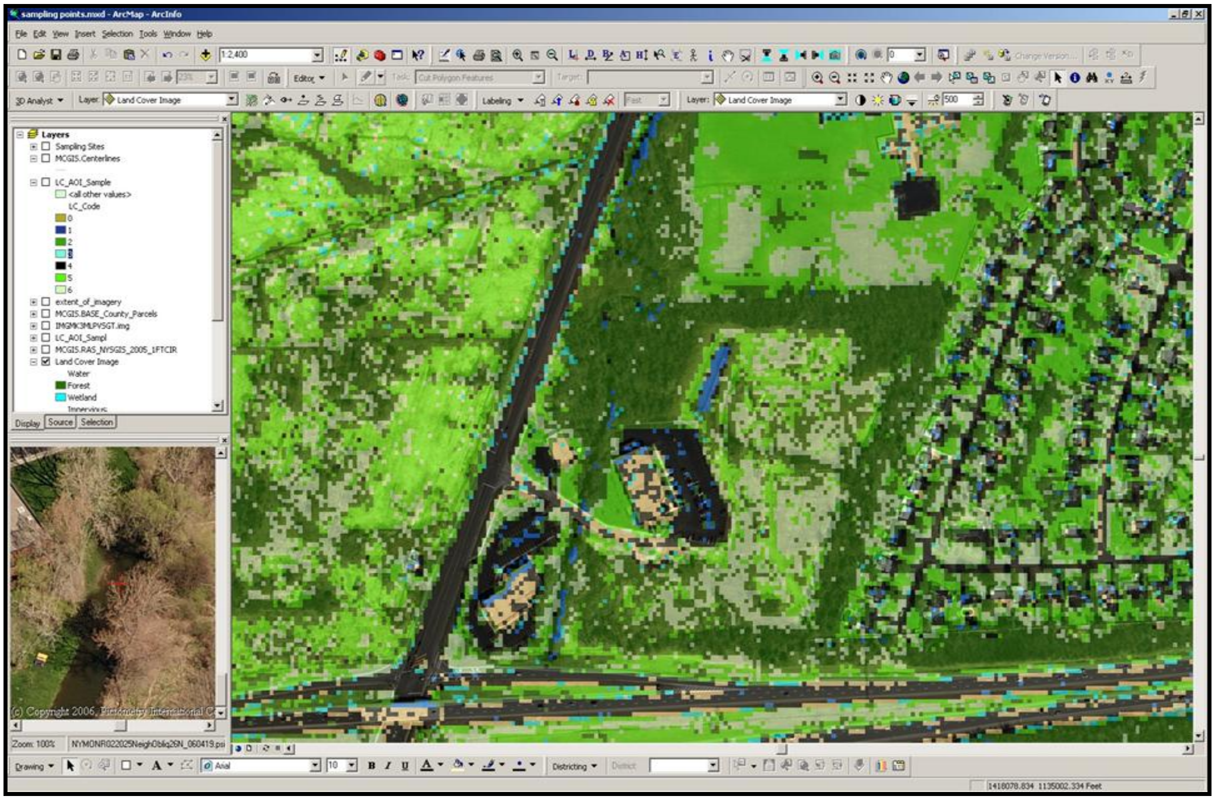

Figure C 3 -ArcGIS with the Remotely Sensed Land Cover Model

Shipbuilders Creek Watershed Separation

Methods

To make the different coverages for the Shipbuilders Creek Watershed I used a Boolean extraction method in IDRISI Andes. This method entailed extracting each sub-water polygon and converting it to a raster. From there the raster was multiplied leaving only the sub watershed. Then the area was calculated for each remaining area. The model below is the actual IDRISI model for the extraction. The model is similar to writing a script but you can see graphically what is going on and it allows you to inspect the steps before running.

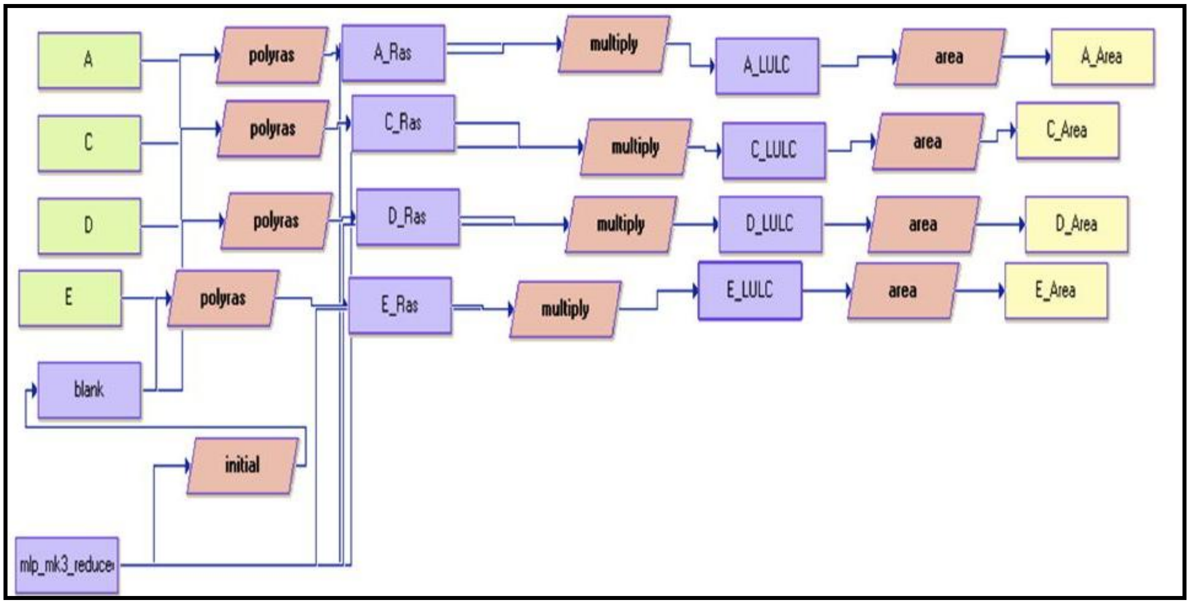

Figure C 4 The IDRISI Model for Extracting the Sub-watersheds

The locations for each watershed were provided in earlier parts of this document.

Results of the Model

Overall the results when broken down showed that approximately 15% of the area in the studied watersheds was impervious. This also is close to the same amount for the entire county, which has 11% impervious (Cole 2008). The model results were displayed both graphically and tabular. Below are the results of the model in the tabular form.

Table C1 - Acreage Measurements for Each Sub-Watershed

Cover Type	Sub-watershed A	Sub-watershed C	Sub-watershed D	Sub-watershed E
Water	8.79	39.53	21.51	15.25
Forest	168.7	540.2	290	152.2
Wetland	7.015	19.41	11.26	11.06
Impervious	71.5	283.7	170.8	57.74
Grass	55.99	326	193.5	99.92
Agriculture	142.1	522.2	252.5	132.9
Bare Earth	16	73.65	61.33	21.3
Total Area in Acres	470	1805	1001	490

Table C2. Percentage of Each Cover Type in Each Sub-Watershed				
Cover Type	**Sub-watershed A**	**Sub-watershed C**	**Sub-watershed D**	**Sub-watershed E**
Water	1.87%	2.19%	2.15%	3.11%
Forest	35.87%	29.93%	28.98%	31.04%
Wetland	1.49%	1.08%	1.13%	2.26%
Impervious	15.21%	15.72%	17.06%	11.77%
Grass	11.91%	18.08%	19.33%	20.38%
Agriculture	30.23%	28.93%	25.23%	27.10%
Bare Earth	3.41%	4.08%	6.13%	4.34%
Total Area Percentage	100.00%	100.00%	100.00%	100.00%

Graphically the results are a little harder to distinguish, due to the fact that the scale of the maps cannot be well represented in a small scale. Other issues that you will notice is the isolated pixel cell errors within a larger subset. This is inherent from the base data and analysis.

