Salmon Creek Watershed Action Plan

MARCH 9, 2012

PREPARED FOR:
Salmon Creek Watershed Coordinating Committee

PREPARED BY:
Center for Environmental Initiatives
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Rochester, NY 14620

CEI

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ACKNOWLEDGEMENT

This Action Plan was put together by a team consisting of representatives from the organizations listed below, along with the generous support from the Healing Our Waters Coalition (http://www.healthylakes.org/category/about-us) administered by Freshwater Future (www.freshwater.org).

- Wayne County (WC) Soil & Water Conservation District;
- WC Planning Department;
- Town of Williamson;
- WC Cornell Cooperative Extension; and
- Center for Environmental Initiatives.

EXECUTIVE SUMMARY

The Pultneyville embayment is plagued by cultural eutrophication with high nutrient levels leading to the unwanted growth of algae and other water quality problems which limit the use of cottages, offending recreational users and detrimentally affecting tourism. Beach closings and posting along the shoreline are common and are in part caused by the nuisance algae and fecal coliform bacteria growth. The Pultneyville Mariners Beach was found to exceed acceptable fecal coliform levels for bathing 37% of the time in 2008. This beach was cited in a Natural Resource Defense Council report in 2009 as the third worst beach in the state in 2008.

A preliminary watershed analysis conducted in 2010 pointed to two water quality impairments that warranted further attention:

1. Beach closings in Pultneyville Harbor; and
2. Elevated phosphorus levels in Salmon Creek, Pultneville Harbor and Lake Ontario.

A more comprehensive study in 2011 led to the complete characterization of the water quality of Salmon Creek, a quantification of the sources of phosphorus pollution loads and bacterial growth in the watershed along with recommendations for remediation.

Beach Closings: The results of this evaluation identified the sources of bacteria that contribute to beach closings during the swimming season in Pultneyville Harbor to be

- Bacteria transported *from the watershed* into the Harbor (30%);
- Bacteria *from geese and gulls* in the Harbor (20%);
- Bacteria *algal mats* in the Harbor (20%); and
- Bacteria *from marine practices* in the Harbor (30%).

Computer modeling was used to determine the relative contribution of various sources to the total bacteria load *from the watershed* into the Harbor. This modeling demonstrated that 53% is associated with farm animals, 40% is associated with land application of food processing plant's by-product solids; and 7% is associated with septic systems. The implementation of the BMPs identified below to reduce **Elevated Phosphorus** by 80% in the watershed will also reduce the amount of bacteria transported *from the watershed* by 80% since they come from the same source.

An evaluation of a variety of bacterial reduction scenarios resulted in the identification of the following best management practices (BMPs) that should be implemented to reduce the bacterial loads in the Harbor and reduce beach closings due to excessive bacterial levels:

- *Clean Marina Initiative* practices;
- Waterfowl management practices; and
- BMPs within the watershed to reduce phosphorus loads.

Implementing BMPs to reduce phosphorus loads in the watershed will reduce bacterial loads to the Harbor directly but will also reduce them indirectly by their impact on algae growth. Less phosphorus coming into the Harbor from Salmon Creek with reduce the formation of algal mats which are homes for bacteria.

Elevated Phosphorus: Analysis of the relative impact of current phosphorus and bacterial loadings from point and non-point sources demonstrates that 50% of the phosphorus released to this watershed is attributable to a point source (food processing plant's wastewater treatment plant effluent). The remaining portion is distributed evenly between septic systems, farm animals, land application of food processing solids, and agricultural sources.

Due to the magnitude of the impact of the food processing plant operation on phosphorus loadings in Salmon Creek the recommendations have been broken down into two categories:

1. <u>Non-Point Sources:</u> septic systems, farm animals, and cropland; and
2. <u>Permitted Sources:</u> Food processing plant's wastewater treatment plant effluent and land application of solids from that activity.

This breakdown allows the separation of remediation activities into those that are permitted and those that can be independently influenced by the Salmon Creek Watershed Coordinating Committee. An adaptive management approach will be used that implements the most effective measures first while monitoring the water quality impact to see if more should be done and consideration of impacts associated with reductions in phosphorus loads.

An evaluation of a variety of phosphorus reduction scenarios resulted in the identification of eight best management practices (BMPs) listed below that would result in a reduction of 6,221 pounds of phosphorus per year. These BMPs are estimated to have a five-year cost of approximately $817,000 and would reduce the phosphorus loading sufficient to obtain over 81% of the reduction needed to meet a 65 µg/L endpoint. More than two-thirds of this reduction (4,263 lbs.) would come from the Permitted Sources and the rest (1,958 lbs.) from Non-Point Sources.

Non-Point Sources: The non-point source BMPs listed below will be implemented over the next five years as described in section **VIII. IMPLEMENTATION**.

BMP	Phosphorus Reduction	Five-Year Cost	Effectiveness	Cumulative Reduction
AWMS Runoff Control	180 lb/yr	$37,000	$204/lb. – phosphorus reduced	180 lbs.
Manure Composting	541 lb/yr	$129,000	$238/lb. – phosphorus reduced	721 lbs.
Nutrient Management	505 lb/yr	$125,000	$248/lb. – phosphorus reduced	1,226 lbs.
Precision Feed Management	271 lb/yr	$80,000	$295/lb. – phosphorus reduced	1,497 lbs.
Vegetative Buffer Strips	57 lb/yr	$23,000	$397/lb. – phosphorus reduced	1,554 lbs.
Septic System Repairs	404 lb/yr	$221,000	$546/lb. – phosphorus reduced	1,958 lbs.

Permitted Sources: The permitted source BMPs listed below were recommended for consideration for implementation over the next five years as described in section **VIII. IMPLEMENTATION**.

BMP	Phosphorus Reduction	Five-Year Cost	Effectiveness	Cumulative Reduction
Pollution Prevention at Food Processing Plant	3,500 lb/yr	$75,000	$21/lb. - phosphorus reduced	3,500 lbs.
By-Product Solids Management at Food Processing Plant	763 lb/yr	$127,000	$167/lb. - phosphorus reduced	4,263 lbs.

I. INTRODUCTION

The U.S. portion of Lake Ontario's shoreline and watershed lies wholly in New York State. New York's Lake Ontario coastal waters are a valuable resource for drinking water, recreational boating, fishing and swimming, tourism, and waste water processing, and a key asset in the economic revitalization of upstate New York.

But in spite of intensive study and significant water quality improvements in the open, offshore waters of the Lake over the last four decades, critical gaps in information and lingering impairments remain in the 322 miles of shoreline. River and creek mouths, and embayments suffer from many impairments that limit their recreational use, elevate the cost of drinking water withdrawals. These lingering impairments affect the region's recreation and tourism based economy and property values, reliant on high quality water resources. Impairments of drinking water quality, shoreline property values, and the attractiveness of the lakeshore to shoreline residents and tourists using the beaches and walking the shoreline, and boating are continuing concerns.

The Pultneyville embayment is plagued by high nutrient levels leading to the unwanted growth of algae and bacteria and other water quality problems which limit the use of cottages, offending recreational users and detrimentally affecting tourism. Beach closings and posting along the shoreline are common and are in part caused by the nuisance algae and fecal coliform bacteria. The Pultneyville Mariners Beach was found to exceed acceptable fecal coliform levels 37% of the time in 2008.

The Center for Environmental Initiatives (CEI: www.ceinfo.org) received funding from the Healing Our Waters Coalition in 2010 (http://www.healthylakes.org/category/about-us) which allowed to them to facilitate the initiation of a watershed analysis, problem prioritization and implementation process for the Salmon Creek watershed resulted in the preparation of a preliminary watershed analysis to enable stakeholders to understand the nature and extent of the impairments to the Salmon Creek Watershed; identification and prioritization of the causes of those impairments; and creation of an Action Plan for pursuing funding to remediate the priority impairments.

The findings of that project point to three water quality impairments that warrant further attention: elevated phosphorus levels in Salmon Creek and Lake Ontario; beach closings due to high bacteria counts in Pultneyville Harbor; and stressed aquatic life in Salmon Creek. Potential causes of these impairments were identified to be: malfunctioning septic systems; land application of wastes; stormwater runoff; waterfowl populations in Pultneyville Harbor; industrial wastewater treatment plant discharge; marina practices in Pultneyville Harbor; and farm animal populations.

A prioritized Salmon Creek Watershed Action Plan recommended that the ad-hoc Salmon Creek Watershed coordinating committee apply for funding to complete the prioritization in the order listed below.

1. Develop a Complete Pollutant Source Quantification: Develop a complete quantification of nutrient and pathogen loadings in the watershed and identify the most effective remediation methods and facilities.
2. Nutrient Management BMP: Develop and implement a nutrient management plan to minimize the nutrients and bacteria resulting from land application of nutrients.
3. Public Education: Develop and implement a public education program to include watershed signs and presentations to community groups and school programs
4. Waterfowl Control: Evaluate means to control waterfowl populations in Pultneyville Harbor to identify the most cost-effective strategies and/or technology to reduce bacterial contamination.
5. Marina Practices: Evaluate "green" marina best management practices for implementation.
6. Septic System Inspection: Develop and implement a septic system inspection program to ensure optimum system performance in protecting water quality.
7. Stormwater Management and Retention: Evaluate stormwater and nutrient flow to identify the most cost-effective stormwater management strategies and technologies to reduce impact on water quality.

A key recommendation of that earlier work was to seek funding to develop a complete quantification of nutrient and pathogen loadings in the watershed and identify the most effective remediation methods and facilities. In July 2011 CEI received additional funding to complete this recommendation. The results of this latest work provided further characterization of the water quality of Salmon Creek, a quantification of the sources of phosphorus pollution loads in the watershed along with recommendations for remediation. This report details the results of all of the work completed.

Public Input

As part of the 2010 grant work a public forum, called a Listening Session, was held on November 29, 2010 to solicit issues and concerns from the citizens and groups with an interest and or stake in improving the quality of the water draining from the Salmon Creek Watershed into Pultneyville Harbor. There were approximately 40 people in attendance. The ideas, comments, questions and issues raised at that meeting are listed below.

1. Why is blue-green algae in Sodus Bay and not Pultneyville Harbor?
2. With a predominant west to east wind that flushes the lake, does the Pultneyville Harbor prevent this flushing action in the harbor?
3. Are their different algae at different times from different sources?
4. Does algae contribute to water quality (close the beach)?
5. How far out into Lake Ontario should be tested?
6. How can water quality fail when water looks fine?

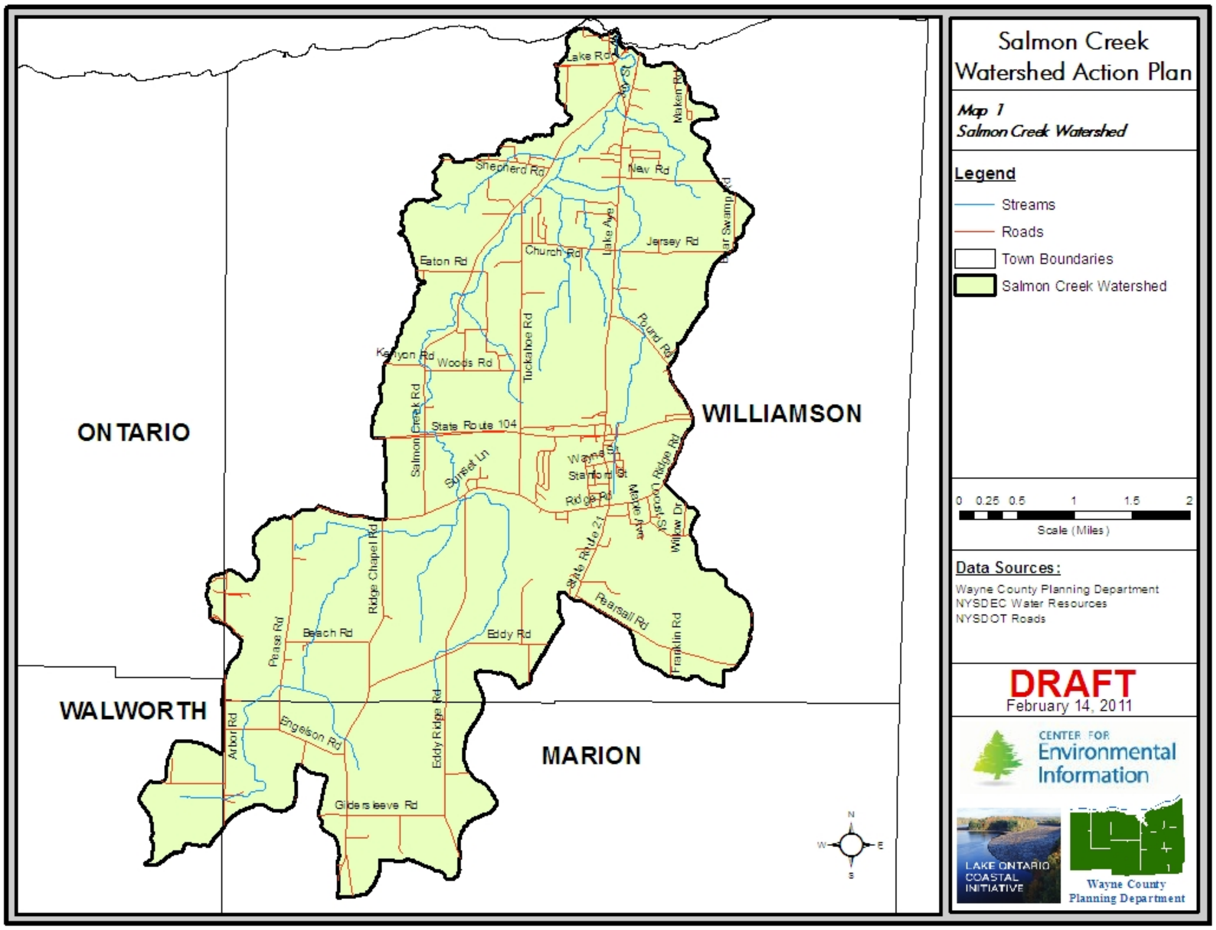
7. How does the resident population of over 200 geese in Pultneyville Harbor contribute to the problem?
8. Can testing be done to identify strains and sources of bacteria?
9. Without animal agriculture numbers in the area what might be the sources of phosphorus?
10. How much does one source of point source contribute to the total?
11. Suds in the stream crevices in the summer..source?
12. Will you include well water testing in this study?
13. Are you only looking at surface waters?
14. Rock snot is prevalent in many places…source? (NOTE: Rock snot is didymosphenia geminata and note that it's a diatom. Cladophora is a filamentous green algae that's also a problem. Cladophora blooms are strongly associated with blue-green algae blooms.)
15. September and October haul outs for boats in Pultneyville Harbor
16. Harbor is dredged every year
17. Can walk across the “islands” at certain times in the summer.
18. What is the schedule testing or stringent testing for Pultneyville Harbor is Charlotte or Sodus?
19. Describe plant death cycle related to algae growth

As part of the 2011 grant another public forum was held on June 30, 2011 to review the results of the earlier work and to outline the work to be done for the rest of 2011.

II. WATERSHED DESCRIPTION

Natural Features and Boundaries

Lake Ontario is the most prominent natural feature in the Salmon Creek Watershed, with the shoreline comprising its northern-most boundary. In addition to Lake Ontario, approximately 90 small, unnamed lakes and ponds are also located within the watershed boundary.



Floodplains: The Federal Emergency Management Agency (FEMA) maintains digital mapping records of floodplains for all of the United States. According to FEMA's Flood Insurance Rate Mapping, approximately 491 acres of floodplains are located along the entire length of Salmon Creek. With the exception of a small area located just south of Gildersleeve Road in the Town of Marion, all 100 year floodplain areas are located in the Town of Williamson.

Floodplains provide a number of community benefits and, as experience has shown, can be far more effective than many man-made structures (e.g., floodwalls, stream channelization, etc.) in reducing downstream flood peaks. First, floodplains provide flood and erosion control by storing and slowly releasing floodwaters, thus reducing the depth and velocity of flooding. Floodplain vegetation can also positively impact water quality, trapping sediments and capturing pollutants before they are carried off downstream. Floodplains also provide groundwater recharge by storing floodwaters and promoting percolation to groundwater.

Wetlands: The New York State Department of Environmental Conservation (NYSDEC) identifies and regulates all freshwater wetlands greater than 12.4 acres in size. The U.S. Fish and Wildlife Service also maps wetland areas through the National Wetlands Inventory (NWI). The National Wetlands Inventory identifies all wetlands, regardless of size and regulatory status, based on a combination of the interpretation of aerial photography and on-the-ground surveys. Given the difference in identification methodologies, significant overlap can occur between those wetlands identified by the NYSDEC and those identified by the NWI. Based on data provided by the NYSDEC, there are 532 acres of state regulated wetlands in the Salmon Creek Watershed. NWI data indicates there are 875 acres of federally regulated wetlands within the watershed. Many of the federal wetlands overlap state wetlands.

In addition to providing food and habitat for a wide range of plant and animal species, wetlands contribute significantly to water quality. By impeding drainage flow from developed land, wetlands can filter out pollutant and sediment-laden run-off before it enters streams, thus improving water quality. Riparian wetlands located along streams and rivers also provide valuable flood protection, acting as storage basins and reducing the amount of downstream flow. This temporary storage of water results in decreased runoff velocities, reduced flood peaks, and delayed distribution of storm flows, all which cause tributaries and main channels to peak at different times. In some instances it has been found that wetlands provide more cost-effective flood control than man-made measures such as reservoirs or dikes.