The following images are representations of each sub-watershed.

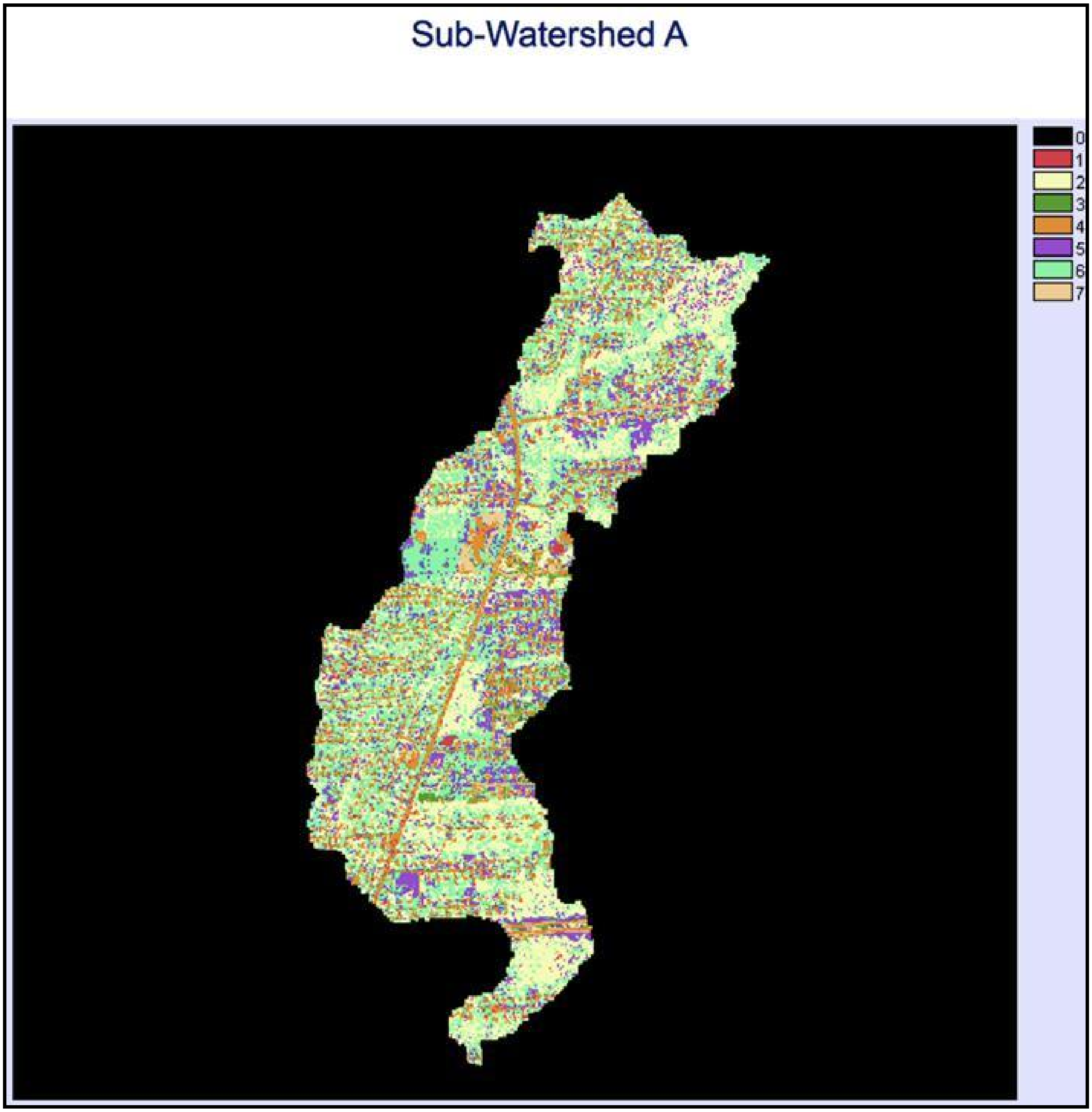

Figure C 5

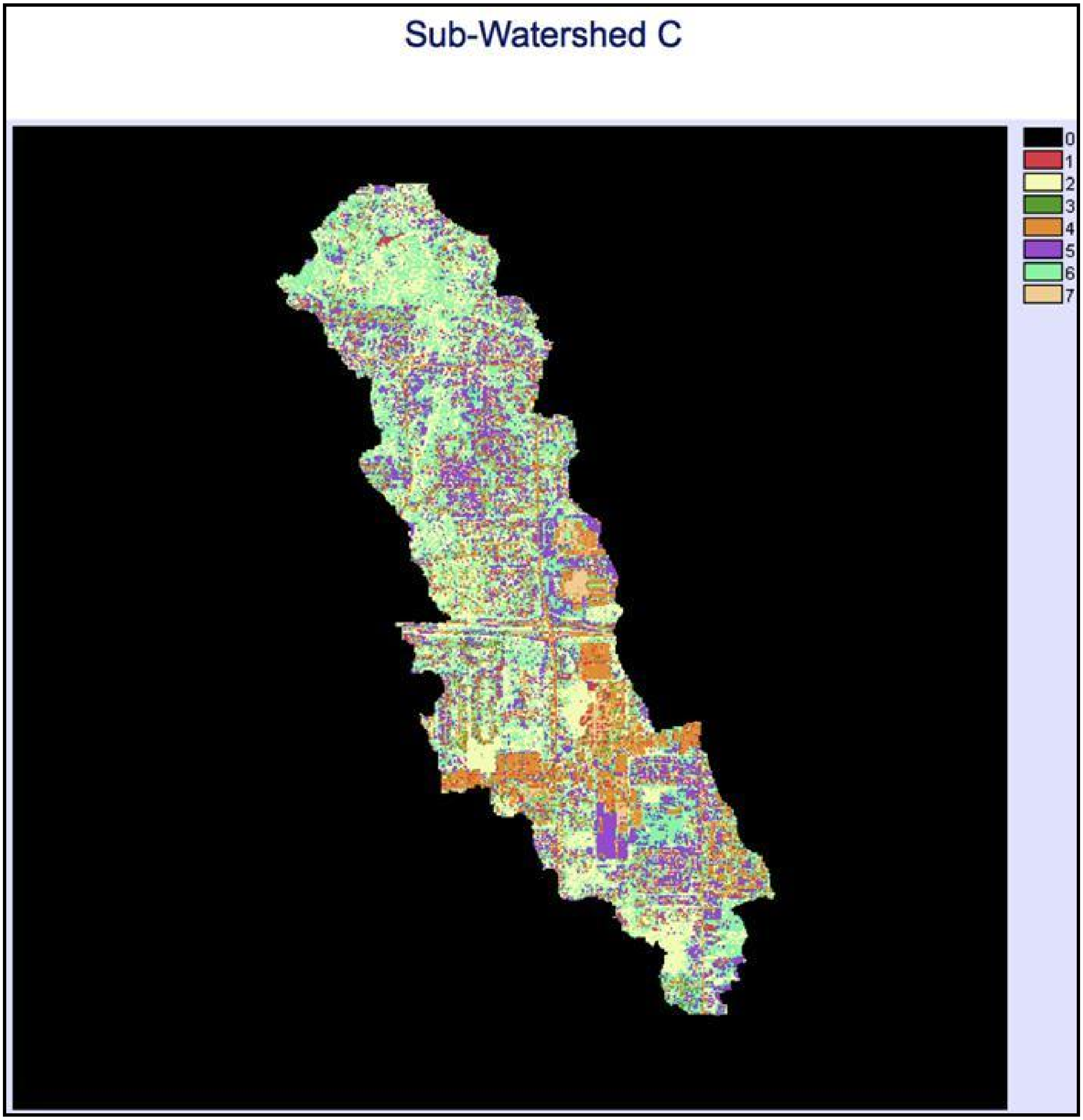

Figure C 6

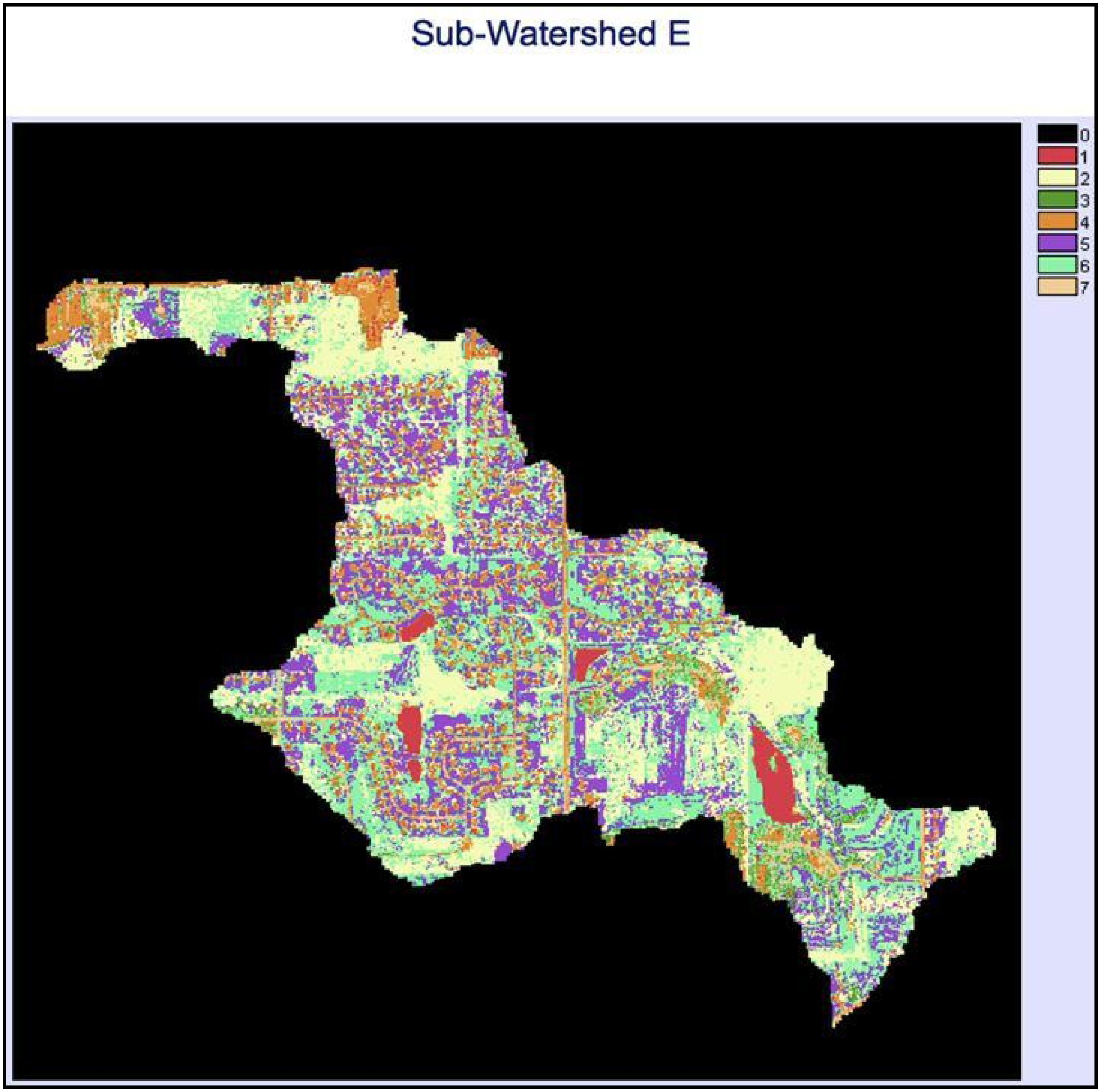

Figure C 7

Appendix D: Description of the Watershed Treatment Model

The Watershed Treatment Model (WTM), version 3.1 (Caraco, 2002) is a simple spreadsheet model typically used to:

- Estimate pollutant loading under current watershed conditions
- Determine the effects of current management practices
- Estimate load reductions associated with implementation of structural and non-structural management practices
- Evaluate the effects of future development

The model has two basic components: Pollutant Sources and Treatment Options. The *Pollutant Sources* component of the WTM estimates the load from primary land uses (i.e. residential, commercial, forest land) and secondary sources (i.e. active construction, managed turf, channel erosion, illicit connections) in a watershed without treatment measures in place. The *Treatment Options* component of the model estimates the potential reduction in this uncontrolled load if various treatment measures (both structural and nonstructural) are used. The WTM can examine a wide suite of treatment measures that are not typically tracked in models such as SLAMM and SWMM . The WTM allows the user to quantitatively examine how these practices can most effectively be combined to reduce pollutant loads.

- Stormwater treatment practices (STP): STPs for new development, retrofits
- Stormwater management program practices: lawn care education, pet waste education, street sweeping, impervious cover disconnection, riparian buffers, catch basin cleanouts, CSO/SSO repair/abatement, illicit connection removal
- Erosion and sediment control
- Better site design
- Non-Stormwater—Septic system education, septic repair/inspection, septic system upgrade, marina pumpout, point source treatment

The model is based on the Simple Method (Schueler, 1987) for pollutant load calculations where impervious cover is used to estimate primary loads from various urban land uses. Loading for rural areas uses literature reported values and is primarily based on the area dedicated to row crops. Specific concentration assumptions used for urban/suburban loading estimates in the WTM model are based on values for different land uses summarized in the National Stormwater Quality Database (NSQD), a summary of national stormwater data from over 200 communities nationwide (Pitt et. al., 2003). Estimated runoff volumes are multiplied by pollutant concentration data to compute stormwater loads. All loads are computed based on an annual time step.

The ***existing management practices*** and ***future management practices*** components of the WTM assess the ability of the treatment options in a watershed to reduce the uncontrolled pollutant loads from primary and secondary sources. The pollutant removal efficiencies associated with various structural and nonstructural urban stormwater management practices are based on existing research and studies in the National Pollutant Removal Performance Database for

Stormwater Treatment Practices (Winer, 2000) and research compiled in the WTM (Caraco, 2002). The existing management practices component is based on information provided by Westchester County and observations made by CWP. The future management practices function of the WTM will be used in the subwatershed treatment analysis to evaluate recommended practices throughout the watershed.

A unique feature of the WTM is the inclusion of ***treatability*** and ***discount*** factors. Treatability is the fraction of a source that can be treated by a practice. For structural practices, treatability is best defined as the area that can be treated, while for education programs, it may reflect the fraction of the population that can be reached. The model uses discount factors to account for various levels of implementation, maintenance, and design criteria, in order to provide a more realistic implementation scenario and to avoid double counting management practices that occur in series or on the same site. Discount factors are applied to potential load reductions to account for imperfect practice application and upkeep, inability of educational programs to reach all citizens, and inadequate funding to implement all practices, to name a few.