Topography

While the topography of the Salmon Creek watershed is predominately gently rolling to flat, areas comprising steeper slopes do occur, particularly in areas along Salmon Creek and its associated tributaries. The northern portion of the watershed is located in an area commonly known as the lake plains and is generally flat. The terrain becomes gently rolling as you move south, with drumlins appearing in and near the watershed area located in the Town of Marion.

Climate

The climate of the Salmon Creek watershed in the Town of Williamson, Wayne County is classified as humid continental with cool summers. The region is marked by a highly variable climate and the possibility of rapid, frequent and extreme weather changes. A weather station located at Sodus Center, about seven miles distant collects weather data for the area.

Average annual precipitation is 36.41 inches and about 50% falls during the growing season. Precipitation is well distributed through the months and adequate for most crops on most soils. In the late fall and winter, snow squalls (lake effect) are frequent and snowfall can be heavy. Average seasonal snowfall is 88 inches. Because winter precipitation often arrives as snow and ice stored in the watershed, there is often a strong pulse of runoff to the lake in the early spring of each year.

Areas of the watershed closest to the lake, such as the hamlet of Pultneyville, are buffered by the lake water temperature, especially during the summer months.

Actual annual evapotranspiration is measured as 21.5 inches per year, with most occurring between June and September.

Rare Species and Ecological Communities: CEI applied to the New York Natural Heritage Program for an assessment of the presence of species or communities in the Salmon Creek watershed that would require special care if actions were pursued to affect the water quality of the Salmon Creek watershed area or its immediate vicinity. NYNHP warns, "The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions."

NYNHP Information Services provider Tara Salerno identified two species of concern as being located in the Salmon Creek watershed area:

1. Podilymbus podiceps, or Pied-bill Grebe, whose NYS status is S3B,S1N- Vulnerable. Its Global Rank is G-5- Secure. The Pied-bill Grebe was noted in the vicinity of the watershed but not in it. The Pied-bill Grebe may breed in New York but rarely winters here.
2. Notropis heterodon, or Blackchin Shiner, whose NYS status is S1- Critically Imperiled. Its Global Rank is G-5- Secure. The Blackchin Shiner was last seen in Salmon Creek in 1939. It is a small stream fish, one of about fifty in the Family Cyprinidae that occur in New York.

Any actions carried out in the watershed as a result of this report would need to address impacts on these species of concern in applications for permits.

Soils

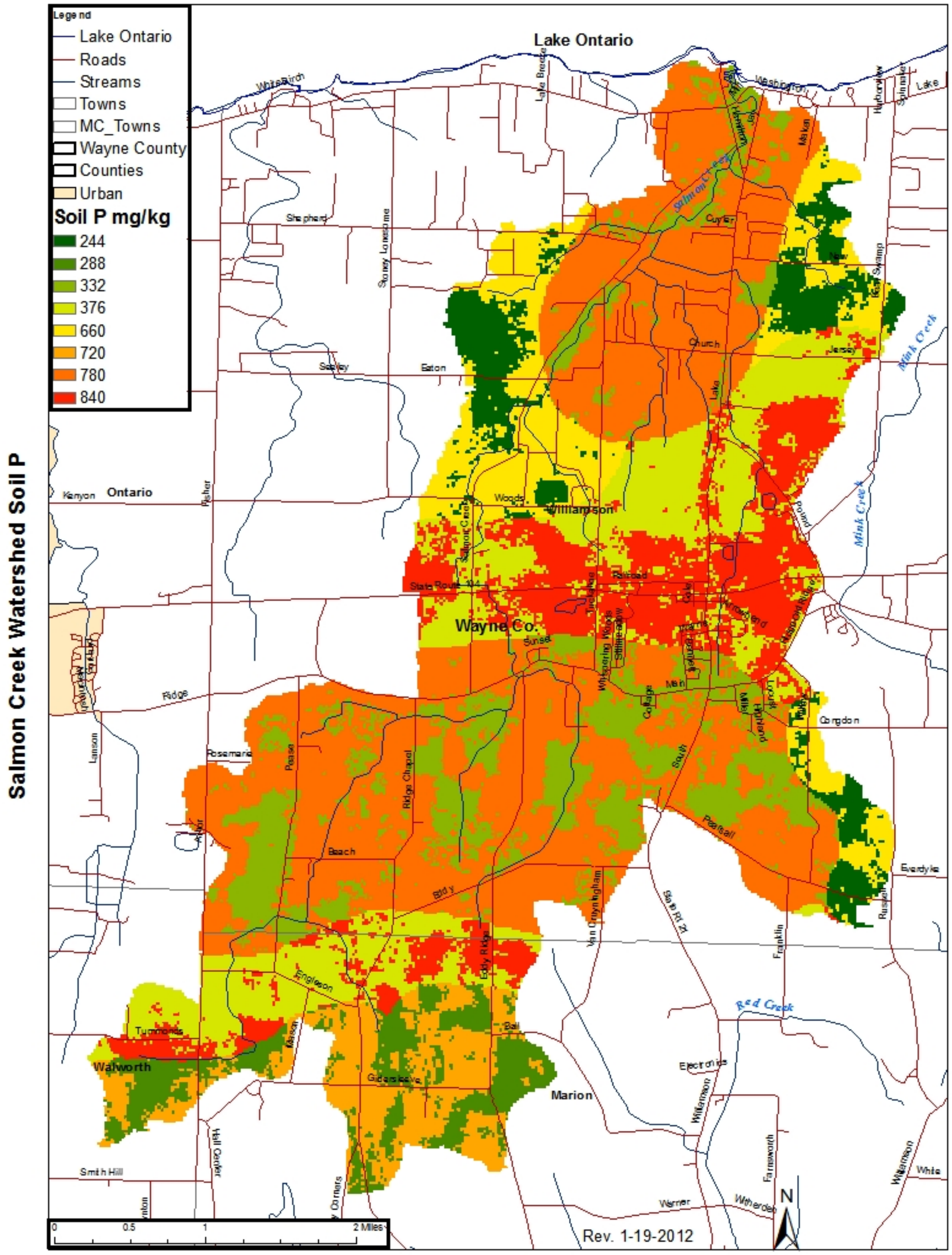
A mantle of glacial till (material detached, transported, processed and deposited by glaciers) averaging forty feet in thickness covers the Ordovician and Silurian bedrock of the watershed area. The most recent glacial period (Wisconsin Stage 65,000 – 11,500 years ago) featured many advances and retreats of the ice in response to global climate. Most of the modern soil has developed in the intervening time.

The four dominant mineral soil associations of the Salmon Creek watershed are (from north to south):

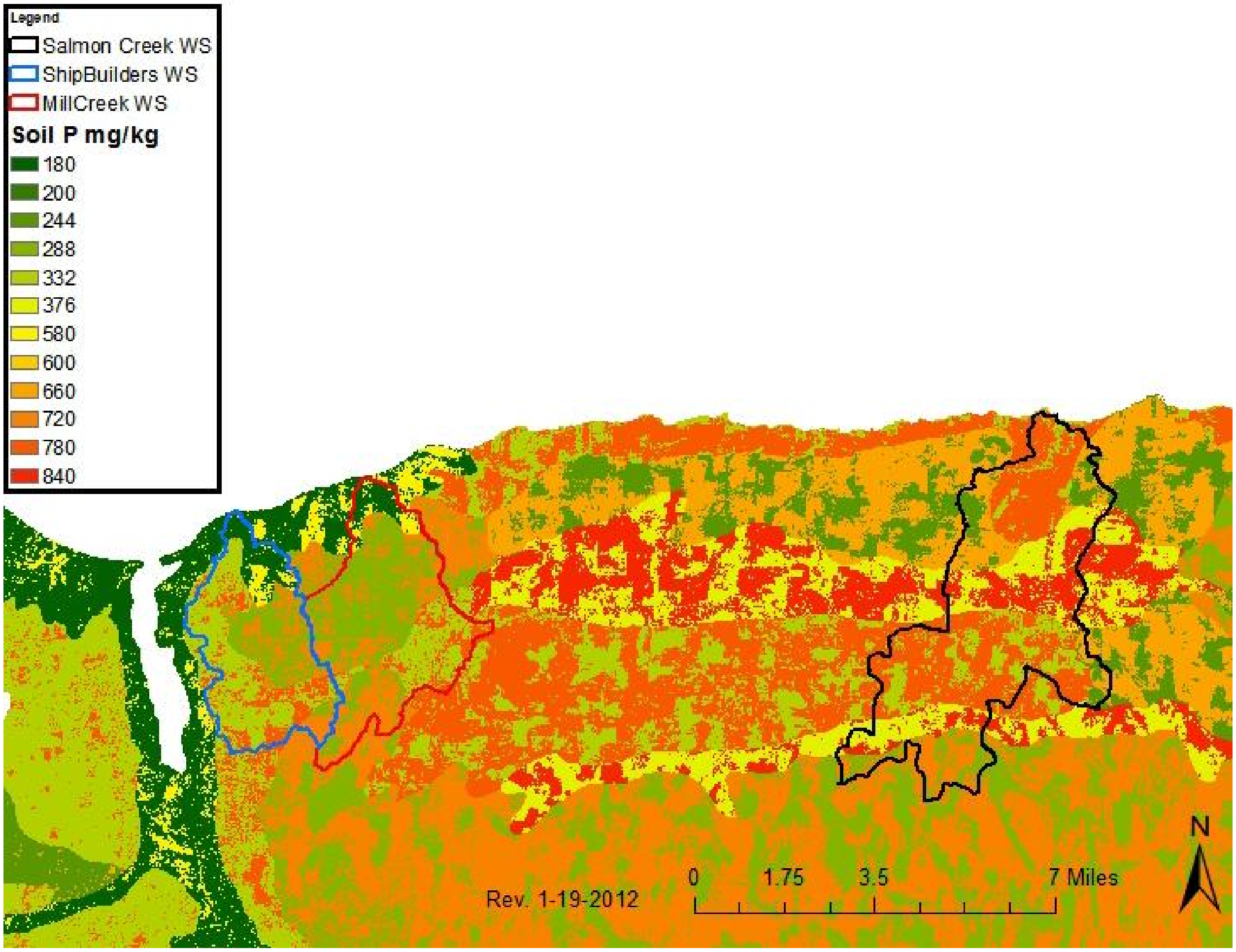
- Williamson-Elnora-Collamer, deep, moderately well-drained, medium and coarse textured soils found on lake plains;
- Appleton-Lockport, deep and moderately deep, somewhat poorly drained, moderately fine and medium textured soils found on glacial till plains;
- Madrid-Bombay, deep, well drained and moderately well-drained, moderately coarse textured soils found on glacial till plains; and
- Ontario-Hilton, deep, moderately well drained and well drained, medium textured soils found on glacial till plains.

Glacially caused soil features include kames, eskers, terraces and outwash plains made of coarser sediments transported by, washed out and sorted by the glaciers. Most of the Salmon Creek watershed is covered by soils deposited in the waters of the glacial Lake Iroquois that covered the area for hundreds of thousands of years during the last glacial retreat.

Soils of the Salmon Creek watershed are relatively high in phosphorus content, averaging over 300 parts per million. Not all of this phosphorus is available as a nutrient to growing plants, but enough is available so that additional phosphorus fertilizer is seldom needed. The first map below shows the soil phosphorus content in the Salmon Creek watershed and the next one compares those levels with ones in Monroe County. Those creeks in Monroe County, Shipbuilders Creek and Mill Creek, have total phosphorus levels on the order of 75 to 80 micrograms per liter versus over 260 micrograms per liter for Salmon Creek. This indicates that the higher soil phosphorus levels in Salmon Creek watershed may contribute to the relatively high background levels of total phosphorus in the stream.



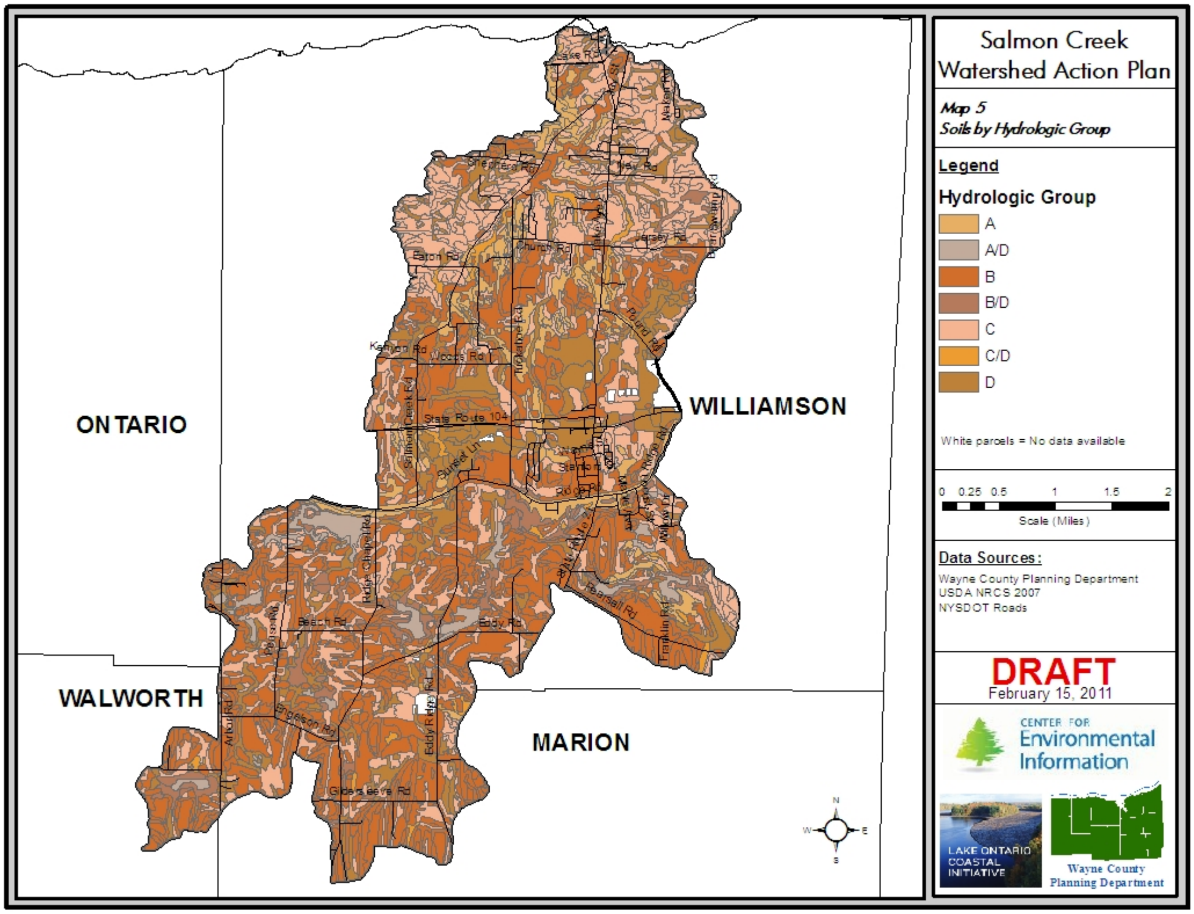
Salmon Creek Watershed Soil Phosphorus



Salmon Creek Soil Phosphorus Compared to Eastern Monroe County Watersheds

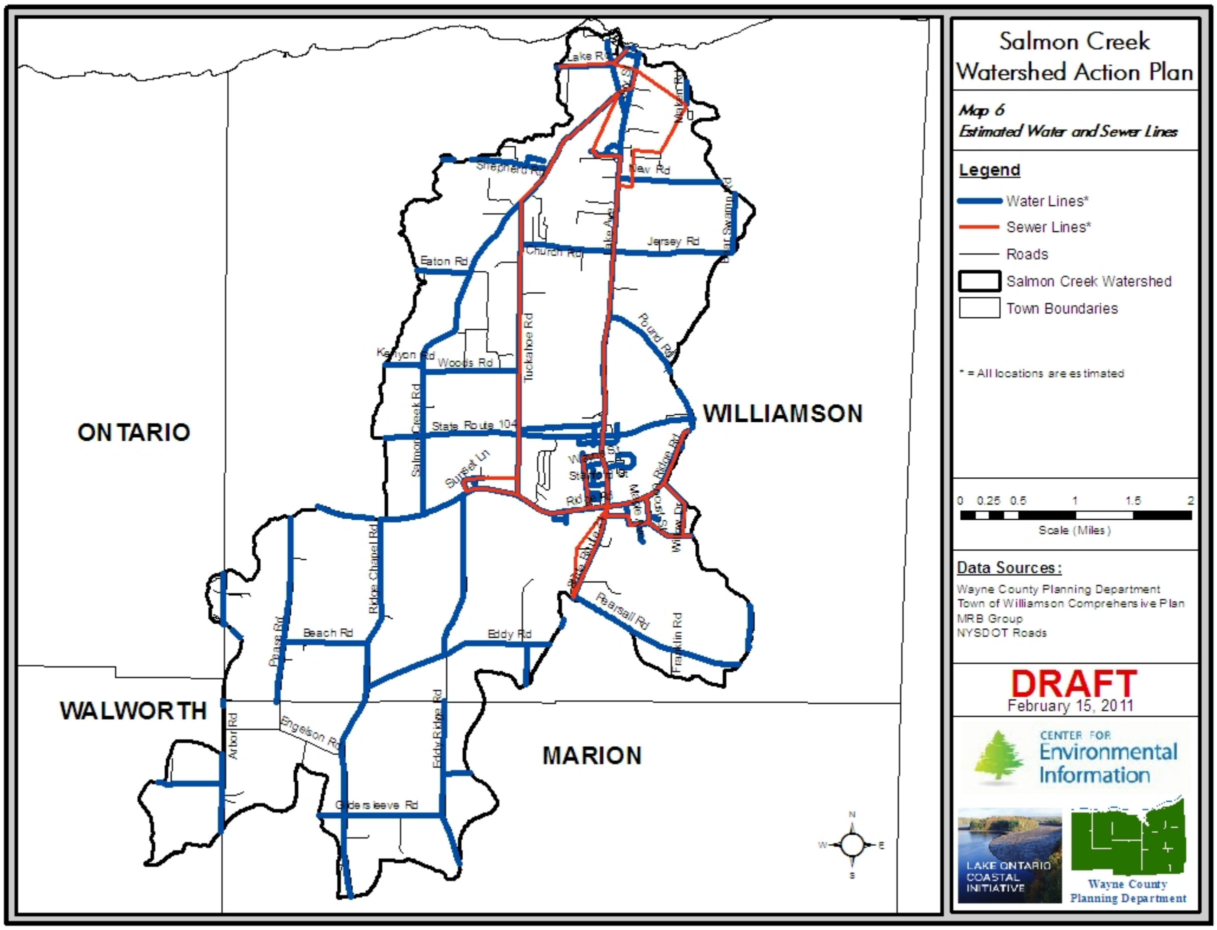
Drumlins are common just south of the Salmon Creek watershed, and several drumlins form the high points delineating the south end of the watershed and separating the Salmon Creek watershed from Red Creek, a tributary of Ganargua Creek and the Barge Canal.

The beach ridge formed on the edge of Lake Iroquois bisects the Salmon Creek watershed. Salmon Creek breaks through this ridge near the intersection of Ridge and Eddy Ridge Road. Water flowing into Lake Iroquois from the south deposited deltas of silts and fine sands. The swamps (wooded wetlands) that exist in the Salmon Creek watershed are often remnants of former glacial lakes and arms of Lake Iroquois. Sometimes they contain organic deposits mapped as “muck “soils.



Sewer Districts

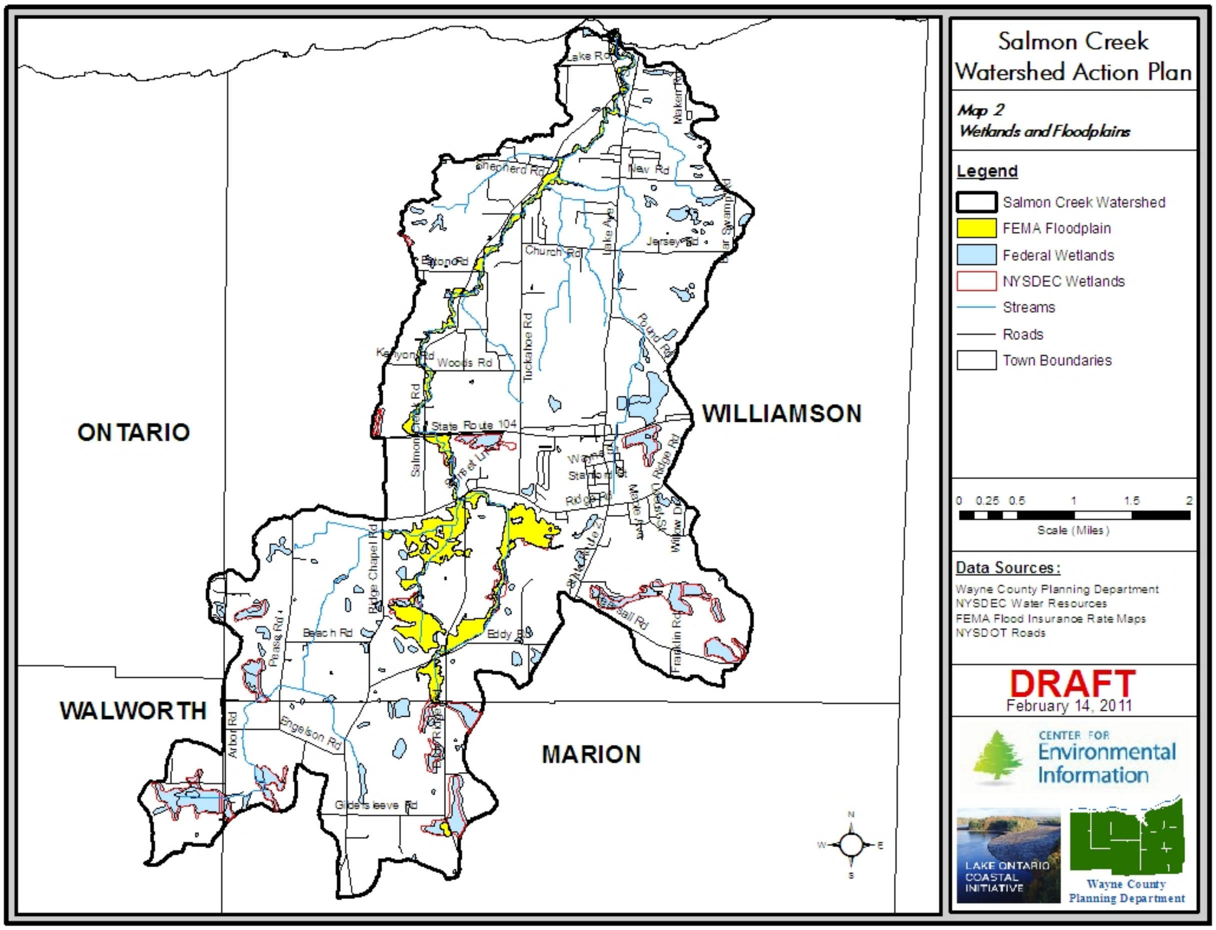
Wastewater is typically treated in one of two ways within a community – through municipal sanitary sewer service or individual septic tanks. In densely populated areas there usually exists a network of pipes that carry sewage from residences and commercial facilities to one or more treatment plants. At the plant, wastewater is separated into liquids and solids, with the solids being removed. The separated water is then treated and discharged into waterways. This is generally referred to as a municipal sewer system. The Town of Williamson currently operates approximately 21 miles of municipal sewer pipes, most of which are concentrated in the two hamlet centers and along Lake Avenue, Tuckahoe Road, and Ridge Road. These pipes are connected to three pumping stations, located in East Williamson and the hamlet area of Williamson, and one wastewater treatment facility located in Pultneyville. Treated wastewater from this facility is discharged directly into Lake Ontario not Salmon Creek. The system commonly used in rural communities consists of septic tanks. Solids are collected into tanks and periodically removed to sewage treatment plants, while the liquids are drained into a leach field. All Town residents outside the service areas noted above have septic tanks.



Streams, Wetlands and Flood Plains

Lake Ontario is the most prominent natural feature in the Town of Williamson, with approximately 6.5 miles of shoreline comprising its northern-most boundary. In addition to Lake Ontario, approximately 63 acres of small, unnamed lakes and ponds are also located within the Town boundaries. Two named streams – Salmon Creek and Mink Creek – and their tributaries flow for more than 40 miles through the Town as they drain into Lake Ontario.

The Federal Emergency Management Agency (FEMA) maintains digital mapping records of floodplains for all of the United States. According to FEMA's Flood Insurance Rate Mapping, approximately 568 acres of 100-year floodplains exist within the Town of Williamson, of which 488 acres are located along the entire length of Salmon Creek. The remaining 80 acres of 100-year floodplains occur at the mouths of the Bear and Mink Creeks.



Population and Demographic Characteristics

General demographic statistics for the Salmon Creek Watershed were derived from block level data supplied by the US Bureau of the Census. The most recent Census information available is from 2000. Preliminary 2010 Census figures released for the communities comprising the Salmon Creek Watershed demonstrates little change in total population. Because of this, the 2000 Census numbers used in this report should be considered relatively accurate.

Population Characteristics: Socioeconomic characteristics are presented for the census block groups that most closely correspond to the borders of the Salmon Creek Watershed. According to the 2000 Census, this area had a total population of 2,855 persons. Of that number, 46 persons were African American, or 1.6 percent of the total population. Approximately 1.3 percent of the population is Hispanic. American Indian and persons of Asian descent comprise 3.5 percent of the population of the watershed. The remainder of the population is classified as white. The population density for the Salmon Creek watershed is 154 persons per square mile.
The highest population densities exist in the hamlets of Williamson and Pultneyville. The areas directly to the west and south of the Hamlet of Williamson, as well as along the western half of the lakefront have population densities of 250 to 500 people per square mile.

Age and Household Characteristics: According to the 2000 Census, only 9 percent of the Salmon Creek Watershed population was 65 or older. A total of 12.1 percent of Wayne County residents were over 65 years old. The median age for the watershed is 40 years old while the median age for all of Wayne County is 37.6 years old.

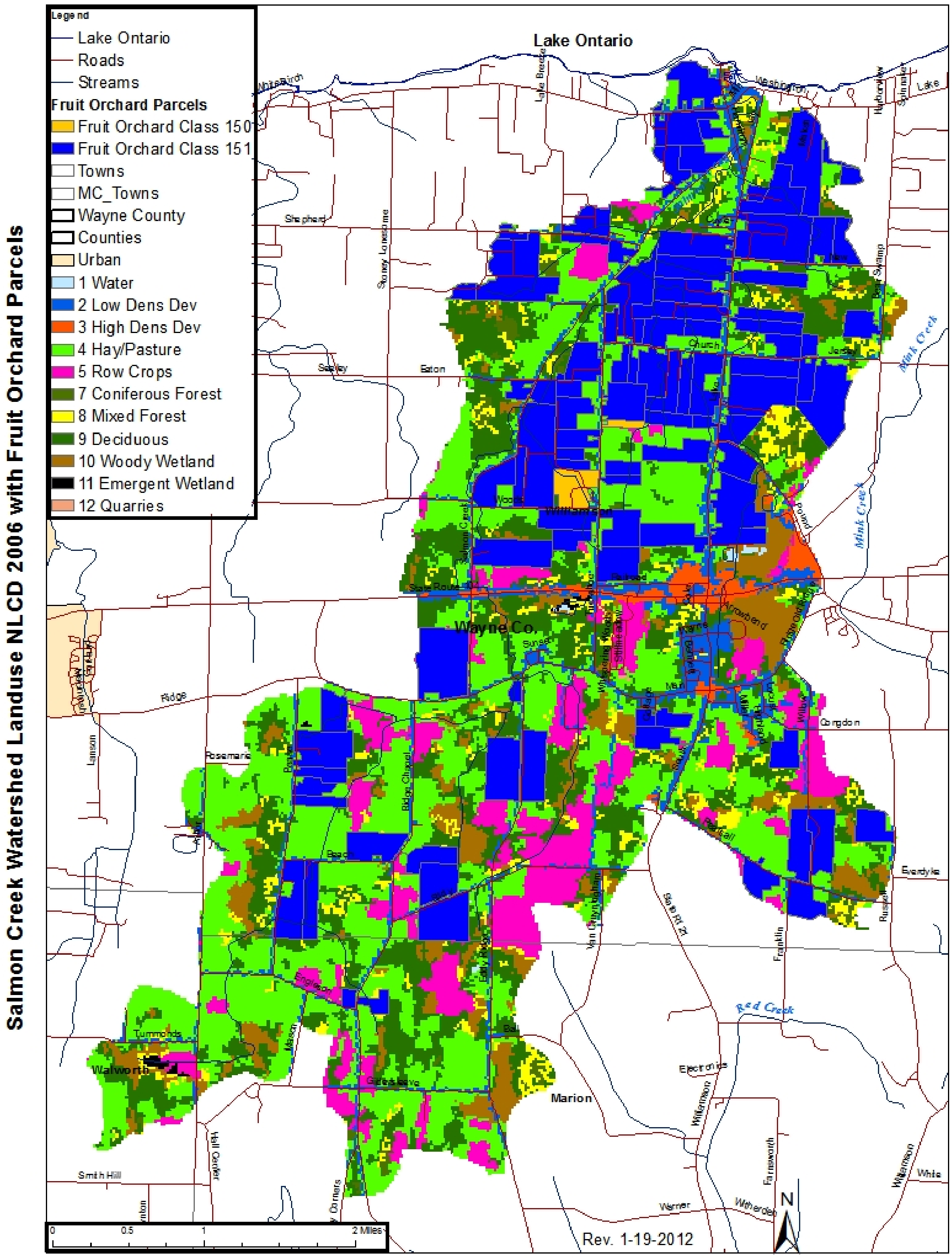
Approximately 31 percent of the population is under the age of 19 and 40 percent of the population is between the ages of 35 and 54 years old. For the under 19 category, this age breakdown is consistent with Wayne County where 29.8 percent of the total population is under the age of 19. Approximately 32 percent of Wayne County's population is between the ages of 35 and 54 while the Salmon Creek watershed has a significantly higher 35 to 54 year old population at 40 percent. The average household size in the watershed is also higher than the County as a whole, at 2.94 and 2.64, respectively.

Housing: Housing within the Salmon Creek Watershed is principally single family residential. One large subsidized multi-family apartment complex is located on Route 21 just south of Route 104 in the Hamlet of Williamson. A large manufactured home community is situated on land between Route 104 and Ridge Road, west of the Hamlet of Williamson. The park is populated by 169 single family manufactured homes on rented lots. There are a total of 807 housing units within the watershed area. The vacancy rate is a relatively low 4.7 percent.

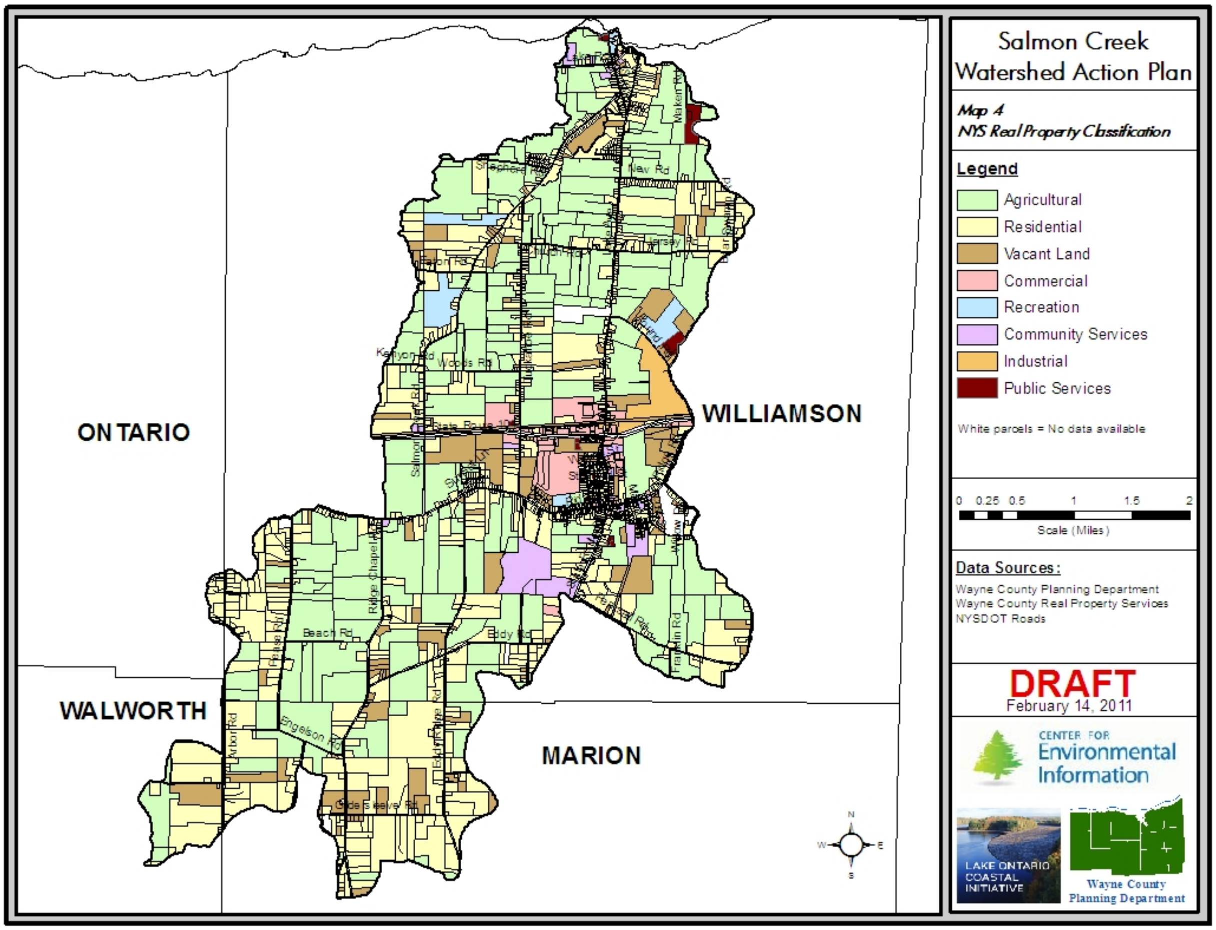
Development Patterns: The Salmon Creek Watershed is characterized by a predominance of agricultural land uses. The northern area near the Lake Ontario shoreline is primarily fruit trees, especially apples and cherries. Field crops and livestock farms are interspersed further south within the watershed. Because the Town of Williamson has public water service available on every road, single family residential development predominates along the road frontage with agricultural land in rear parcels. This same development pattern is evident in the area of the watershed that extends into the Town of Marion.