Appendix E: Blank USA/USSR/Retrofit Field Forms

Severe Bank Erosion **ER**

WATERSHED/SUBSHED:		DATE: ___/____/___	ASSESSED BY:
SURVEY REACH:	TIME:___:___AM/PM	PHOTO ID (CAMERA-PIC #): /#	
SITE ID: *(Condition-#)* ER-_____	*START* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____ *END* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		GPS: *(Unit ID)*

PROCESS: ☐ Currently unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both *(looking downstream)*
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length *(if no GPS)*	LT______ft and/or RT________ft	Bottom width ______ft
Bank Ht	LT______ft and/or RT_________ft	Top width _________ft
Bank Angle	LT_______° and/or RT_______°	Wetted Width ______ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown LAND COVER: ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY *(circle#)* Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3	2 1
ACCESS:	**Good access**: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access**: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3	2 1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**____:_____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) IB-_____	*START* **LAT** ____° ____' ____" **LONG** ____° ____' ____" **LMK** _____ *END* **LAT** ____° ____' ____" **LONG** ____° ____' ____" **LMK** _____		**GPS:** (*Unit ID*)

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE:		Private	Institutional	Golf Course	Park	Other Public
(*Facing downstream*)	LT Bank	☐	☐	☐	☐	☐:
	RT Bank	☐	☐	☐	☐	☐:

DOMINANT LAND COVER:		Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
	LT Bank	☐	☐	☐	☐	☐	☐	☐:
	RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ no ☐Active reforestation ☐Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ Other:

RESTORABLE AREA

	LT	BANK	RT
Length (ft):	________		________
Width (ft):	________		________

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Stream Crossing **SC**

WATERSHED/SUBSHED:	DATE: ___/_____/___	ASSESSED BY:
SURVEY REACH ID: TIME:____:____AM/PM	PHOTO ID: (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC-_____ LAT ___°_____'_____" LONG___°_____'_____" LMK_____		GPS (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY	**SHAPE:** ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:	**# BARRELS:** ☐ Single ☐ Double ☐ Triple ☐ Other:	**MATERIAL:** ☐ Concrete ☐ Metal ☐ Other:	**ALIGNMENT:** ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know	**DIMENSIONS:** (*if variable, sketch*) Barrel diameter: _________(ft) Height: _________(ft)
	CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):			**CULVERT SLOPE:** ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)	Culvert length: _________(ft) Width: _________(ft) Roadway elevation:_________(ft)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Channel Modification **CM**

WATERSHED/SUBSHED:		DATE: ___/____/___	ASSESSED BY:
SURVEY REACH ID:	TIME:___:____AM/PM	PHOTO ID: *(Camera-Pic #)* /#	
SITE ID: *(Condition-#)* CM-_____	*START* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____ *END* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		GPS: *(Unit ID)*

TYPE: ☐ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL:			DIMENSIONS:
☐ Concrete ☐ Gabion	Does channel have perennial flow?	☐ Yes ☐ No	Height ____________(ft)
☐ Rip Rap ☐ Earthen	Is there evidence of sediment deposition?	☐ Yes ☐ No	Bottom Width ____________(ft)
☐ Metal	Is vegetation growing in channel?	☐ Yes ☐ No	Top Width: ____________(ft)
☐ Other:	Is channel connected to floodplain?	☐ Yes ☐ No	Length: ____________(ft)

BASE FLOW CHANNEL	ADJACENT STREAM CORRIDOR
Depth of flow ___________(in)	Available width LT________(ft) RT________(ft)
Defined low flow channel? ☐ Yes ☐ No	Utilities Present? ☐ Yes ☐ No Fill in floodplain? ☐Yes ☐ No
% of channel bottom _________%	

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☐ Can't tell
☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering

CHANNEL-IZATION SEVERITY: *(Circle #)*	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3	2 1

NOTES:

TR
Trash and Debris

WATERSHED/SUBSHED: | **DATE:** ___/____/___ | **ASSESSED BY:**

SURVEY REACH ID: | **TIME:**___:____AM/PM | **PHOTO ID:** (*Camera-Pic #*) /#

SITE ID: (*Condition-#*) **TR-**_____ | **LAT** ___° _____' _____" **LONG** ___° _____' _____" **LMK** _____ | **GPS:** (*Unit ID*)

TYPE:
☐ Industrial
☐ Commercial
☐ Residential

MATERIAL:
☐ Plastic ☐ Paper ☐ Metal
☐ Tires ☐ Construction ☐ Medical
☐ Appliances ☐ Yard Waste
☐ Automotive ☐ Other:

SOURCE:
☐ Unknown
☐ Flooding
☐ Illegal dump
☐ Local outfall

LOCATION:
☐ Stream
☐ Riparian Area
☐ Lt bank
☐ Rt bank

LAND OWNERSHIP:
☐ Public ☐ Unknown
☐ Private

AMOUNT (*# Pickup truck loads*):

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal
EQUIPMENT NEEDED : ☐ Heavy equipment ☐ Trash bags ☐ Unknown
WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other

DUMPSTER WITHIN 100 FT: ☐ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5 4	3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Utility Impacts **UT**

WATERSHED/SUBSHED:	DATE: ___/____/___	ASSESSED BY:
SURVEY REACH ID:	TIME:___:___AM/PM	PHOTO ID: (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) UT-_____	LAT___° _____' _____" LONG ___° _____' _____" LMK: _____	GPS: (*Unit ID*)

TYPE:	MATERIAL:	LOCATION:	POTENTIAL FISH BARRIER:	PIPE DIMENSIONS:
☐ Leaking sewer ☐ Exposed pipe ☐ Exposed manhole ☐ Other:	☐ Concrete ☐ Corrugated metal ☐ Smooth metal ☐ PVC ☐ Other:	☐ Floodplain ☐ Stream bank ☐ Above stream ☐ Stream bottom ☐ Other:	☐ Yes ☐ No	Diameter: _____in Length exposed: _____ft
			CONDITION: ☐ Joint failure ☐ Protective covering broken ☐ Other:	☐ Pipe corrosion/cracking ☐ Manhole cover absent

EVIDENCE OF DISCHARGE:		
	COLOR	☐ None ☐ Clear ☐ Dark Brown ☐ Lt Brown ☐ Yellowish ☐ Greenish ☐ Other:
	ODOR	☐ None ☐ Sewage ☐ Oily ☐ Sulfide ☐ Chlorine ☐ Other:
	DEPOSITS	☐ None ☐ Tampons/Toilet Paper ☐ Lime ☐ Surface oils ☐ Stains ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Structural repairs ☐ Pipe testing ☐ Citizen hotlines ☐ Dry weather sampling
☐ no ☐ Fish barrier removal ☐ Other:

If yes to fish barrier, Water Drop: ________ (in)

UTILITY IMPACT SEVERITY: (*Circle #*)			
Leaking= ☐ 5	Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.
	5	4 3	2 1

NOTES:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Photo Inventory

(By Camera)

Project: ______________

Group: _______________

Camera: _____________

This field sheet is to be completed AS photos are taken in the field. The intent is to force us to organize pictures taken on a camera basis. Fill out one sheet per camera (add sheets as needed). Only fill in Date/Reach/Location ID when you start in a new spatial or temporal location.