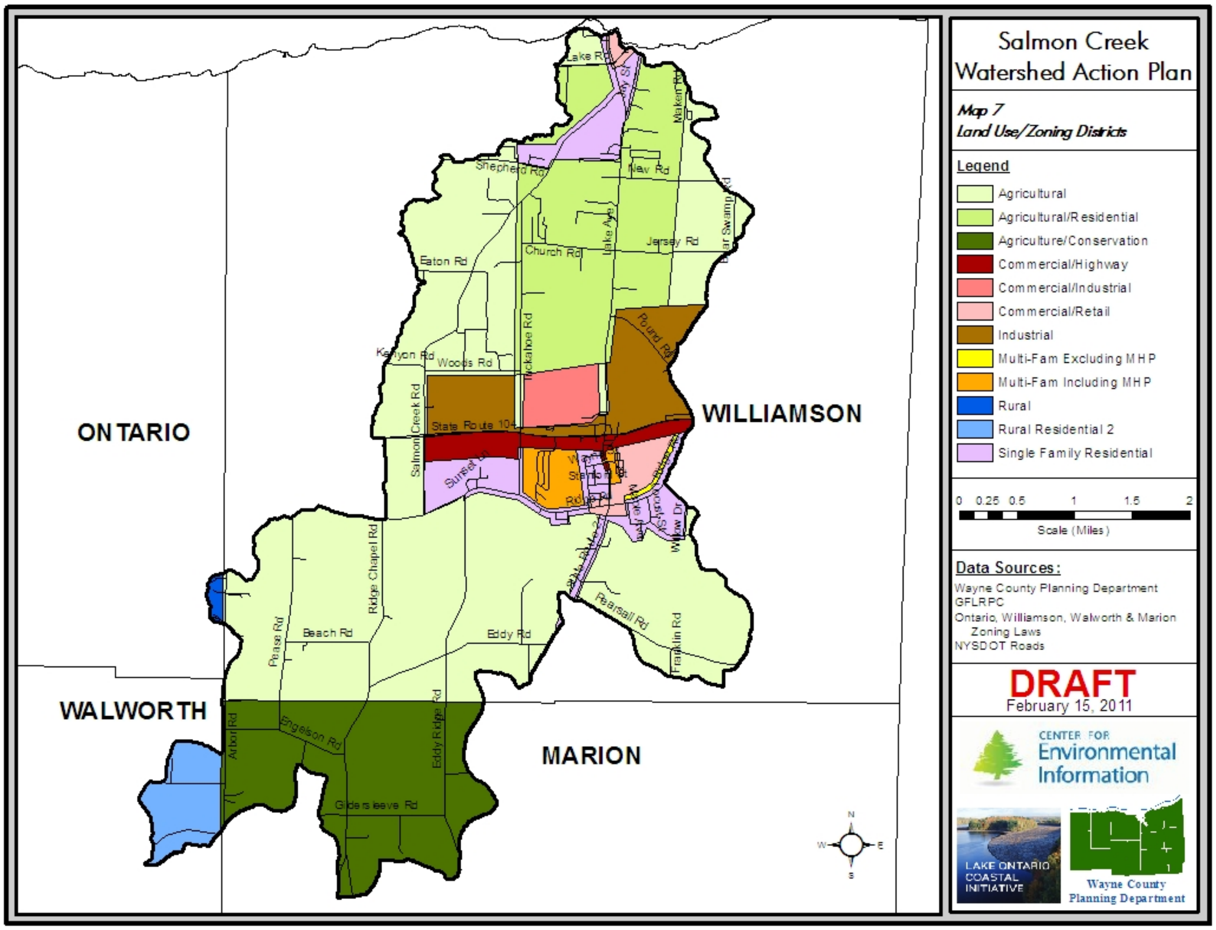
Industrial and larger commercial development is located along the Route 104 corridor. The Hamlet of Williamson is characterized by smaller, locally owned businesses in historic buildings within a traditional main street setting. A large portion of the Hamlet of Pultneyville is listed on the National Register of Historic Places. Many of the homes in this area have been preserved and authentically restored. Commercial development of an appropriate scale includes a restaurant, boutique art gallery, an antique and gift barn, and several bed and breakfasts.

Economic Profile: The Salmon Creek Watershed is situated in a heavily agricultural area. In addition to a robust fruit growing industry, the watershed hosts a major food processing corporation employing a total of 353 full time employees, with another 80 temporary employees hired during harvest season. See map below showing orchards. Two cold storage facilities collectively have 35 full time and 2 part time employees. The industrial profile of the watershed also includes a large chemical company with 22 full time employees and a high tech company with 90 full time employees. Other businesses include retail (grocery, pharmacy, clothing, hardware, and specialty stores); restaurants, car repair shops and dealerships; school district and town government.


Salmon Creek Watershed Landuse NLCD 2006 with Fruit Orchard Parcels
Legend
Lake Ontario
Roads
Streams
Fruit Orchard Parcels
Fruit Orchard Class 150
Fruit Orchard Class 151
Towns
MC_Towns
Wayne County
Counties
Urban
1 Water
2 Low Dens Dev
3 High Dens Dev
4 Hay/Pasture
5 Row Crops
7 Coniferous Forest
8 Mixed Forest
9 Deciduous
10 Woody Wetland
11 Emergent Wetland
12 Quarries
Lake Ontario
Wayne Co.
Walworth
Marion
Mink Creek
Red Creek
Rev. 1-19-2012
N
0 0.5 1 2 Miles

Land Use


Salmon Creek Watershed Action Plan
Map 4
NYS Real Property Classification
Legend
Agricultural
Residential
Vacant Land
Commercial
Recreation
Community Services
Industrial
Public Services
White parcels = No data available
0 0.25 0.5 1 1.5 2
Scale (Miles)
Data Sources:
Wayne County Planning Department
Wayne County Real Property Services
NYSDOT Roads
DRAFT
February 14, 2011
CENTER FOR Environmental Information
LAKE ONTARIO COASTAL INITIATIVE
Wayne County Planning Department
ONTARIO
WILLIAMSON
WALWORTH
MARION
N
S
E
W



According to parcel data obtained from Wayne County, the Salmon Creek Watershed has 2,036 parcels encompassing approximately 11,491 acres of land. Another 370 acres are predominantly roads and their associated rights-of-way. Land use is determined by the New York State Office of Real Property Services (NYSORPS) based on property assessments. NYSORPS has identified nine land use categories which are used to classify lands within New York State. Eight of the nine land use categories are present within the watershed. The Conservation & Parks land use category is not present in the watershed. Since the land use data from NYSORPS is based on assessments, which may not be updated on a regular basis, there may be a margin of error associated with land use information. As an example, agricultural parcels that also serve as a farmer's primary residence can be assessed as residential even though the majority of the parcel is used for agricultural production. The Williamson Town Park is classified as an Agricultural parcel, likely due to the fact that the property was at one time used for farming. A breakdown of the land uses, parcels, and acreages of land within the watershed are summarized in Table 1.

Agriculture: Agricultural land uses are defined by NYSORPS as "properties used for the production of crops or livestock." Within the watershed, agriculture is the largest land use category, accounting for 5,292 acres or 44.6 percent of the total land area. While agricultural uses account for almost half the land within the watershed, the actual number of parcels comprises only 7.6 percent of the total number of parcels. On average agricultural parcels are much larger than other land use classifications. Agricultural land uses are spread uniformly throughout the watershed, with the exception of limited agricultural parcels in Pultneyville, the Hamlet of Williamson, and along Route 104, particularly east of Tuckahoe Road.

Residential: Residential land uses are defined by NYSORPS as “properties used for human habitation, but excluding hotels, motels, and apartments.” Residential uses are the second largest land use in the watershed, accounting for 4,209 acres, or 35.5 percent of the watershed, on 1,529 parcels. The average residential parcel size is 2.8 acres. Smaller parcels and higher density residential development are concentrated in each of the three hamlet areas, and along Lake Avenue and Salmon Creek Road to Route 104.

Industrial: Industrial land uses are defined by NYSORPS as “properties used for the production and fabrication of durable and non-durable man-made goods.” There are 7 Industrial parcels in the watershed, accounting for 132 total acres (1.2 percent of total land area). Industrial land uses are primarily located along Route 104 between Lake Avenue and Pound Road in the Town of Williamson.

Commercial: Commercial land uses are defined by NYSORPS as “properties used for the sale goods or services.” There are 97 commercially classified parcels in the watershed, with an average parcel size of 3 acres. Commercial properties occupy approximately 287 acres, or 2.5 percent of the watershed’s total land area. The majority of commercial parcels are concentrated along Route 104 in the Town and Hamlet of Williamson.

Recreation and Entertainment: Recreation & Entertainment land uses are defined by NYSORPS as “properties used by groups for recreation, amusement, or entertainment.” There are 7 parcels classified in the watershed under this land use category. All are located in the Town of Williamson. Recreation & Entertainment land use accounts for 167 acres, or 1.5 percent, of the total land area in the watershed, with an average parcel size of 23.8 acres. Parcels in this category are primarily situated along the lakefront, on Salmon Creek Road, on Pound Road, and at various locations along Route 104.

Community Services: Community Service land uses are defined by NYSORPS as “properties used for the well being of the community.” There are 29 Community Service parcels occupying a total of 223 acres, or 1.8 percent of the total land area of the watershed. Community Service parcels include schools and the Williamson Town Hall and library. The majority of Community Service parcels are located south of Route 104 in the Town of Williamson.

Public Services: Public Service land uses are defined by NYSORPS as “properties used to provide services to the general public.” There are 14 Public Service parcels in the watershed on a total of 53 acres. This land use category represents the smallest land use within the watershed, accounting for only 0.45 percent of the total land area.

Recreational Uses: The Williamson Town Park, which is owned and maintained by the Town of Williamson, is located to the west of and directly behind Williamson Central School. Established in 2001, it is a passive/active recreation park which currently offers a pond and fishing platform, several picnic shelters, a band shell, walking/hiking trails, 4 baseball diamonds, 6 bathrooms, 2 soccer fields, a volleyball court, and a bocce court. If funds can be raised, future improvements include a paved main parking lot, lighting, fenced-in basketball courts, a multi-purpose field, a concession stand, press box, and an all season enclosed shelter.

Historic Resources

Historical buildings and sites can be found throughout the Salmon Creek watershed, with concentrations of historic structures in the hamlets of Pultneyville and Williamson.
The Pultneyville Historic District, located along Lake Road and Jay Street in Pultneyville hamlet, includes the original hamlet that was laid out in 1806. The Pultneyville Historical Society Museum is located within the historic district and features displays of local artifacts and archives. The museum is open during the summer on Saturday and Sunday. One of the most recognized historic structures in the Town is Gates Hall. Gates Hall was built in 1825 as the Union Church and has served as a church, meeting hall, and community playhouse since that time. In 1967 it was designated as the second oldest little theatre in the United States by the Library of Congress. It has since been listed on the New York State and National Registers of Historic Places.

A more detailed description of the Salmon Creek Watershed can be found in **APPENDIX I**.

III. WATERSHED CONDITIONS

Water Quality Standards

NYSDEC documented the quality of the water in Salmon Creek in 2007. The Upper Salmon Creek and Tributaries are Class C, and the Lower Salmon Creek is Class B. Since this project focuses principally on phosphorous, the applicable water quality standard for total phosphorus is presented in the table below.

Parameter	Standard
Phosphorus (and Nitrogen) – Classes B and C	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.

The report also states that aquatic life in Salmon Creek may experience minor impacts/threats due to unidentified stressors. A 2001 macroinvertebrate assessment indicated moderately impacted water quality conditions. The sample collected indicated that the impacts were the result of toxic inputs. They further stated that these impacts need to be verified with more sampling due to poor sampling conditions in 2001. That additional sampling has not been done.

The Salmon Creek is currently categorized as a Class C stream. This is defined by NYSDEC as: "*The best usage of Class C waters is fishing. These waters shall be suitable for fish, shellfish and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.*"

Fisherman with Typical Fall Catch in Salmon Creek

The US Environmental Protection Agency has established a phosphorus water quality standard for flowing streams/rivers entering lakes at 50 µg/L (or 0.050 mg/L) and 100 µg/L (or 0.10 mg/L) for all other streams/rivers.

Wisconsin has established a phosphorus water quality standard for flowing streams/rivers entering lakes at 75 µg/L (or 0.075 mg/L) and 100 µg/L (or 0.10 mg/L) for all other streams/rivers.

Recent work in New York State by A.J. Smith, et.al. (see references) suggests a threshold for nutrient impairment in flowing waters is the boundary between mesotrophic and eutrophic condition in a stream. This translates to approximately 65 µg/L (or 0.065 mg/L) for phosphorus.

<u>Current Watershed Endpoint:</u> The monitoring data collected by CEI and SUNY Brockport indicated that the average concentration of total phosphorus leaving the Salmon Creek watershed is 261 µg/L (or 0.261 mg/L). This is the average concentration measured during the monitoring conducted on Salmon Creek in 2010 and 2011.

<u>Desired Watershed Endpoint:</u> CEI decided to use a value of 65 µg/L (or 0.065 mg/L) for phosphorus as the desired watershed endpoint. Compared to existing conditions of 261 µg/L, meeting this endpoint would require a reduction in phosphorus concentration of approximately 196 µg/L or a 75% reduction.

Monitoring Data

CEI has been involved with water quality issues in the near-shore waters of Lake Ontario since 2002. During that time CEI has worked with SUNY Brockport to monitor phosphorus concentrations in selected tributaries to the lake and the near-shore areas at those discharge points. The two figures below summarize that data and give a comparison of the phosphorus contamination associated with the Salmon Creek Watershed in relation to other streams/rivers along New York's Lake Ontario coast.

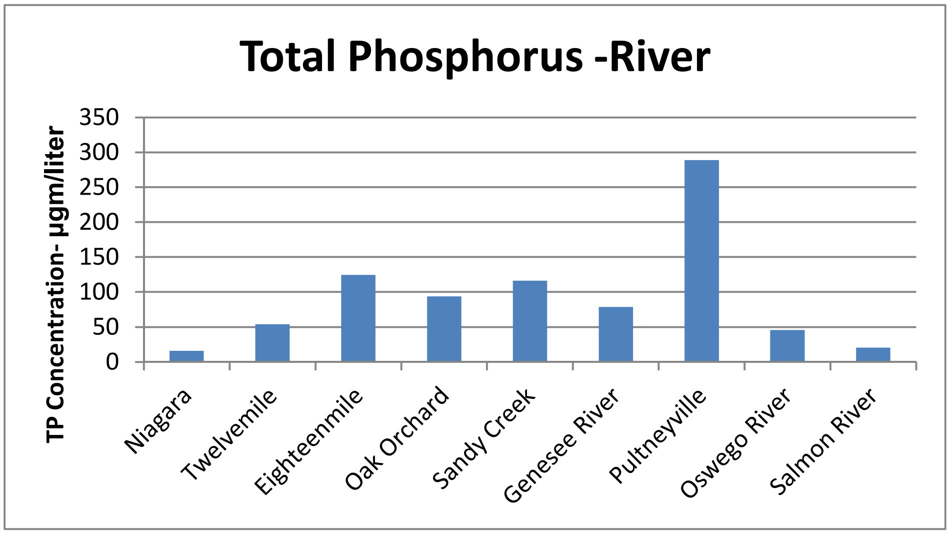


Figure 1: Total Phosphorus in Selected Tributaries, 2006 – 2009

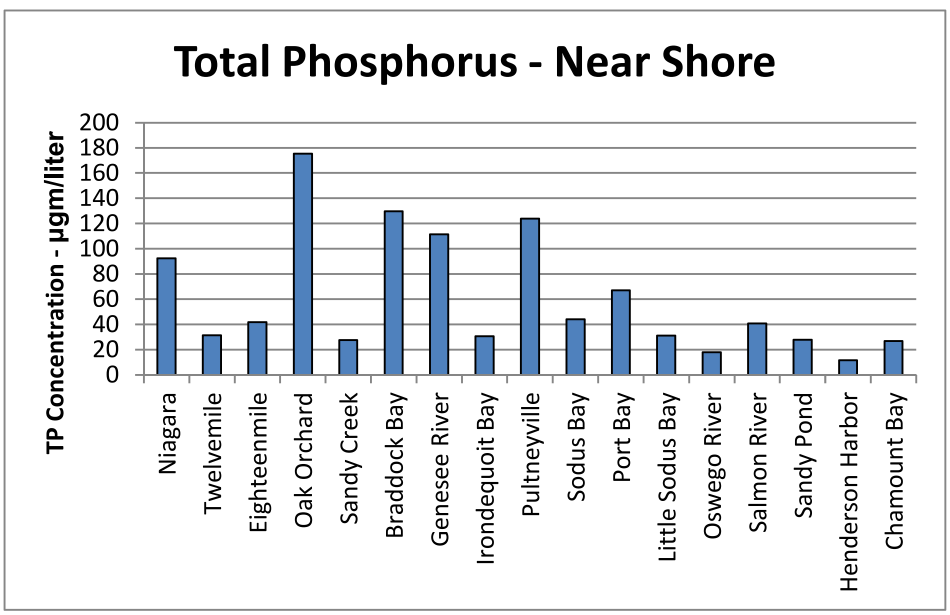
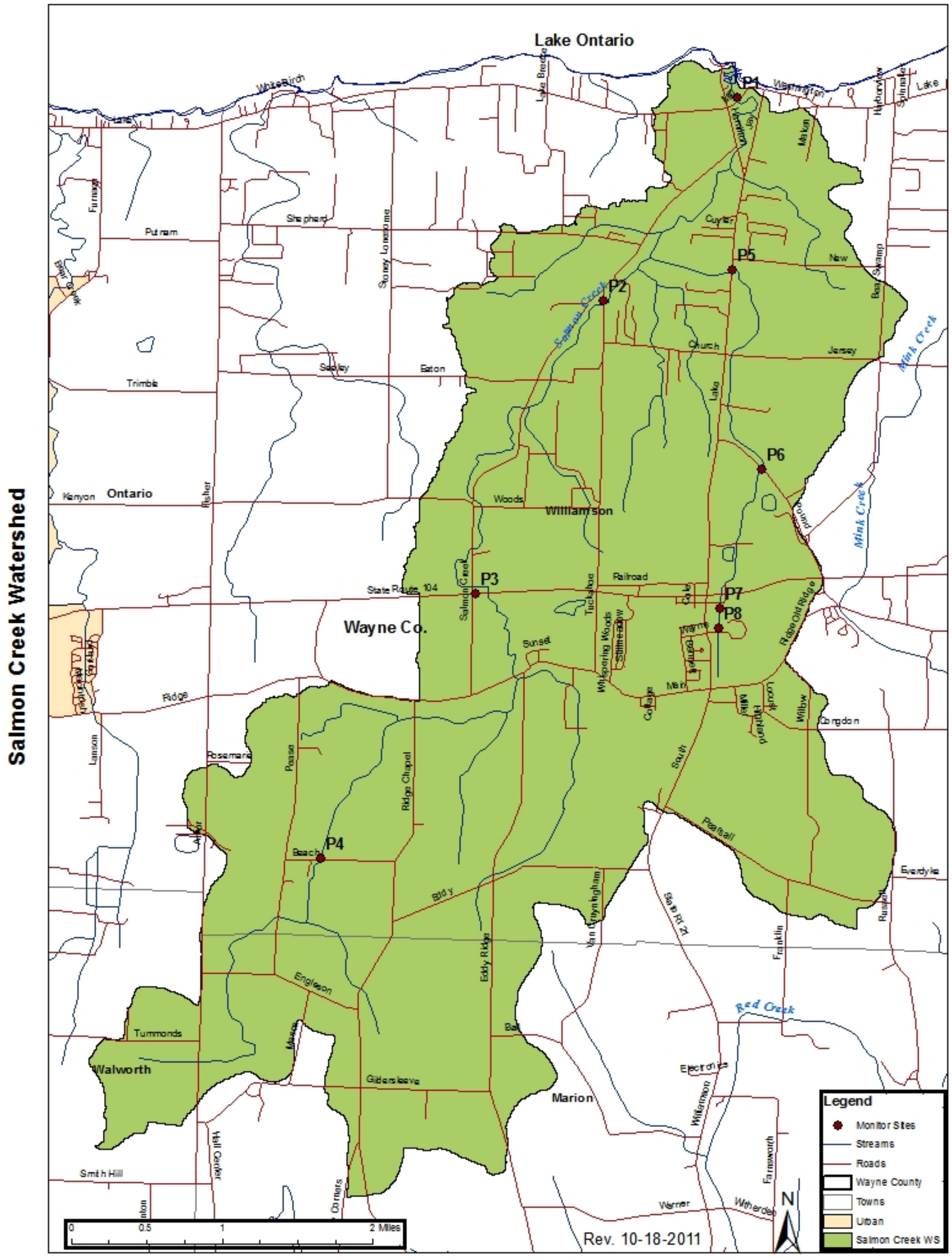


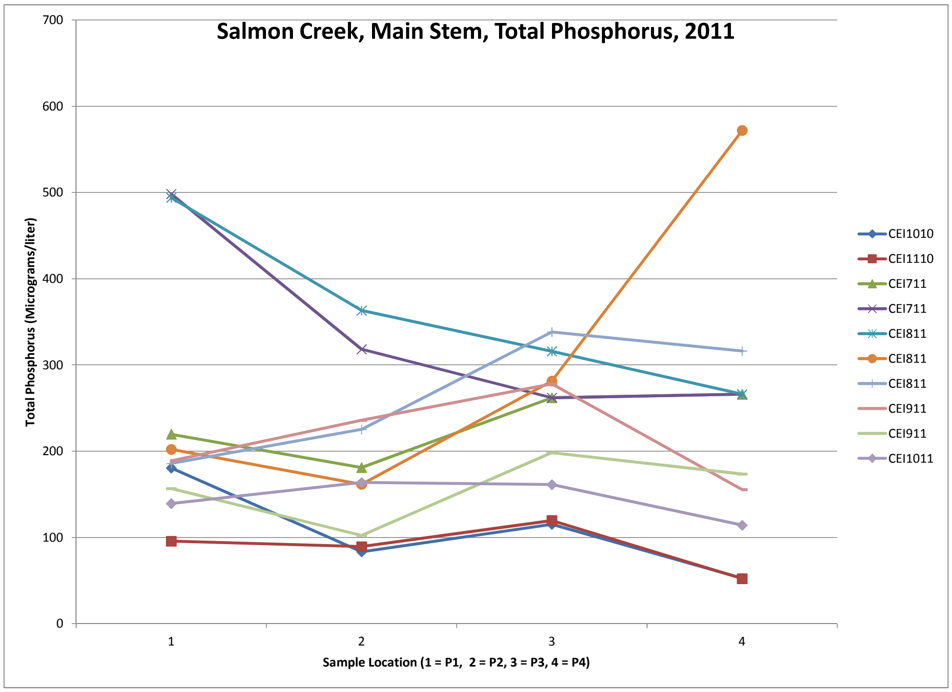
Figure 2: Total Phosphorus in Nearshore Waters, 2006 - 2009

Both the 2010 and 2011 projects funded the collection of samples in this watershed to better characterize the phosphorus contamination in Salmon Creek at key locations. Samples were taken at the eight locations shown in the map below.

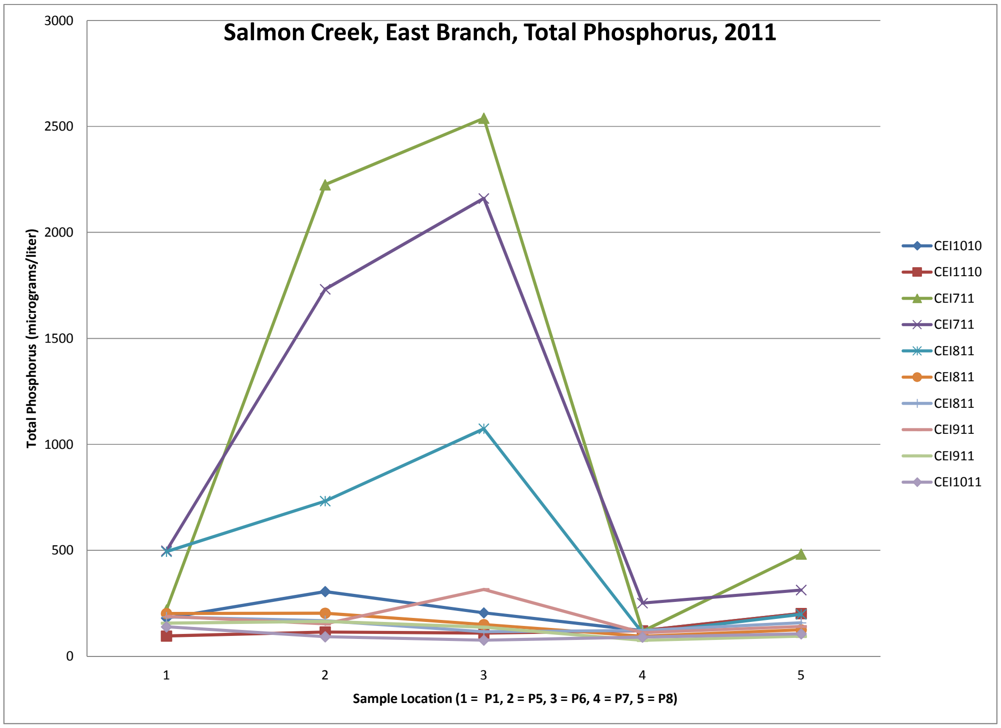


Salmon Creek Watershed Map with Stream Sampling Locations

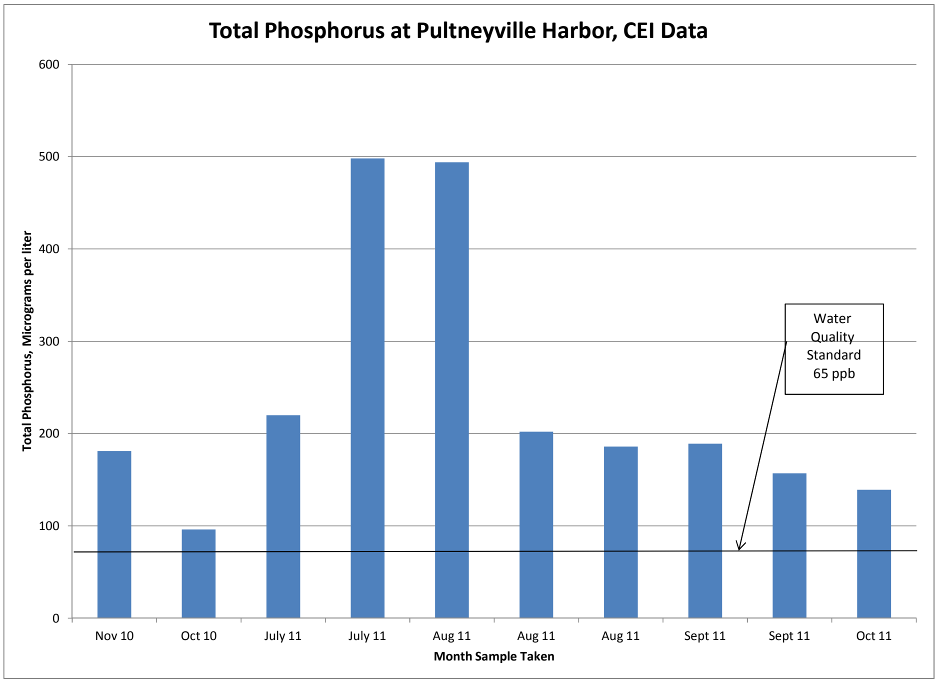
Phosphorus Water Quality Data: The tables below summarize some of the pertinent total phosphorus data collected in 2011.



NOTE: The Sample Location numbers in the graph above correspond to the sample locations on the map above as indicated on the x-axis. Sample point "P1" is at the endpoint of Salmon Creek at Pultneyville Harbor. Sample point "P4" is the furthest upstream point sampled on the Main Stem.



NOTE: The Sample Location numbers in the graph above correspond to the sample locations on the map above as indicated on the x-axis. Sample point “P1” is at the endpoint of Salmon Creek at Pultneyville Harbor. Sample point “P8” is the furthest upstream point sampled on the East Branch.

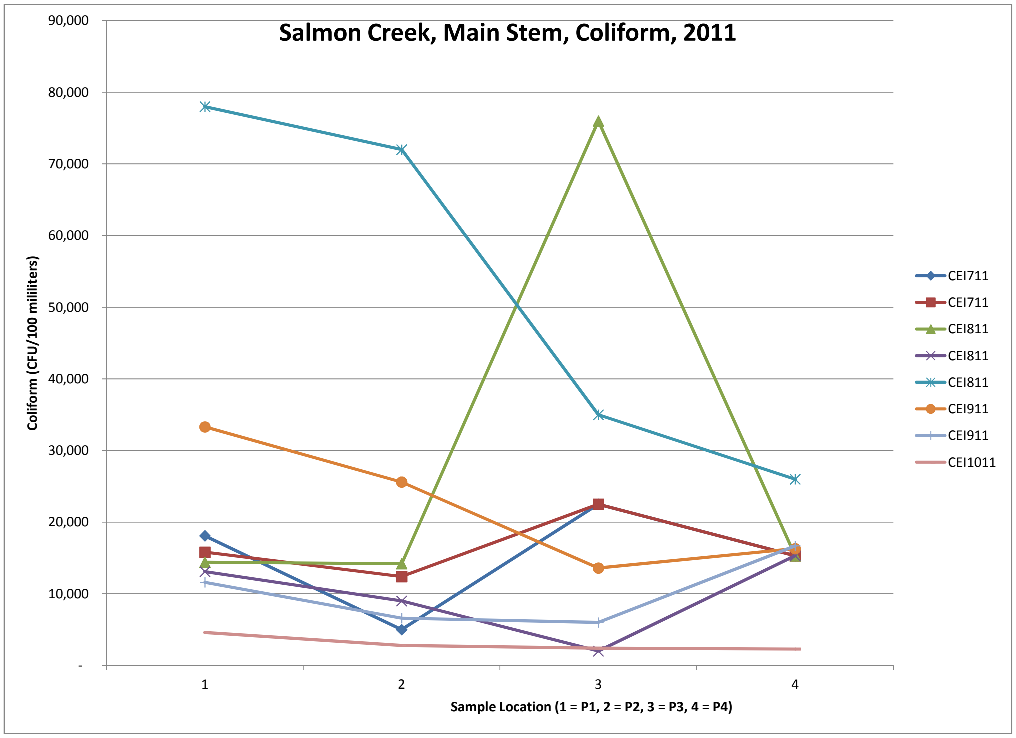


Details of all the data collected by CEI in 2010 and 2011 can be found in **APPENDIX III**.

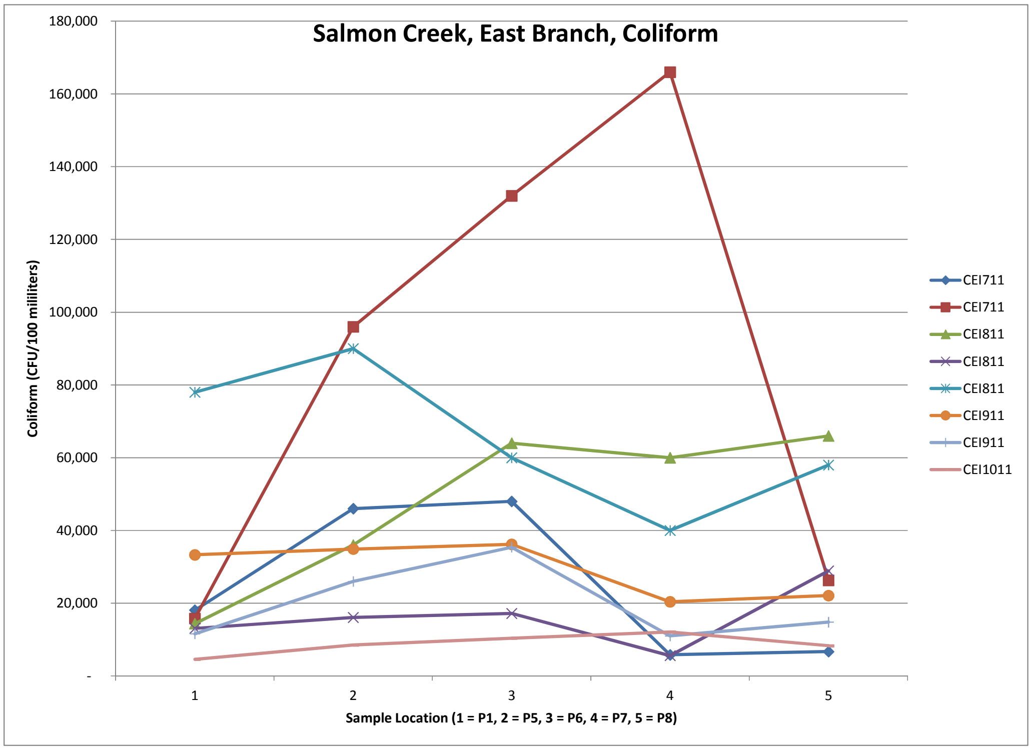
Phosphorus in Salmon Creek – A closer examination of the phosphorus water quality data provided in the previous section of this report supports the following conclusions:

1. Salmon Creek has a highest total phosphorus concentration of all the major tributaries to Lake Ontario;
2. The near-shore water at Pultneyville Harbor has a total phosphorus concentration among the highest on Lake Ontario; and
3. The two main branches of the Salmon Creek show highly variable total phosphorus concentrations with the east branch show higher concentrations than the west branch.

Bacteria Data: The tables below summarize some of the pertinent coliform data collected.