Date	Stream/ Reach	Location ID	Photo #	Description

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface			
D3. Downspouts discharge to pervious area			
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☐ N			◇

E. COMMON AREAS	
E1. Storm drain inlets? ☐ Y ☐ N If yes, are they stenciled? ☐ Y ☐ N Condition: ☐ Clean ☐ Dirty	◇
Catch basins inspected? ☐ Y ☐ N If yes, include Unique Site ID from SSD sheet: ________	○
E2. Storm water pond? ☐ Y ☐ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre	◇
E3. Open Space? ☐ Y ☐ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N	○
Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply)* ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ________	○

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ________

Describe Recommended Actions:

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

WATERSHED:	**SUBWATERSHED:**		**UNIQUE SITE ID:**
DATE: ___/___/_____	**ASSESSED BY:**	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___° _____' _____" **LONG** ___° _____' ___"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION	
Name and Address: ________________ ________________ ________________ SIC code (if available): __________ NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown	Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related; Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility. Basic Description of Operation: ________________

	INDEX*
B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — **Observed Pollution Source?**	☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: __________	
B2. Approximate number of vehicles: _______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?**	☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition *(check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☐ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: _______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)* **Observed Pollution Source?**	☐
F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?**	☐
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)

☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

- ☐ Refer for immediate enforcement
- ☐ Suggest follow-up on-site inspection
- ☐ Test for illicit discharge
- ☐ Include in future education effort
- ☐ Check to see if hotspot is an NPDES non-filer
- ☐ Onsite non-residential retrofit
- ☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: __________________
- ☐ Schedule a review of storm water pollution prevention plan

Notes:

PAA

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE: ___/___/_____	ASSESSED BY:	CAMERA ID:	PIC #:
MAP GRID:	LAT ___° _____' _____" LONG ___° _____' _____"		LMK #

A. PARCEL DESCRIPTION

Size: ___acre(s) Access to site (*check all that apply*): ☐ Foot access ☐ Vehicle access ☐ Heavy equipment access
Ownership: ☐ Private ☐ Public Current Management: ☐ School ☐ Park ☐ Right-of-way ☐ Vacant land
☐ Other (please describe) ____
Contact Information: ____
Connected to other pervious area? ☐ Y ☐ N If yes, what type? ☐ Forest ☐ Wetland ☐ Other _______________
Estimated size of connected pervious area: ____ acre(s) Record Unique Site ID of connected fragment: ____________

PART I. NATURAL AREA REMNANT

FOREST

B. CURRENT VEGETATIVE COVER

B1. Percent of forest with the following canopy coverage:
Open _____% Partly shaded _____% Shaded _____%
**Note – these should total 100%*
B2. Dominant tree species: ________________________

B3. Understory species: ________________________

B4. Are invasive species present? ☐ Y ☐ N
☐ Unknown
If yes, % of forest with invasives: _______
Species: ________________________

C. FOREST IMPACTS

C1. Observed Impacts (*check all that apply*): ☐ Animals
☐ Clearing/encroachment ☐ Trash and dumping ☐
Storm water runoff ☐ Other

D. NOTES

WETLAND

B. CURRENT VEGETATIVE COVER

B1. % of wetland with following vegetative zones:
Aquatic: __________
Emergent: __________
Forested: __________
**Note – these should total 100%*
B2. Dominant species: ________________________

B3. Are invasive species present? ☐ Y ☐ N
☐ Unknown
If yes, % of wetland with invasives: _______
Species: ________________________

C. WETLAND IMPACTS

C1. Observed Impacts (*check all that apply*): ☐ Animals
☐ Clearing/encroachment ☐ Trash and dumping ☐
Storm water runoff ☐ Hydrologic impacts ☐ Other

D. NOTES

E. INITIAL RECOMMENDATION

☐ Good candidate for conservation/protection
☐ Potential restoration candidate
☐ Poor restoration or conservation candidate

PART II. OPEN PERVIOUS AREAS

A. CURRENT VEGETATIVE COVER

A1. Percent of assessed surface with:
Turf _____% Other Herbaceous _____% None (bare soil) _____% Trees _____% Shrubs ____ % Other _____% (please describe): ______________________________ **Note – these should total 100%*

A2. Turf: Height: _____ inches Apparent Mowing Frequency: ☐ Frequent ☐ Infrequent ☐ No-Mow ☐ Unknown
Condition (*check all that apply*): ☐ Thick/Dense ☐ Thin/Sparse ☐ Clumpy/Bunchy ☐ Continuous Cover

A3. Thickness of organic matter at surface: _______ inches

A4. Are invasive species present? ☐ Y ☐ N ☐ Unknown If yes, % of site with invasives: _____
Species:____

B. IMPACTS

B1. Observed Impacts (*check all that apply*): ☐ Soil Compaction ☐ Erosion ☐ Trash and Dumping
☐ Poor Vegetative Health ☐ Other (describe): ______________________________

C. REFORESTATION CONSTRAINTS

C1. Sun exposure: ☐ Full sun ☐ Partial sun ☐ Shade ☐ Unknown

C2. Nearby water source? ☐ Y ☐ N ☐ Unknown

C3. Other constraints: ☐ Overhead wires ☐ Underground Utilities ☐ Pavement ☐ Buildings
☐ Other (please describe): _______________

D. NOTES

E. INITIAL RECOMMENDATION

☐ Good candidate for natural regeneration
☐ May be reforested with minimal site preparation
☐ May be reforested with extensive site preparation
☐ Poor reforestation or regeneration site

PART III. SKETCH

Appendix F: Delineation of Subwatersheds with Stream Stats

The following application description is from the USGS:

StreamStats is an integrated GIS application developed through a cooperative effort of the USGS and ESRI, Inc[1]. StreamStats makes the process of computing streamflow statistics for ungaged sites much faster, more accurate, and more consistent than previously used manual methods. It also makes streamflow statistics for gaged sites available without the need to locate, obtain, and read the publications in which they were originally provided. Examples of streamflow statistics that can be provided by StreamStats include the 100-year flood, the mean annual flow, and the 7-day, 10-year low flow. Examples of basin characteristics include the drainage area, stream slope, mean annual precipitation and percentage of forested area. Basin characteristics are the physical factors that control delivery of water to a point on a stream.

StreamStats uses ArcIMS, ArcSDE, ArcGIS, and ArcHydro Tools. It incorporates a map-based user interface for site selection; a Microsoft Access database that contains information for data-collection stations; a GIS program that delineates drainage basins and measures basin characteristics; and a GIS database that contains land elevation models, historic weather data, and other data needed for delineations, for measuring drainage-basin characteristics, and for locating sites of interest in the user interface.

The user interface can be used to zoom in by various methods to select locations where information is desired. When a USGS data-collection station is selected, information for the station appears in a pop-up Web browser window. When an ungaged site is selected, StreamStats computes the drainage-basin boundary for the site and presents it to the user in the map frame. The user can then check the validity of the boundary and use the EditBasin tool to make any necessary corrections. After the user indicates that the boundary is correct, StreamStats measures the drainage-basin characteristics for the site. The values are then input to a separate program named the USGS National Flood Frequency Program (NFF), which is a Microsoft Windows program that contains all of the USGS-developed equations for estimating flood-frequency statistics in the nation. NFF has been modified for StreamStats to contain equations for estimating other types of streamflow statistics. NFF estimates the streamflow statistics for the ungaged site and then StreamStats presents the statistics and the basin characteristics for the site in a pop-up Web-browser window. All of the equations in NFF are documented through links to each individual state from the NFF Web site.

The equations used to estimate streamflow statistics for ungaged sites were developed through a process known as regionalization. This process involves use of regression analysis to relate streamflow statistics computed for a group of selected streamgaging stations (usually within a state) to basin characteristics measured for the stations. Basin characteristics measured for ungaged sites can be entered into the resulting equations to obtain estimates of the streamflow statistics. Users should note that estimates provided assume natural flow conditions at the site. Learn about additional limitations of the equations and StreamStats in the Limitations section.

Each state is implemented in StreamStats as a separate application that can be accessed from the State Applications page. For states that have not yet been implemented, information for USGS data-collection stations can be accessed through the USGS Station Statistics page.