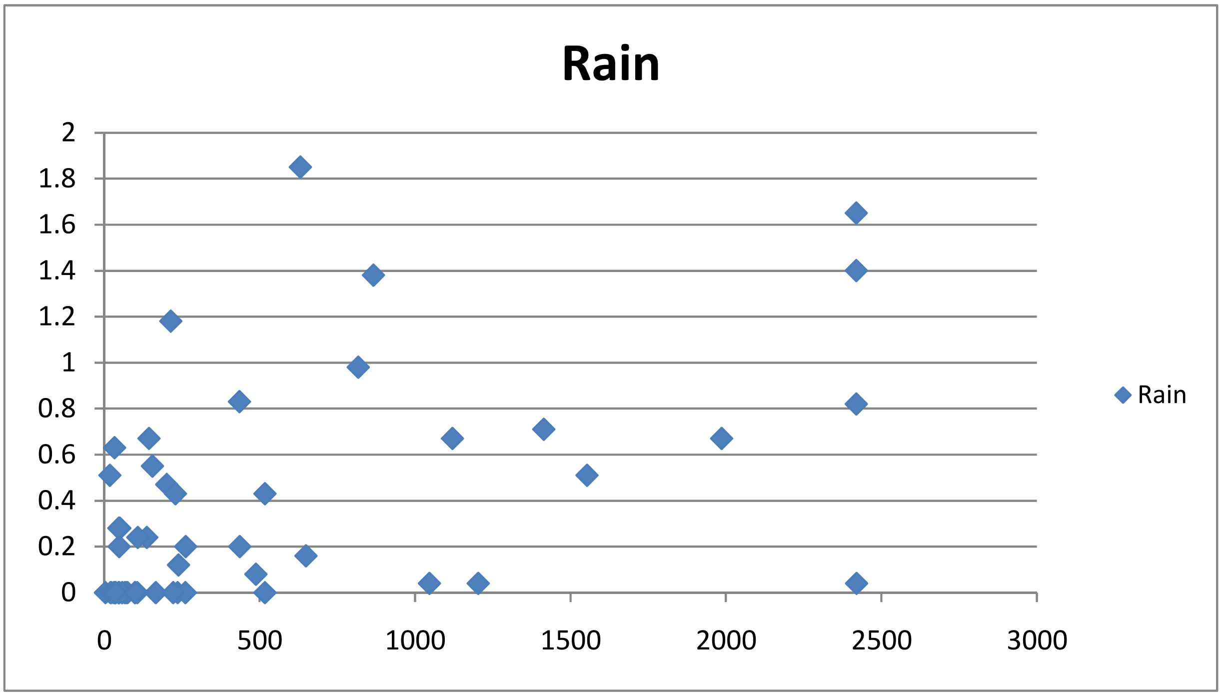


NOTE: The Sample Location numbers in the graph above correspond to the sample locations on the map above as indicated on the x-axis. Sample point "P1" is at the endpoint of Salmon Creek at Pultneyville Harbor. Sample point "P4" is the furthest upstream point sampled on the Main Stem.



NOTE: The Sample Location numbers in the graph above correspond to the sample locations on the map above as indicated on the x-axis. Sample point "P1" is at the endpoint of Salmon Creek at Pultneyville Harbor. Sample point "P8" is the furthest upstream point sampled on the East Branch.

Beach Closing and Rainfall Data – Rainfall data for Pultneyville was obtained from a resident who has been recording meteorological data for several years. The data obtained from the NYS DOH for coliform counts at Pultneyville Beach was compared with the rainfall data. The graph below plots inches of rain versus coliform levels.



Coliform versus Rainfall for Pultneyville Beach, (Inches of Rain) **2008 - 2010**

A closer look at the data indicates that during this period from 2008 through 2010 the following observations can be made:

1. 55 E-coli samples were taken
2. 32 were associated with a rain event up to two days prior
3. 22 of those 32 showed E-coli over 235 #/100ml (Level above which beaches are closed.)

The analysis indicates that there is a positive relationship between rainfall events and bacterial conditions leading to beach closings.

Beach closings

Data was obtained from the NYS Department of Health Regional Office in Geneva that characterizes the coliform bacteria levels at the Pultneyville Beach from 2004 through 2010. That data, summarized below, highlights the days that the E-coli exceeded the allowable level of 235/100ml.

Date	E-coli	Date	E-coli	Date	E-coli	Date	E-coli	Date	E-coli	Date	E-coli	Date	E-coli
6/15/2004	27	6/8/2005	9	6/12/2006	9	5/22/2007	10	6/2/2008	48	6/1/2009	1203	6/7/2010	631
7/6/2004	202	6/23/2005	199	6/26/2006	1553	6/11/2007	20	6/9/2008	2420	6/4/2009	75	6/14/2010	214
7/12/2004	24	7/7/2005	54	6/29/2006	921	6/18/2007	10	6/11/2008	144	6/8/2009	222	6/21/2010	236
6/26/2004	86	7/18/2005	365	7/5/2006	146	6/25/2007	60	6/16/2008	649	6/15/2009	48	6/28/2010	1553
8/9/2004	62	7/20/2005	649	7/10/2006	36	7/2/2007	10	6/19/2008	239	6/22/2009	2419	6/29/2010	866
8/25/2004	48	7/25/2005	411	7/17/2006	236	7/9/2007	10	6/24/2008	262	6/24/2009	37	7/6/2010	4
		7/26/2005	2420	7/20/2006	105	7/16/2007	100	6/26/2008	23	6/29/2009	137	7/12/2010	99
		7/28/2005	135	7/24/2006	105	7/23/2007	10	7/1/2008	1120	7/6/2009	71	7/19/2010	261
		8/1/2005	127	7/31/2006	115	7/25/2007	250	7/7/2008	31	7/13/2009	1986	7/21/2010	57
		8/23/2005	35	8/7/2006	192	7/30/2007	170	7/14/2008	229	7/15/2009	36	7/26/2010	435
				8/14/2006	96	8/6/2007	30	7/21/2008	817	7/20/2009	46	7/28/2010	166
				8/21/2006	219	8/13/2007	700	7/23/2008	108	7/27/2009	33	8/2/2010	20
				8/28/2006	365	8/15/2007	280	7/28/2008	47	8/3/2009	517	8/9/2010	488
				8/31/2006	93	8/20/2007	120	8/4/2008	106	8/6/2009	517	8/11/2010	1414
						8/27/2007	160	8/11/2008	18	8/10/2009	2419	8/16/2010	1046
								8/18/2008	35	8/12/2009	201	8/18/2010	47
								8/25/2008	436	8/18/2009	58	8/24/2010	2419
								8/27/2008	99	8/24/2009	155	8/30/2010	66
										8/31/2009	50		

Pultneyville Beach Bacteria Levels

A 2010 Natural Resources Defense Council report Testing the Waters 2009 identified Pultneyville Beach as one of the Lake Ontario beaches with the highest rate of exceeding the bacterial standards for bathing beeches. .

IV. Pollutant Source Assessment

Non-point sources

Animal Concentrations: Only one concentration of farm animals was identified within this watershed though animal waste from outside the watershed may be spread in this watershed. The operation is bounded by Kenyon Road, Stony Lonesome Road, Seeley Eaton Road and Salmon Creek Road and is immediately adjacent to the Salmon Creek. CEI estimated that 245 cows are located in this watershed. Actual animal counts were not available at the time of this report.

Land Application Nutrients: Nutrients (phosphorus and nitrogen) are applied to the land in various parts of this watershed. There are many acres of farmland that apply nutrients in a variety of ways. Some applications are of commercial fertilizers, some are of manure from dairy operations and some are by-product solids associated with a local food processing operation.

Data was available from NYSDEC on the amount of by-product solids applied by the local food processing plant based upon data from 2007, 2008 and 2010 it was estimated that 3.5 million gallons per year of solids are applied to various plots of land within the watershed. Data was available on the amount of phosphorus in those solids indicates that they contain an average of 24,500 milligrams of phosphorus per kilogram of solids. Using this information CEI calculated that 8,700 pounds of phosphorus were applied to this watershed from this source each year.

Four Ponds: There are four man-made ponds north of railroad tracks in the Town of Williamson. No information was found to describe what the ponds were used for or what is in them. The Salmon Creek flows in between two of the ponds.

Septic Systems: The number and relative effectiveness of residential wastewater treatment (septic) systems within a watershed can have a significant impact on groundwater and or/surface water quality. Effective septic systems sited too near waterbodies can leach nutrients and pathogens directly into the waterbody before they can be sequestered or treated in the soil. And it has been shown that the effluent from a malfunctioning system can be informally conducted ("short circuited') much closer to or directly into a water body. The *MapShed* model utilizes information on the estimated septic system population and various failure modes in its calculations.

CEI estimated the number of people served by septic systems in the Salmon Creek watershed by taking the most recent census tract data with information on household wastewater systems (1990 census) and proportionally clipping it down to the watershed boundaries. This yielded a population served by septic systems to be 1,443 people.

Following methodology of earlier studies conducted by CEI for the NYSDEC, CEI projects that a total of 276 people (19%) in the Salmon Creek watershed use septic systems that are substandard. This overall percentage is similar to that reported from surveys in other states.

Understanding the likely failure modes is also important. The *MapShed* model provides for the following categories of substandard septic systems: direct discharge (i.e., piped directly to surface waters), short-circuiting (i.e., close proximity to surface/ground waters not allowing full treatment), and ponding (i.e. discharge to ground surface). Based on previous TMDL studies in NY, and utilizing its best judgment and understanding of the watershed, CEI estimated the breakdown of septic system conditions below.

Condition	Number of People Served	Percent of Total
Normal	1,167	81
Ponded	41	2.9
Short Circuited	229	15.8
Direct Discharge	6	0.3
TOTAL:	1,443	100

Marina Practices in Pultneyville Harbor: There are many marina management practices that could influence water quality in Pultneyville Harbor. They include solid and fish waste management, liquid material management, petroleum control, boat cleaning, sewage management and boat operation. The NOAA and EPA sponsor a *Clean Marina Initiative* that could help the Pultneyville Mariners Club and Pultneyville Yacht Club reduce the impact of their activities.

Point Sources

One NYS-permitted point source was identified in this watershed. This plant runs year-round and has a NYS SPDES permitted wastewater treatment plant designed to primarily remove BOD and solids. The permit also shows collection of stormwater on-site that is discharged directly into Salmon Creek. Phosphorus does not appear on their permit to discharge as is the case with most wastewater treatment plants in New York State.

Based upon this lack of phosphorus data and the results of the stream monitoring that shows a significant increase in the concentration of phosphorus after the discharge from the plant it was decided to estimate the phosphorus loading from their operation. Their permit file indicates that they add approximately 14,900 gallons of Ammonium Phosphate to their wastewater treatment plant as a nutrient for the microorganisms. Based upon the fraction of phosphorus associated with this material they add approximately 40,000 pounds per year of phosphorus to their wastewater treatment plant. Assuming that 70% of that phosphorus is absorbed by the microorganisms and the plant flow is permitted at 0.5 million gallons per day, the effluent concentration of phosphorus was estimated to be 3.5 parts per million. This is consistent with other work CEI has done for the NYSDEC on estimating phosphorus loads from industrial wastewater treatment plants.

Other Waste Sites

Hazardous Waste Disposal Sites: According the NYS DEC Environmental Site Remediation Database, there are no active hazardous waste disposal sites located in the Salmon Creek watershed area.

Hazardous Waste Spills: According the NYS DEC Environmental Site Remediation Database, there have been no major spills in the last three years. However, there have been several spills of a relatively minor nature. Table 3 summarizes the spills reported to DEC in 2008, 2009 and 2010.

TABLE 3: DEC SPILL INCIDENTS
Salmon Creek Watershed

Spill Date	Material Spilled	Amount	Resource Affected	Date Spill Closed
3/13/08	Ammonia	164 lbs.	Air	3/13/08
6/6/08	Transformer oil	2 gallons	Soil	7/11/08
7/16/08	#2 fuel oil	Unknown	Soil	10/28/08
5/7/09	#2 fuel oil	1 gallon	Soil	6/16/10
6/5/09	Gasoline	1 gallon	Impervious surface	6/5/09
6/25/09	Algae	Unknown	Surface water	7/2/09
8/15/09	Wastewater	Unknown	Surface water	8/17/09
11/16/09	Hydraulic oil	Unknown	Soil, impervious surface	6/16/10

Landfill Sites: The former Town landfill along Pound Road was closed in 1990 in accordance with DEC Part 360 regulations. This landfill accepted municipal solid waste for several years before it was capped in 1990 and groundwater monitoring sites established. The Town conducts monitoring of the site as required by DEC. The landfill site is inactive, but the property is registered as a weekly drop-off for municipal solid waste and recycling.

The landfill is at the eastern edge of the watershed. The gradient of groundwater flow is north. Based upon the location of the landfill and the water quality data collected this does not seem to be a significant source of contamination of the creek.

Brownfield Sites: According the NYS DEC Environmental Site Remediation Database, there are no Brownfield sites within the Salmon Creek Watershed.

V. POLLUTANT LOADS AND WATER QUALITY

Models provide an approach for estimating loads, providing source load estimates, and evaluating various management alternatives. A model is a set of equations that can be used to describe the natural or man-made processes in a watershed system, such as runoff or stream transport. By building these cause-and-effect relationships, models can be used to forecast or estimate future conditions that might occur under various conditions. Models can be highly sophisticated, including many specific processes such as detailed descriptions of infiltration and evapotranspiration. Models can also be very generalized, such as a simple empirical relationship that estimates the amount of runoff based on precipitation. Some models are available as software packages, whereas simple models or equations can be applied with a calculator or spreadsheet. Compared to the simple approaches models add more detailed procedures that represent the separate processes of rainfall, erosion, loading, transport, and management practices. By separately addressing each process, models can be adapted to local conditions, and the simulation can be made more sensitive to land use activities and management changes.

When considering model inputs, nonpoint sources are a significant contributor to water quality impacts in New York State. Nonpoint sources typically account for as much as 90% of the major sources contributing to water quality impacts for rivers and streams. There is an increasing focus on efforts to develop tools and methods to identify and quantify nonpoint source pollutant loads. While long-term surface water monitoring is the most effective technique for determining the extent and magnitude of nonpoint source pollutant loading, resource constraints have prompted the development of other techniques, such as computer-based simulation models, to supplement monitoring efforts. Water quality models are frequently used for assessing pollutant loading.

<u>Model Selection:</u> It is important to maintain a proper compatibility between model complexity and data availability and knowledge. For example, a more complex watershed model, with a distributed spatial resolution and mechanistic representation of hydrological processes, would likely require more detailed data on flow, land use, topography, and physical characteristics of the sub-basins compared to a simpler, lumped model. Similarly, a receiving water model with a high level of mechanistic complexity should be supported by adequate spatial and temporal water quality, flow, and loading data to allow for defensible model parameterization. In the absence of comprehensive data, a simpler, or less mechanistic, model may be more appropriate. This type of model would focus on the known processes and make use of available data and local knowledge to the fullest extent possible.

Establishing the relationship between watershed source loading and in-stream water quality is a critical component of Watershed Action Plan (WAP) development. It allows for the evaluation of management options that can achieve the desired source load reductions. This link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. This project used a linked watershed-water quality model. The following criteria were used for model selection:

- Level of complexity and compatibility with available data;
- Ability to meet all modeling objectives;
- User-friendliness;

- Track record and acceptance in the scientific and engineering communities; and
- Availability of model(s) and model source code.

For the watershed runoff, the model must be able to simulate the loading and delivery of phosphorus from the target watersheds. Watershed loadings are closely tied to hydrology and land use practices, therefore, adequate hydrological representation must be included in the model. Explicit assessment of watershed pollutant sources will also be required. The ability to adequately delineate the watersheds spatially will be an important screening criterion. A model that can incorporate the impacts of urban, rural, and agricultural practices in the watershed is also desirable.

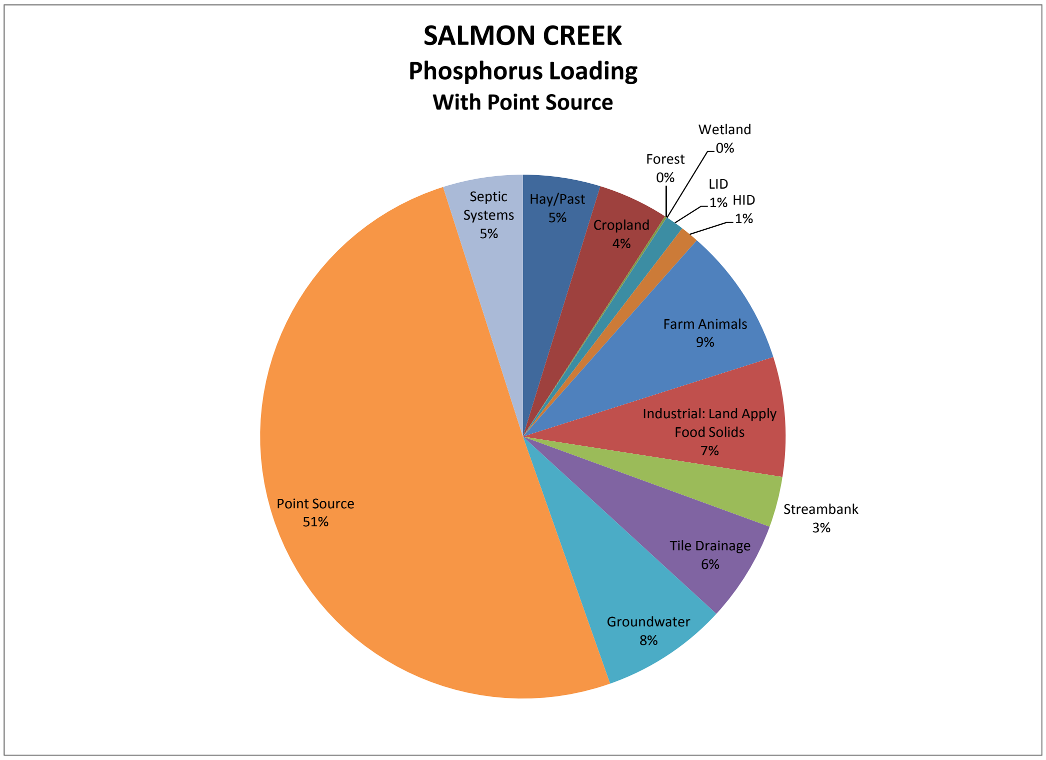
Ease of use of the model(s) will be an important screening criterion. Since the model will be used for WAP analyses that will be presented to the public for comment, a visually appealing model with easily edited inputs and illustrative output capabilities is preferable. Compatibility with GIS software is also desired. The selected model should have a proven track record and be accepted by EPA and the scientific community. Public domain models with open source code are desirable.