Appendix G: Validation of the Impervious Cover Model for Future Use in Monroe County

The relationship between subwatershed impervious cover (IC) and stream quality indicators can be predicted by the ICM, which is based on hundreds of research studies on first to fourth order urban streams (CWP, 2003). It is important to keep in mind that the Impervious Cover Model (ICM) is a guide and not a guarantee: ICM stream indicator predictions are general, and will not apply to every stream within the ICM classification. Urban streams are notoriously variable, and factors such as gradient, stream order, stream type, age of subwatershed development, and past management practices can and will make some streams depart from these predictions. In general, subwatershed IC causes a continuous but variable decline in most stream indicators in a stream category. Therefore, the severity of impacts tends to be greater at the high end of the IC range within each stream category.

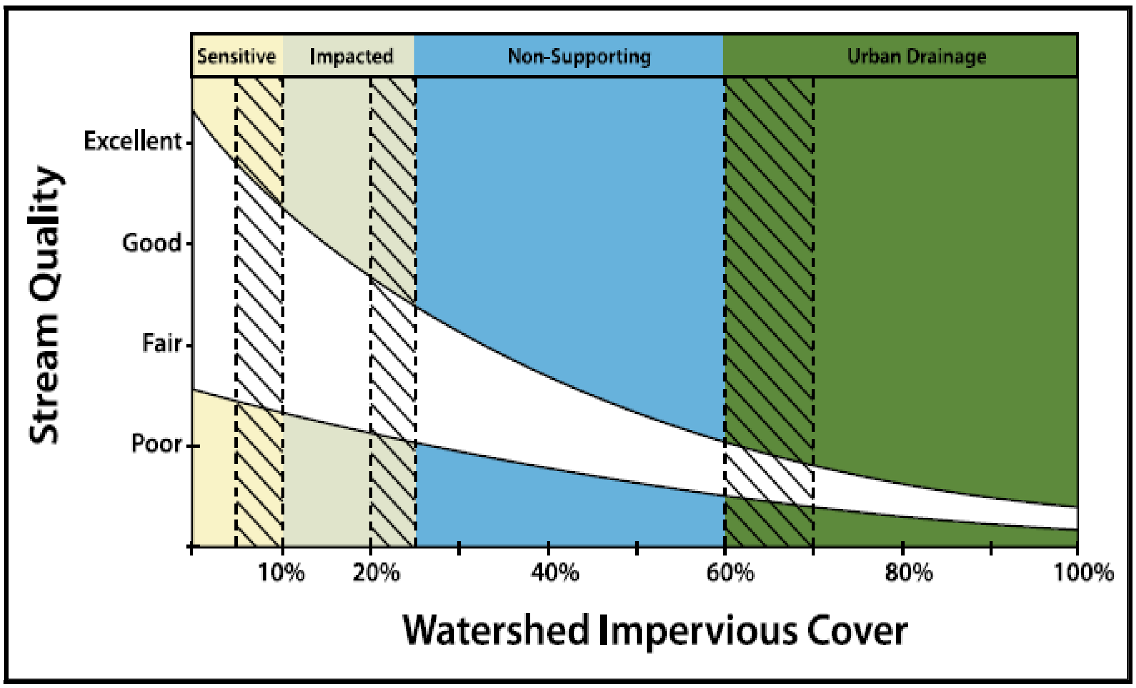

Figure G 1

The ICM was first developed for use by the Center for Watershed Protection in the mid-Atlantic region. Although the relationship between impervious cover and water quality has been well established over many years, the use of the measure of impervious cover as a predictor of water quality impacts and restoration potential has not been done in Monroe County. The initial goal of the Shipbuilders Creek Watershed study was to establish this relationship in a local stream and determine the utility of the impervious cover model for future rapid stream assessments in Monroe County.

Table G1. ICM Shipbuilders Creek Subwatershed Predicted Status					
	Subwatershed				
Metric	**A**	**B**	**C**	**D**	**E**
ICM Predicted Value for all Metrics Based on Percent Impervious Cover	**Impacted**	**Impacted**	**Impacted**	**Impacted**	**Impacted**

Table G2. ICM Validated Status of Stream Metrics for Impacts to Shipbuilders Creek					
	Subwatershed				
Metric	**A**	**B**	**C**	**D**	**E**
Stream Crossings (bridges & culverts / stream mile)	**Impacted**	**Impacted**	**Impacted**	**Impacted**	**Impacted**
Fraction of Riparian Forest Buffer Intact (50 ft on either side)	**Impacted**	**Impacted**	**Urban Drainage**	**Urban Drainage**	**Urban Drainage**
Fraction of Original Stream Network Remaining	**Impacted**	**Impacted**	**Impacted**	**Non Supporting**	**Non Supporting**
Increased Summer Stream Temperatures	70.75 ave. 83.6 Max	66.42 ave. 75.22 Max	67.71 Ave 78.0 Max	68.81 ave. 80.82 Max	68.1 ave 77.3 Max
Annual Phosphorus Load (lbs)	190	545	825	558	150
Sediment Load (lbs) and Yields (lbs/acre/yr)	Load 218,253 Yield 500.6	Load 735,739. Yield 430.7	Load 991,532 Yield 499	Load 504,311 Yield 499	Load 90,811 Yield 500
Violations of Bacteria Standards	**Impacted**:	**Non Supporting**	**Non Supporting**	**Non Supporting**	**Non Supporting**
Stormwater Runoff as Fraction of Annual Rainfall	**Impacted**	**Impacted**	**Impacted**	**Impacted**	**Impacted**
Presence of Large Woody Debris	**Impacted**	**Impacted**	**Non Supporting**	**Non Supporting**	**Non Supporting**
EPTA Taxa Diversity	**Impacted**	**Impacted**	**Impacted**	**Impacted**	**Impacted**

Table G1 shows the status that the impervious cover model predicts for all shipbuilders subwatersheds based on the current percent impervious cover. Each subwatershed has an impacted status. The ICM predicts that Impacted Streams have between 10 and 25% subwatershed impervious cover and show clear signs of declining stream health. Most indicators of stream health in impacted streams fall in the fair range, although some reaches may still be rated as being of good quality. Impacted streams often exhibit the greatest restoration potential since they experience only moderate degradation, often have an intact stream corridor, and usually have enough land available in the subwatershed to install restoration practices.

The foundation of the model is a series of predicted impacts associated with urban streams. These impacts can be grouped into 5 categories; changes to stream hydrology, physical alteration of the stream corridor, stream habitat degradation, declining water quality and loss of aquatic habitat. For an example of an indicator that illustrates changes to stream hydrology we could look at the volume of stormwater runoff as a fraction of annual rainfall. As impervious cover in a subwatershed increases the volume of stormwater would also increase. The ICM relates this to a scale to predict associated impacts to streams. If up to 30% of rainfall is converted to runoff, the stream is considered Impacted. Up to 60% of that fraction would put it into the Non-Supporting category and from 60-90% would be considered Urban Drainage.