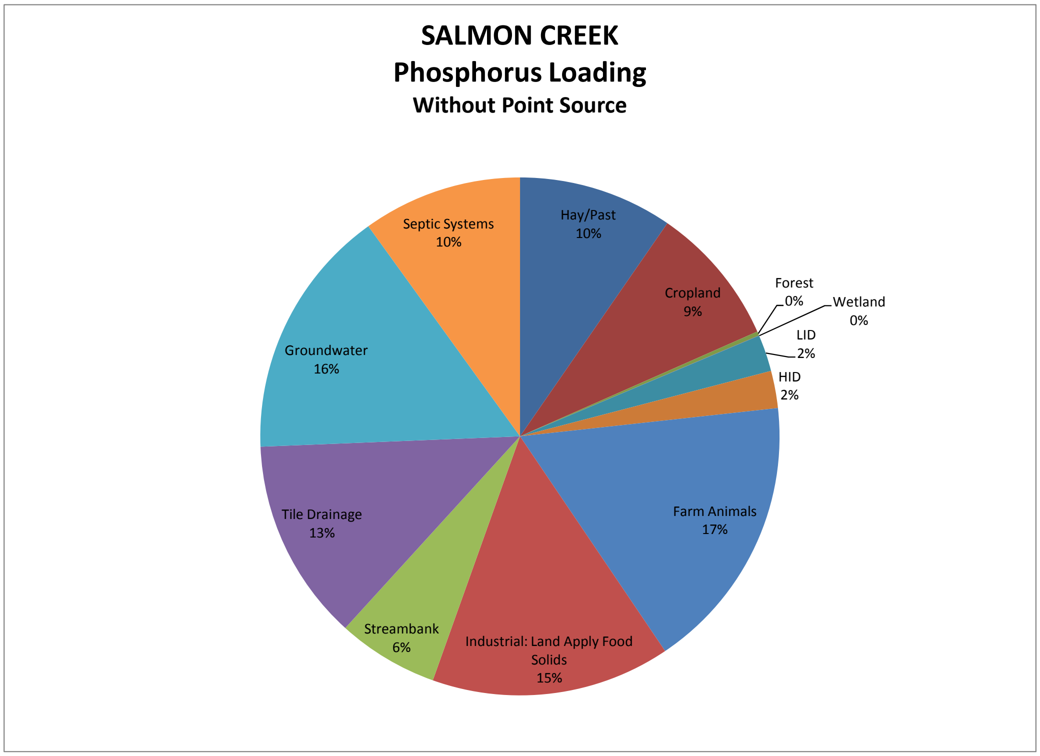
CEI has extensive experience using the *AVGWLF* Version 7.2.3 (ArcView Generalized Watershed Loading Function, http://www.avgwlf.psu.edu/) for a two-year water quality project for NYSDEC in 2010 and 2011. However, during the later part of 2011, CEI worked with Penn State University to switch over to using their *MapShed* model for this project (http://www.mapshed.psu.edu/). The description below was taken from this site.

> For more than a decade, Dr. Barry Evans and his group at PSIEE have been improving *AVGWLF*. To extend the utility of this software, a major revision was recently undertaken to move the tool from a commercial GIS software package to a free one called MapWindow (see www.mapwindow.org). It is believed that this new software, called *MapShed*, will expand the use of this type of modeling tool to a much larger number of users, many of whom do not have the means to purchase the commercial GIS software needed for *AVGWLF*. In addition to the GIS platform upgrade, numerous analytical tools have been enhanced to provide additional modeling capabilities such as the simulation of pathogen loads, better simulation of pollutant transport processes in urban settings, and improved assessment of the effects of best management practice (BMP) implementation on pollutant load reduction.
>
> Like *AVGWLF*, *MapShed* is a customized GIS interface that is used to create input data for an enhanced version of the GWLF watershed model originally developed at Cornell University. In utilizing this interface, the user is prompted to identify required GIS files and to provide other information related to “non-spatial” model parameters. This information is subsequently used to derive values for required model input parameters which are then written to the input file needed for model execution. Also accessed through the interface is regional climate data stored in Excel-formatted files that is used to create the necessary “weather” input file for a given watershed simulation. With *MapShed*, a user selects areas of interest, creates model input files, runs the simulations model, and views the output in a series of seamless steps.

Modeling Approach: CEI built a *MapShed* model for the Salmon Creek watershed. The table below summarizes the results of the baseline run of the model. It identifies aggregate sources of phosphorus in the Salmon Creek watershed and their approximated contribution to the whole watershed phosphorus load.

Major Source Category	Sub-Category	Current Phosphorus Load	Percent of Total Current Load
		(Pounds /year)	(%)
Agriculture	Hay/Pasture	488	4.8
	Cropland	444	4.3
	Tile Drainage	640	6.2
	Farm Animals	878	8.6
Forest/Other	Streambank	320	3.1
	Wetlands	1	0.0
	Groundwater	797	7.8
	Forest	13	0.1
Industrial	Land Apply Food Solids	756	7.4
Wastewater	WWTP at food processor	5,170	50.5
Urban Stormwater	LID*	116	1.1
	HID**	118	1.2
Septic Systems	Septic Systems	504	4.9
	TOTAL:	**10,245**	100.0
*	Low Intensity Development		
**	High Intensity Development		


SALMON CREEK
Phosphorus Loading
With Point Source
Wetland
0%
Forest
0%
LID
1%
HID
1%
Septic
Systems
5%
Hay/Past
5%
Cropland
4%
Farm Animals
9%
Industrial: Land Apply
Food Solids
7%
Streambank
3%
Tile Drainage
6%
Groundwater
8%
Point Source
51%



<u>Sources of Bacteria</u> : US Geological Survey research (www.glsc.usgs.gov) has established that algal mats can harbor high concentrations of bacteria and pathogens. These mats become a source of bacteria because they are a suitable habitat for bacteria and pathogens to persist and grow. These mats in turn can impact recreational beach water quality. Consultation with SUNY Brockport and Monroe County Health Department on this issue reinforced this association. CEI used the results of the computer modeling and estimates of fecal matter from water fowl to establish the sources of bacteria that contribute to beach closings during the swimming season in Pultneyville Harbor. The results of those estimates are provided below.

- Bacteria transported *from the watershed* into the Harbor (30%)
- Bacteria *from geese and gulls* in the Harbor (20%)
- Bacteria *algal mats* in the Harbor (20%)
- Bacteria *from marine practices* in the Harbor (30%)

Our computer modeling determined the relative contribution of various sources to the total bacteria load *from the watershed* into the Harbor. This modeling demonstrated that 53% is associated with farm animals, 40% is associated with land application of food processing plant's by-product solids; and 7% is associated with septic systems. The implementation of the BMPs identified below to reduce **Elevated Phosphorus** in the watershed will reduce the amount of bacteria transported *from the watershed* by 80% since they come from the same source.

The following BMPs have been identified as feasible ways to reduce bacteria levels in Pultneyville Harbor:

> *Marine Practices in Pultneyville Harbor:* There are many marina management practices that could influence water quality in Pultneyville Harbor. They include solid and fish waste management, liquid material management, petroleum control, boat cleaning, sewage management and boat operation. The NOAA and EPA sponsor a Clean Marina Initiative that could help the Pultneyville Mariners Club and Pultneyville Yacht Club.
>
> *Waterfowl Populations:* The Pultneyville Harbor sees its share of geese and gulls and has a resident population of several hundred birds. Research has found that several techniques have been successfully applied to manage waterfowl (particularly geese) populations. Those techniques include:

- Habitat Modification – Reduce the food supply, the sense of security for geese, the ability of geese to move easily between land and water, the available nesting sites, and provide alternate foraging areas.
- Public Education – Help general public understand that feeding the birds attracts them.
- Egg Addling – Oil, shake, puncture or replace eggs. Requires a federal permit.
- Chemical Lawn Treatments – Use repellents to make grass unpalatable to geese.
- Exclusion – Create barriers to prevent geese from moving quickly between water and land so they feel less inclined to stay there.
- Hazing and Harassment – Use border collies to consistently and persistently haze birds into thinking the area is dangerous.
- Scare Devices – Use devices that emit loud and abrupt sounds that mimic predators.

VI. WATERSHED GOALS

The findings of this watershed characterization and action plan point to two related water quality impairments that warrant further attention:

1. Beach closings due to high levels of bacteria washed into the Harbor during rain events; and
2. Elevated phosphorus levels in Salmon Creek that contribute to unwanted growth of algae in Pultneyville Harbor;

Objectives

Based upon these findings the Salmon Creek Watershed Coordinating Committee has adopted the Objectives listed below.

Objective	Indicators
No beach closings due to bacteria	• Beach closings • Bacteria load reductions
Stream water quality supports intended uses as described by Class C categorization.	• Total phosphorus in stream • Phosphorus load reductions
Less algae growth in Pultneyville Harbor	• Total phosphorus in stream • Phosphorus load reductions

Targets

The monitoring data collected by CEI and SUNY Brockport indicated that the average concentration of total phosphorus leaving the Salmon Creek watershed is 261 µg/L (or 0.261 mg/L). This is the average concentration measured during the monitoring conducted on Salmon Creek in 2010 and 2011.

CEI decided to use a value of 65 µg/L (or 0.065 mg/L) for phosphorus as the desired watershed endpoint. Compared to existing conditions of 261 µg/L, meeting this endpoint would require a reduction in phosphorus concentration of approximately 196 µg/L or a 75% reduction.

Objective	Target
No beach closings due to bacteria	Reduce beach closings to less than 5% by 2020
Stream water quality supports intended uses as described by Class C categorization.	Reduce phosphorus loading to stream by 75% by 2020
Less algae growth in Pultneyville Harbor	No algae blooms in Harbor by 2022

VII. MANAGEMENT STRATEGIES

The next step in the process of developing this Watershed Action Plan is to assess how the loading patterns shown in the *Baseline* modeling run (Page 43) would change as various management and control measures were applied.

The steps used to develop and evaluate phosphorus reduction scenarios are described below. Generally, the *MapShed* model was used to evaluate the implementation of both rural and urban pollution reduction strategies at the watershed level. Various scenarios in which current landscape conditions and pollutant loads (both point and non-point) were compared against future conditions were created. Those scenarios reflect the use of different pollution reduction strategies such as agricultural and urban best management practices (BMPs), stream protection activities, the repair of septic systems, and upgrading of treatment plants from primary to secondary to tertiary. A simple cost-accounting approach was used to estimate their associated costs.

> *Step 1 – Select Sub-Category*: Select a Sub-Category from complete list for evaluation
>
> *Step 2 – Evaluate BMPs:* Review applicable BMPs and select appropriate ones
>
> *Step 3 – Modify Model Inputs:* Establish modifications to *MapShed* model to simulate impact of BMPs
>
> *Step 4 – Repeat Steps 1-3:* Repeat Steps 1 through 3 until all applicable BMPs have been identified
>
> *Step 5 – Run Model:* Modify inputs to *MapShed* model to predict impact on load
>
> *Step 6 – Calculate Costs:* Apply cost factors and calculate cost effectiveness (Dollars per pound of phosphorus reduction)

BMPs are structural and non-structural approaches used to reduce pollutant loads in watersheds draining both urban and rural areas. When considering options for BMP implementation, it is often useful to know how effective such BMPs might be in terms of reducing various types of pollutants such as sediment, bacteria, nitrogen, and phosphorus. There are a very wide range of BMPs that could potentially be employed, as well as a wide range of associated costs and inherent pollutant reduction efficiencies. At the farm scale, it is critical that the most cost-effective BMP be implemented to address the pollutant(s) of concern at specific geographic locations given the marginal economies of this industry. Conversely, when addressing general water quality concerns within a watershed, it is not as important to identify specific BMPs for implementation at exact locations (at least at the planning stage). However, it is very useful to have a good sense of whether or not general types of BMPs would be potentially beneficial in reducing pollutant loads within a watershed in which non-point source pollutants are of primary concern.

Most of the pollutant reduction effectiveness information discussed below was obtained from the documentation of Penn State Institutes of Energy and the Environment's *PRedICT* model. This model was originally going to be used to evaluate scenarios but the software did not work as described in the documentation. Subsequent discussions with Penn State led CEI to scrap the use of *PRedICT* for this purpose. CEI did however use the pollutant reduction efficiencies to evaluate scenarios as described later. These values essentially reflect the average values for the individual BMPs that comprise each BMP option. Consideration was also given to the BMP efficiencies provided by the Chesapeake Bay Program.

As with the reduction efficiency values, the costs associated with implementing the various individual BMPs in *PRedICT* were drawn from several sources. The primary one used, however, was the *Conservation Catalog* prepared by the Pennsylvania Conservation Partnership (2000). In addition to a description of various agricultural conservation practices currently used in Pennsylvania, the publication also has average costs for these practices at the time the document was written. These costs were assumed to be generally equivalent to New York. Overall costs have likely escalated in 10 years since the referenced costs were derived. Consideration was also given to the BMP costs provided by the Chesapeake Bay Program.

The five-year costs associated with initial BMP implementation and construction are considered; long-term operational and maintenance costs are not included. In calculating the cost for any given BMP system, the separate costs for each individual BMP are calculated and subsequently summed according to the set of individual BMPs comprising each system.

NOTE: The numbers after some of the BMPs below, such as BMP1, are the designations assigned by the *MapShed* model and *PRedICT.*

CEI used values for nutrient reduction efficiencies provided in the PRedICT documentation for each of the wastewater alternatives described above. These values are based on information provided in various wastewater technology textbooks. While these values are believed to be reasonable estimates, they are still only approximate since wastewater treatment technology can vary widely, and must be revised based on local treatment plant characteristics.

Table 2 summarizes all of the BMPs considered in development of the improvement scenarios discussed in this section. Many of the BMPs listed in the Agriculture Category are applicable to several Sub-Categories but are only listed once under the most appropriate Sub-Category.

Table 2: Summary of Best Management Practices (BMPs)

Category	Subcategory	BMP	Effectiveness
Agriculture	Cropland	Vegetative buffer strips	52%
		Contour farming / strip cropping (BMP3)	40%
		Cover crops (BMP1)	36%
		Crop rotation (BMP1)	36%
		Crop residue management (BMP2)	38%
		Streambank stablization	95%
		Nutrient management (BMP6)	28%
		Terraces and diversions (BMP8)	42%
	Cropland/Hay/Pasture	Ag land retirement to wetland (BMP5)	98%
		Ag land retirement to forest (BMP4)	94%
	Hay/Pasture	Streambank fencing	78%
		Grazing land management (BMP7)	34%
	Tile Drainage	Nutrient management (BMP6)	28%
	Farm Animals	AWMS Livestock (confined area)	75%
		AWMS Runoff control (confined area)	15%
		AWMS Karst Soils	Unknown
		Alternative manure use - composting	70%
		Alternative manure use - ADG to electricity	70%
		Manure incorporation in soil	25%
		Manure injection in soil	50%
		Precision Feed Management	35%
Forest/Other	Forest	Tree planting	Unknown
Wastewater	Point Sources	WWTP - Secondary to tertiary treatment	60%
		WWTP - Primary to secondary treatment	10%
		WWTP - Primary to tertiary treatment	60%
Urban Stormwater	LID/HID	Stormwater management practices	75%
		Bioretention area	61%
		Detention basin (urban)	61%
		Constructed wetland (urban)	51%
Septic Systems	Septic Systems	Inspection/Monitoring	5%
		Septic system repairs	80%
		Upgrade septic systems to tertiary treatment	60%
		Connect septic to sewer w/secondary treatment	10%
			:CEI Assumption

Improvement Scenarios

This section describes the phosphorus reduction scenarios considered to attain the water quality endpoint of 65 µg/L (or 0.065 mg/L) using the first four steps of the six-step process outlined previously. Those steps are:

> *Step 1 – Select Sub-Category*: Select a Sub-Category from complete list for evaluation
> *Step 2 – Evaluate BMPs:* Review applicable BMPs and select appropriate ones
> *Step 3 – Modify Model Inputs:* Establish modifications to AVGWLF model to simulate impact of BMPs
> *Step 4 – Repeat Steps 1-3:* Repeat Steps 1 through 3 until all applicable BMPs have been identified

The AVGWLF model has a limited number of inputs that the user can change to simulate different scenarios. When testing scenarios CEI often had to change a model input parameter that simulated the anticipated effect of applying a particular BMP rather than changing a more "obvious" parameter. The discussion in this section provides the rationale for each BMP considered (*Step 2 – Evaluate BMPs*).

AGRICULTURE SOURCE CATEGORY

Cropland/Hay/Pasture – Related BMPs: The BMPs listed in the table below were evaluated as options in scenario development.

BMP	Scenario Considerations
Vegetative buffer strip	Increase in application of this practice.
Nutrient Management (BMP6)	Increase in application of this practice.
Wetland Reserve	Increase the portion of the stream flow that passes through wetlands.
Ag Land Retirement	Reduce the amount of land used for agriculture.

Farm Animal-Related BMPs: The BMPs listed in the table below were evaluated as options in scenario development.