Ten indicators of urban stream health were selected for use as a comparison. Based on the existing percent impervious cover in the watershed the ICM would predict that all the indicators would fall in the Impacted range. Each indicator was then assessed to determine what the actual value was in Shipbuilders Creek. The ten indicators are;

1. Stream Crossings of culverts and bridges
2. Fraction of riparian forest buffer intact
3. Fraction of original stream network remaining
4. Increased summer stream temperatures
5. Annual phosphorus load
6. Sediment load and yield
7. Violations of bacteria standards
8. Stormwater runoff as fraction of annual rainfall
9. Presence of large woody debris
10. EPTA taxa diversity

Appendix H Stormwater Retrofit Projects

Table H1 Retrofit Projects									
#	Project	Project Type	Ownership	Feasibility[1]	Cost Effectiveness[2]	Environmental Benefit[3]	Acres Treated	Multiple Benefits[4]	Total Score
S1A	Loews Theatre Parking Lot	IC reduct	Private	3	3	2	6	S,WQ	**10**
S1B	Loews Theatre ROW Swale	Storage	Public	3	2	2	37	S,WQ,I	**10**
S2	Daniels Creek	Rain garden	HOA	2	3	1	3	S,WQ	**8**
S3	Bauman Farm low berm	New pond	Private *	2	3	3	1.5	S,WQ,CP, I	**12**
S4	755 Ridge Rd, Holtz Auto Dealer	Hot spot	Private	3	3	2	2.5	S,WQ, I	**11**
S5	Webster Thomas	Rain garden	Public	4	3	1	0.5	S,WQ,E, I	**12**
S6	104 Swale storage	Storage	Public	3	2	2	7	S,WQ,E, I	**11**
S7	104 Swale storage	Storage	Public	3	2	2	1.5	S,WQ,E	**10**
S8	104 Swale storage	Storage	Public	3	2	2	0.5	S,WQ,E	**10**
S9	104 Swale storage	Storage	Public	3	2	2	3	S,WQ,E	**10**
S10	Webster Shroeder	Storage	Public	4	2	2	3	S,WQ,E	**11**
S11	Webster Shroeder	Storage	Public	4	2	2	3	S,WQ,E	**11**
S12	Maier's nursery	Buffers/hotspot		3	3	1	3	WQ	**8**
S13	Penfield Property S. Side State Road	New pond	Penfield	4	3	3	3	S,WQ,CP,E, A	**15**
S14	Fi*nn* Park	New pond	Webster	4	3	3	3	S,WQ,CP,E, A	**15**
S15	BJs/Lowes Conveyance	Storage	Commercial	3	2	2	0.5	S,WQ, I, A	**11**

[1] Land Ownership and accessibility - Public property = 3 HOA or Commercial w/Easement = 2 Residential w/Easement = 1 point. Accessible – add 1 point

[2] Low medium and high costs = 3 , 2 or 1 respectively based on table of cost per cubic foot of storage ($1-11 low;$12-25 med.;$26 + high)

[3] Drainage area to practice: 0<1 acres = 1 point; 1-5 acres = 2 points; >5 acres = 3 points

[4] Each objective is 1 point: S = flood storage; WQ = Water Quality; CP = reduced streambank erosion; I = infiltration; E= education; A=augment (ie CP is added and a downstream erosion site is w/in 2500 feet add 1 point)

* Property's development rights have been purchased. The Bauman Farm field is rotionally cropped- wet field -appears non state or fed regulated

Stream Restoration Projects

Table H2						
#	**Project**	**Project Type**	**Ownership**	**Feasibility[1]**	**Field Score[2]**	**Total Score**
CM3	475 Klem	Ch. Mod	Private	0	3	**3**
CM1	478 Bay Meadow	Ch. Mod.	Private	0	2	**2**
CM2	779 Wood Meadow	Ch. Mod.	Private	0	2	**2**
CM4	100 Bay Meadow	Ch. Mod.	Private	0	4	**4**
CM9	800 Five Mile Line (RL Thomas)	Ch. Mod.	Public	3	4	**7**
CM8	682 Hightower	Ch. Mod.	Private	0	4	**4**
CM10	938 Lotario	Ch. Mod.	Private	0	4	**4**
CM7	860 Ridge Rd	Ch. Mod	HOA	1	1	**2**
CM14	635 Adeline	Ch. Mod.	Private	0	2	**2**
CM6	760 Sugar Creek	Ch. Mod.	Private	0	4	**4**
CM5	4 Meadows End	Ch. Mod.	Private	0	4	**4**
CM12	Daniels Creek	Concrete ch.	HOA	1	2	**3**
CM11	59 Seabury Blvd.	Ch. Mod.	HOA	1	5	**6**
CM14	Rosebud	Concrete ch.	Private	1	4	**5**

[1] Land Ownership and accessibility (point system) - Public property = 2 HOA or Commercial = 1 Private Properties for buffers =0

[2] Only high scores (3, 4 or 5s) from field assessments were considered. A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel. A moderate length (> 200'), but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.

Impacted Buffers and Erosion Projects

Table H3						
#	Project	Project Type	Ownership	Feasibility1	Field Score2	Total Score
B02	900 Five Mile Line (Lowes)	Buffer/4	Commercial	2	4	**6**
B03	686 Hightower	Buffer/4	Private	0	4	**4**
B04	800 Five Mile Line (Thomas HS)	Buffer/5	School	3	5	**8**
B05	821 Lindsay Circle	Buffer/4	Private	0	4	**4**
B07	752 Patty Ln	Buffer/4	Private	0	4	**4**
B09	58 Seabury	Buffer/4	Private	0	4	**4**
B19	875 Ridge Rd (Schroeder)	Buffer	School	3	4	**7**
B20	4 Meadows End	Buffer	Private	0	4	**4**
B21	772 Mont Vista	Buffer	Private	0	4	**4**
B23	1093 Terry Dr	Buffer	Private	0	4	**4**
B25	471-479Wood Harbor Trail	Buffer	Private	0	4	**4**
E02	900 Five Mile Line (Lowes)	Erosion	Commercial	2	3	**5**
E03	682 Hightower	Erosion	Private	1	4	**5**
E04	800 Five Mile Line (Thomas HS)	Erosion	School	3	3	**6**
E05	821 Lindsay	Erosion	Private	1	5	**6**

#	Project	Project Type	Ownership	Feasibility1	Field Score2	**Total Score**
E06	644 Van Alstin	Erosion	Private	1	3	**3**
E07	938 Lotario	Erosion	School	1	3	**4**
E10	2100 Empire Blvd.	Erosion	Commercial	1	3	**4**
E13	762 Maple	Erosion	Private	1	3	**4**
E16	575 Drumm	Erosion	Private	1	5	**6**
E17	595 Vosburg Sewer Pump Sta.	Erosion	Webster	3	5	**8**
E19	616 Hosta Circle	Erosion	Private	1	4	**5**
E23	680 Maple	Erosion	Private	1	3	**4**
E24	680 Maple	Erosion	Private	1	3	**4**
E25	574 Drumm	Erosion	Private	1	3	**4**
E27	772 Mont Vista	Erosion	Private	1	3	**4**
E35	475 Klem	Erosion	Private	1	3	**6**
E36	616 Old Woods	Erosion	Private	1	5	**6**
E39	498 Bay Meadow Trail	Erosion	Private	1	3	**4**
E41	BentBrook Circle N of Pond	Erosion	HOA	2	3	**5**

Table H 1

[1] Land Ownership and accessibility (point system) - Public property = 2 HOA or Commercial = 1 Private Properties for buffers =0.

[2a] Only high scores (3, 4 or 5s) from field assessments were considered. Score from field assessment - Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting.

[2b] Only high scores (3, 4 or 5s) from field assessments were considered. Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure. Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure

Existing Stormwater Pond Retrofits

#	Project	Project Type	Ownership	Feasibility[1]	Cost Effectiveness[2]	Environmental Benefit [3]	Acres Treated	Multiple Benefits[4]	Total Score
	Several Ponds not included – see notes below this table (see note 5)								
2	Strand Subd Ponds (also ponds 3&4)	Modify pond outlet	HOA/easement	3	3	2	20	CP,	**9**
5	Galant Woods Ph 1 and section 2 ponds (also #46)	Modify pond outlet	Private/easemen t	1	3	2	17	CP,	**7**
6	Baytown Plaza (Walmart)	Dry pond conv.	Commercial/eas ement	3	3	3	60	S, WQ, CP, A	**13**
7	Silverwood Subd Ponds(both 7 & 8)	Modify pond outlet	Penfield	3	3	3	65	S, CP, A	**12**
9	Bentbook Circle Meadowbrook Subd	Modify pond outlet	HOA/easement	1	3	3	50	CP, A	**9**
10	Green Pine Lane Wetland	Modify pond outlet	Penfield	3	3	2	15	CP,	**9**
12	Watersong Trail Pond	Pond retro	Penfield	4	3	2	21	S, WQ, CP	**12**
13	Bryden Park Dr	Pond retro	Penfield	4	3	3	67	WQ, CP, A	**13**
14	Vintage Place Pond - Old Way Ln	Modify pond outlet	Private/easemen t	1	3	1	9	CP,	**6**

#	Project	Project Type	Ownership	Feasibility[1]	Cost Effectiveness[2]	Environmental Benefit [3]	Acres Treated	Multiple Benefits[4]	Total Score
15	Webster Woods Plaza (also 16)	Modify pond outlet	Commercial/Easement	3	3	1	7	CP,	**8**
17	932 Lathario Cir.- Sirianni Sub Ph I	Modify pond outlet	Private/Easement	1	3	2	10	S, CP,	**8**
18	772 Patty Ln – Silver Birch Estates	Modify pond outlet	Private/Easement	1	3	2	20	S, CP,	**8**
19	Lowes Pond (s. side entrance)	Modify pond outlet	Commerical/easement	3	3	2	15	S, CP, A	**11**
20	St. Ann's Pond	Pond retro	Commerical/easement	3	3	2	32	S, WQ, CP, A	**12**
21	Hegedorns Prop at Lowes (also # 22)	Pond retro	Commerical/easement	3	3	2	20	WQ, CP, A	**11**
23	794 Somerset Dr	Modify pond outlet	Private/ easement	1	3	2	17	CP,	**7**
24	Dunnbridge Estates ph 2	Modify pond outlet	Private/easement	1	3	2	14	CP, I, A	**9**
25	Wood Harbor Estates Ponds (also 26)	Pond retro	Webster	4	3	2	10	S, WQ, CP	**12**
27	Wood Harbor Estates Resub Pond	Pod Retro	Webster	4	3	1	8	S, WQ, CP, I, A	**13**
28	#608 Brookstone Bend	Modify pond Outlet	Private/easement	1	3	2	13	S, CP, I, A	**10**
30	Deer Haven Subd Pond	Modify pond outlet	Private/Easement	1	3	2	24	CP, A	**8**

#	Project	Project Type	Ownership	Feasibility[1]	Cost Effectiveness[2]	Environmental Benefit [3]	Acres Treated	Multiple Benefits[4]	Total Score
31	Spring Meadow Lane	Modify pond outlet	Private/easement	1	3	2	37	CP, A	**8**
33	Preston Park –Don Cerracchi	Modify pond outlet	Private/easement	1	3	2	17	CP, A	**8**
34	Sunningdale Meadows Pond	Modify pond outlet	Private/Easement	1	3	2	20	CP, I	**8**
35	Sandystone Wood Sub ph 1 and 2 (drains #38)	Modify pond outlet	Private/easement	1	3	2	34	S, CP, I	**9**
38	Sandystone Wood Sub ph 2	Modify pond outlet	Private/easement	1	3	2	17	S, CP, I	**9**
36	NYSDOT Rt 104 pond	Modify pond outlet	NYSDOT	3	3	3	70	S, CP,	**11**
37	Rossotti Subd Pond	Modify pond outlet	Private/Easement	1	3	2	21	CP,	**7**
39	Heritage Park Dr	PondRetro	Webster	4	3	2	17	WQ, CP	**11**
41	Maple grove Subd Pond	Modify pond outlet	Private/Easement	1	3	2	17	CP, I	**8**
42	Shirewood Subd – Friar Tuck ln	Modify pond outlet	Private/easement	1	3	2	14	S, CP,	**8**
43	Graceland Estates	Modify pond outlet	Private/Easement	1	3	3	46	CP,	**8**
44	Meadow Ridge (near Schroeder)	Dry pond conv.	Private/Easement	1	3	2	20	S, WQ, CP	**9**

#	Project	Project Type	Ownership	Feasibility[1]	Cost Effectiveness[2]	Environmental Benefit [3]	Acres Treated	Multiple Benefits[4]	Total Score
47	Val Car Subd	Dry pond conv.	Webster	4	3	3	51	WQ, CP, A	**13**
48	705 Northbrook Way	Modify pond outlet	Private/easement	1	3	2	10	S, CP,	**8**
49	Sommerset Sect 2	Modify pond outlet	Private/easement	1	3	2	20	S, CP, I	**9**
50	599 Galbro Cir Pioneer Acres	Dry pond conv.	Private/easement	1	3	2	20	S, WQ, CP,	**9**
51	Autumn Woods Sub Ph 1 pond	Dond retro	Private/easement	1	3	2	20	WQ, CP, I	**9**
52	Birch Meadows Sub pond	Dry pond conv.	Private/easement	1	3	1	3	S, WQ, CP, I	**9**
53	Pioneer Acres East Pond	Dry pond conv.	Private/easement	1	3	1	7	WQ, CP	**7**
54	Bishops Ln Dry pond east of empire park	Dry pond conv.	Webster	4	3	2	26	S, WQ, CP, I	**13**
55	Dunnbridge Estates ph 1	Dry pond conv.	Private/easement	1	3	2	18	WQ, CP, I, A	**10**
56	Preston Park Subd pond	Dry pond conv.	Private/easement	1	3	3	50	WQ,CP,IA	**11**
57	Hills Pond Rd Brookeville Subd	Pond retro	Private/easement	1	3	3	55	S, CP, A,	**10**

Table H 2

NOTES: Gray shade indicates a pond within the watershed that appears to be drained to Irondequoit Bay

[1] Land Ownership and accessibility - Public property = 3 HOA or Commercial w/Easement = 2 Residential w/Easement = 1 point. Accessible – add 1 point

[2] Low medium and high costs = 3 , 2 or 1 respectively based on table of cost per cubic foot of storage

[3] Drainage area to pond: 1- 9 acres = 1 point; 10-39 acres = 2 points; >40 acres = 3 points

[4] Each objective is 1 point: S = flood storage; WQ = Water Quality; CP = reduced streambank erosion; I = infiltration; E= education; A=augment (if CP is added and a downstream erosion site is w/in 2500 feet add 1 point)

[5] Ponds not included (1, 11, 29 32, 40, 45, 49 and 58) due to small drainage areas or recently retrofitted or cnsiderend in another retrofit category (ie 58 stream restoration). However, ponds 29, 32 and 45 are online with little buffer and downstream poor macroinvertebrate scores so retrofitting ponds off-line + buffer would be beneficial

Volume Controls for Retrofitting

A write is needed to explain the 4 volume controls…….

Table H3. Table XZ. Shipbuilders Creek Subwatershed Target Retrofit Control Volumes					
Subwatershed Metric	**A**	**B**	**C**	**D**	**E**
1) Area (Acres)	470	1231	1805	1001	490
Current Impervious Cover	19%	15%	20%	23%	16%
Percent Hydrologic Soil Group (HSG) (A,B,C,D respectively)					
Recharge (in acre-feet) = (WQv)(HSG soil infiltration capacity) HSG A = 0.55, HSG B = 0.40, HSG C = 0.30, HSG D = 0.20					
Water Quality Volume using the 90% Rule (in acre-feet): WQ_v = [(P)(Rv)(A)] /12 Rv = 0.05+0.009(I) I = Impervious Cover (Percent) Minimum Rv = 0.2 if WQv > RRv P = 90% Rainfall Event Number (0.8inches) A = site area in acres	**6.9**	**15.2**	**27.7**	**17.2**	**6.3**
Channel Protection Volume = WQv + WQv(.3)	**8.9**	**19.8**	**36.0**	**22.4**	**8.2**
Overbank Flood					
Total volume					