BMP	Scenario Considerations
AWMS livestock	Have the one facility with significant number of farm animals implement this practice.
AWMS runoff control	Have the one facility with significant number of farm animals implement this practice.
Alternative Manure Use - composting	This technology could treat the manure managed in confined areas and transfer it to land outside of the watershed.
Precision Feed Management	This practice can reduce phosphorus loading by managing the phosphorus content of farm animal feed.
Manure incorporation /injection in soil	This practice reduces phosphorus the surface runoff

FOREST AND OTHER LAND SOURCE CATEGORY

The BMPs were evaluated as options in scenario development:

WASTEWATER SOURCE CATEGORY

The BMP listed in the table below was evaluated as an option in scenario development. There is some uncertainty associated with this BMP. The information available about the phosphorus concentration in the effluent from the food processing facility was limited. Therefore it was estimated to be 3.5 part per million as discussed in this report.

BMP	Scenario Considerations
Upgrade WWTP at food processing plant	Improve phosphorus removal in WWTP to achieve an 80% reduction in phosphorus loading using anoxic/oxic operation of their activated sludge wastewater treatment plant with alum addition.
Pollution Prevention at food processing plant	Apply source reduction BMPs to achieve a 70% reduction in phosphorus loading.

URBAN STORMWATER SOURCE CATEGORY

No stormwater management practice (SWMP) BMPs other than development of a Stormwater Management Plan were evaluated further as options in scenario development due to the low contribution to the overall watershed phosphorus load from urban areas.

SEPTIC SYSTEMS SOURCE CATEGORY

The BMPs listed in the table below were evaluated in scenario development.

BMP	Rationale
Inspection/Monitoring of septic systems	Implementing a program over 5 – 10 years could reduce the number of non-working systems.
Repair of failed septic systems	Restore the 19% failing systems to proper working order over a five year period.

Improvement Scenario Summary

The collective inputs discussed above were inputted in the AVGWLF model *(Step 5 – Run Model)* to determine the overall reduction in phosphorus loads. The Table 4 below summarizes the estimated results of implementing all of the improvement scenarios described in this section of the report.

Table 4: Improvement Scenario Results, Salmon Creek

			Reduction
Category	**Subcategory**	**BMP**	(pounds/year)
Agriculture	Cropland	Vegetative buffer strips	57
		Wetland Reserve	303
		Nutrient management (BMP6)	505
	Cropland/Hay/Pasture	Ag land retirement	88
	Hay/Pasture	None	
	Farm Animals	AWMS Livestock (confined area)	36
		AWMS Runoff control (confined area)	180
		Alternative manure use - composting	541
		Manure incorporation/injection in soil	198
		Precision Feed Management	271
Forest/Other	Forest	None	
Industrial	Food processor solids	Alternative solids mgmt. at food processor	763
Wastewater	Point Sources	WWTP upgrades at food processing plant	4,657
		Pollution Prevention at food processing plant	3,500
Urban Stormwater	LID/HID	Stormwater management practices	10
Septic Systems	Septic Systems	Inspection/Monitoring	50
		Septic system repairs	404
		Connect septic to sewer w/secondary treatment	504

Cost Effectiveness of Improvement Scenarios

Using the output from the model simulation of the scenarios discussed in the previous section, each BMP was assigned a quantity of phosphorus reduction as shown in the table below. The costs associated with the reduction in phosphorus loads were calculated along with the cost-effectiveness of each one.

The non-shaded BMPs in the Table 5 were considered further for implementation because they represent the most cost-effective and lowest cost options *(Step 6 – Calculate Costs).*

Table 5: Salmon Creek, Cost-Effectiveness of Selected Best Management Practices

					CURRENT			SCENARIOS						
Subcategory	Permitted Source BMPs	Unit Cost to Set Up	Annual Unit Cost to Maintain	Units (per year)	Available Units	Current Level of Implementation	Units	Scenario	Units	Total Cost to Set Up	Total Cost to Maintain 5 Years	Total Five Year Cost	Phosphorus Reduced	$/pound of Phosphorus Reduced
Point Source	Pollution Prevention at food processing plant	50,000	5,000	$/plant	1	0	Plant	1		$ 50,000	$ 25,000	$ 75,000	3,500	21
Industrial	Compost food processing plant solids	500	5	$/cow	242	0	Cows	242	Cows	$ 121,000	6,050	$ 127,050	763	167
Point Source	Increase Phosphorus Removal at WWTP	2,400,000	660,000	$/plant	1	0	Plant	1		$ 2,400,000	$ 3,300,000	$ 5,700,000	4,657	1,224
	Non-Point Source BMPs													
Cropland	AWMS Runoff control (confined area)	35,000	350	S/farm	1	0	Farms	1	Farm	$ 35,000	$ 1,750	$ 36,750	180	204
Farm Animals	Alternative Manure Use - composting	500	5	$/cow	245	0	Cows	245	Cows	$ 122,500	$ 6,125	$ 128,625	541	238
Cropland	Nutrient management (BMP6)	25	5	$/acre	5,459	0	Acres	2,500	Acres	$ 62,500	$ 62,500	$ 125,000	505	248
Farm Animals	Precision Feed Management	30,000	10,000	$/farm	1	0	Farms	1	Farm	$ 30,000	$ 50,000	$ 80,000	271	295
Cropland	Vegetative buffer strips	1,500	605	$/mile	14	0	Miles	5	Miles	$ 7,500	$ 15,125	$ 22,625	57	397
Septic Systems	Septic system repairs	1,850	50	$/household	555	0	Households	105	Households	$ 194,250	$ 26,250	$ 220,500	404	546
Cropland/Hay/Pasture	Wetland Reserve	80	8	$/acre	11,528	1,730	Acres	1,730	Acres	$ 138,400	69,200	$ 207,600	303	685
Farm Animals	Manure incorporation/injection in soil	100,000	8,000	$/Farm	1	0	Farms	1	Farm	$ 100,000	$ 40,000	$ 140,000	198	707
Septic Systems	Connect septic to sewer w/secondary treatment	15,000	0	$/household	555	0	Households	100	Households	$ 1,500,000	0	$ 1,500,000	504	2,976
Septic Systems	Inspection/Monitoring	100	50	$/household	555	0	Households	555	Households	$ 55,500	$ 138,750	$ 194,250	50	3,885
Farm Animals	AWMS Livestock (confined area)	200,000	4,000	S/farm	1	0	Farms	1	Farm	$ 200,000	$ 20,000	$ 220,000	36	6,111
Urban Stormwater	Stormwater Management Plans	100	5	$/acre	1,117	0	Acres	500	Acres	$ 50,000	$ 12,500	$ 62,500	10	6,250
Cropland/Hay/Pasture	Ag land retirement	8,000	0	$/acre	6,680	0	Acres	668	Acres	$ 5,344,000	0	$ 5,344,000	88	60,727

VIII. IMPLEMENTATION

Beach Closings: The results of this evaluation identified the sources of bacteria that contribute to beach closings during the swimming season in Pultneyville Harbor to be

- Bacteria transported *from the watershed* into the Harbor (30%);
- Bacteria *from geese and gulls* in the Harbor (20%);
- Bacteria *algal mats* in the Harbor (20%); and
- Bacteria *from marine practices* in the Harbor (30%).

Computer modeling was used to determine the relative contribution of various sources to the total bacteria load *from the watershed* into the Harbor. This modeling demonstrated that 53% is associated with farm animals, 40% is associated with land application of food processing plant's by-product solids; and 7% is associated with septic systems. The implementation of the BMPs identified below to reduce **Elevated Phosphorus** by 80% in the watershed will also reduce the amount of bacteria transported *from the watershed* by 80% since they come from the same source.

An evaluation of a variety of bacterial reduction scenarios resulted in the identification of the following best management practices (BMPs) that should be implemented to reduce the bacterial loads in the Harbor and reduce beach closings due to excessive bacterial levels:

- *Clean Marina Initiative* practices;
- Waterfowl management practices; and
- BMPs within the watershed to reduce phosphorus loads.

Implementing BMPs to reduce phosphorus loads in the watershed will reduce bacterial loads to the Harbor directly but will also reduce them indirectly by their impact on algae growth. Less phosphorus coming into the Harbor from Salmon Creek with reduce the formation of algal mats which are homes for bacteria.

Elevated Phosphorus: Analysis of the relative impact of current phosphorus and bacterial loadings from point and non-point sources demonstrates that 50% of the phosphorus released to this watershed is attributable to a point source (food processing plant's wastewater treatment plant effluent). The remaining portion is distributed evenly between septic systems, farm animals, land application of food processing solids, and agricultural sources.

Due to the magnitude of the impact of the food processing plant operation on phosphorus loadings in Salmon Creek the recommendations have been broken down into two categories:

1. <u>Non-Point Sources:</u> septic systems, farm animals, and cropland; and
2. <u>Permitted Sources:</u> Food processing plant's wastewater treatment plant effluent and land application of solids from that activity.

This breakdown allows the separation of remediation activities into those that are permitted and those that can be independently influenced by the Salmon Creek Watershed Coordinating

Committee. An adaptive management approach will be used that implements the most effective measures first while monitoring the water quality impact to see if more should be done and consideration of impacts associated with reductions in phosphorus loads.

An evaluation of a variety of phosphorus reduction scenarios resulted in the identification of eight best management practices (BMPs) listed below that would result in a reduction of 6,221 pounds of phosphorus per year. These BMPs are estimated to have a five-year cost of approximately $817,000 and would reduce the phosphorus loading sufficient to obtain over 81% of the reduction needed to meet a 65 µg/L endpoint. More than two-thirds of this reduction (4,263 lbs.) would come from the Permitted Sources and the rest (1,958 lbs.) from Non-Point Sources.

Non-Point Sources: The non-point source BMPs listed below will be implemented over the next five years as described in section **VIII. IMPLEMENTATION**.

BMP	Phosphorus Reduction	Five-Year Cost	Effectiveness	Cumulative Reduction
AWMS Runoff Control	180 lb/yr	$37,000	$204/lb. – phosphorus reduced	180 lbs.
Manure Composting	541 lb/yr	$129,000	$238/lb. – phosphorus reduced	721 lbs.
Nutrient Management	505 lb/yr	$125,000	$248/lb. – phosphorus reduced	1,226 lbs.
Precision Feed Management	271 lb/yr	$80,000	$295/lb. – phosphorus reduced	1,497 lbs.
Vegetative Buffer Strips	57 lb/yr	$23,000	$397/lb. – phosphorus reduced	1,554 lbs.
Septic System Repairs	404 lb/yr	$221,000	$546/lb. – phosphorus reduced	1,958 lbs.

Permitted Sources: The permitted source BMPs listed below were recommended for consideration for implementation over the next five years as described in section **VIII. IMPLEMENTATION**.

BMP	Phosphorus Reduction	Five-Year Cost	Effectiveness	Cumulative Reduction
Pollution Prevention at Food Processing Plant	3,500 lb/yr	$75,000	$21/lb. - phosphorus reduced	3,500 lbs.
By-Product Solids Management at Food Processing Plant	763 lb/yr	$127,000	$167/lb. - phosphorus reduced	4,263 lbs.

Schedule of Activities and Milestones

Beach Closings: An evaluation of a variety of bacterial reduction scenarios resulted in the identification of the following best management practices (BMPs) that should be implemented to reduce the bacterial loads in the Harbor and reduce beach closings due to excessive bacterial levels:

- *Clean Marina Initiative* practices;
- Waterfowl management practices; and
- BMPs within the watershed to reduce phosphorus loads.

Implementing BMPs to reduce phosphorus loads in the watershed will reduce bacterial loads to the Harbor directly but will also reduce them indirectly by their impact on algae growth. Less phosphorus coming into the Harbor from Salmon Creek with reduce the formation of algal mats which are homes for bacteria.

The table below details the activities associated with reducing the bacterial loads in Pultneyville Harbor.

Activity	2012	2013	2014	2015	2016
Clean Marina Initiative					
Form Team					
Apply for Funding					
Implement BMPs					
Waterfowl Management					
Investigate Options					
Select Best Option(s)					
Secure Funding					
Implement					

Elevated Phosphorus: As discussed earlier, Salmon Creek the recommendations have been broken down into two categories:

1. Non-Point Sources: septic systems, farm animals, and cropland; and
2. Permitted Sources: Food processing plant's wastewater treatment plant effluent and land application of solids from that activity.

This breakdown allows the separation of remediation activities into those that are permitted and those that can be independently influenced by the Salmon Creek Watershed Coordinating Committee. An adaptive management approach will be used that implements the most effective measures first while monitoring the water quality impact to see if more should be done and consideration of impacts associated with reductions in phosphorus loads.

Non-Point Sources: The table below details the activities associated with reducing the phosphorus loads from the non-point sources described in this report: septic systems, farm animals, and croplands.

Activity	**2012**	**2013**	**2014**	**2015**	**2016**
Select project(s)					
Prepare cost estimate					
Apply for funding					
Secure funding					
Implement project(s)					
Evaluate effectiveness					

Permitted Sources: The table below outlines the potential activities associated with reducing the phosphorus loads from the permitted sources described in this report: Pollution Prevention in food processing plant and land application of by-product solids. Progress on these activities will be the purview of the food processing plant management. The New York State Pollution Prevention Institute has identified the food processing industry as an area of focus for their work. They have state funding to pay for pollution prevention, energy reduction and process improvement assessments for this industry sector. The Salmon Creek Watershed Coordinating Committee will assist the plant personnel in this effort.

Activity	**2012**	**2013**	**2014**	**2015**	**2016**
Conduct Assessment					
Investigate options					
Select best options(s)					
Prepare cost estimate					
Apply for funding					
Secure funding					
Implement project(s)					
Evaluate effectiveness					

Measures of Progress

Category	Measure
Beach Closings	• Number of Clean Marina BMPs implemented • Number of waterfowl deterrent projects implemented • Number of phosphorus reduction projects implemented
Elevated Phosphorus	• Number of projects implemented • Pounds of phosphorus reduced • Total phosphorus in stream at Pultneyville Harbor

Education and Outreach Activities

A public education program focusing on Salmon Creek as an important asset to the area, impairments of that asset, sources of the impairments, and the need for restoration should be undertaken by a group that includes Town leaders, County agencies, stakeholders, and concerned private citizens.

Category	Education/Outreach Activities
Beach Closings	• Website progress reports • Press releases • Community updates
Elevated Phosphorus	• Watershed signs • Public meetings on progress • Articles in Newsletters • Water quality education in schools

Monitoring Approach and Evaluation Framework

As stated earlier, the application of the more practical BMPs above will not result in the watershed meeting the water quality endpoint. Every effort will be made to conduct a disciplined implementation of BMPs to begin the process of meeting the desired water quality endpoint.

An adaptive management approach will be used by the Salmon Creek Watershed Coordinating Committee that implements the most cost-effective measures first while monitoring the water quality impact to see if more should be done.

Water quality sampling will be conducted in a manner that provides sufficient date to evaluate the effectiveness of the implementation of phosphorus and bacterial load reduction projects. The sampling will be conducted each year and will involve at least 6 sets of samples in the stream at Pultneyville Harbor and 2 sets of screening samples at all 8 sampling sites. This will be coordinated by the Wayne County Soil and Water Conservation District.

<u>Other Considerations:</u> Because the majority of the Salmon Creek watershed falls within the Town of Williamson, Williamson’s “home rule” powers of land use regulation can play a major role in the restoration of Salmon Creek’s water quality. In particular, the Town’s zoning

regulations should include setbacks for development activities near streams and stipulate erosion control and stormwater management practices consistent with NYS regulations.

The Town's management of existing infrastructure of roads, sewer and water and their expansion can play an important role in achieving water quality improvements. An active program of monitoring and repairing private wastewater treatment (septic) facilities is also within the purview of the Town's powers.

Expertise to guide the restoration of Salmon Creek's water quality exists within Wayne County agencies already tasked with environmental improvements, including the Soil and Water Conservation District, the Planning Department, Cornell Cooperative Extension, and the Regional Office of the NYS Department of Health.

New York State programs developed by the Departments of State (Coastal Management), Agriculture and Markets (AEM), Environmental Conservation and Health could also supply both expertise and funding.

If classified as an impaired stream on the 303(d) list, the Salmon Creek watershed would become eligible for further study, development of formal remediation strategies, and funding to assist in carrying these strategies into action. Though NYS lacks a numeric standard for Total Phosphorus concentrations in stream water, Salmon Creek far exceeds the various standards under consideration for adoption as that standard, which ranges from 20 to 100 ppb. In addition, the recent listing of Lake Ontario's coastline as impaired due to excessive nutrients, especially phosphorus points to the influence watershed sources of phosphorus such as Salmon Creek Remediation of Lake Ontario's coastal waters will necessitate remediation of watershed sources such as Salmon Creek.

Lists of Best Management Practices exist for activities such as development and agriculture. This report makes recommendations for the deployment of specific best management practices to address sources of excessive bacterial growth, sediment generation and transport, and excessive nutrient concentrations impacting Salmon Creek. Implementation of these best management practices will require the cooperation of municipal leaders, county and state agencies, and private citizens living and working in the Salmon Creek watershed. BMPs are not without costs, and special funding will need to be found and dedicated to their implementation, to both defray upfront costs and to demonstrate their effectiveness as integrated with other activities.

An ongoing water quality monitoring program for Salmon Creek will be necessary to guide implementation, track water quality changes affected by the implementation of best management practices and to apply adaptive management principles, especially targeting of resources, to the process.

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Septic Systems

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Phosphorus Removal

1. *Estimation of Costs of Phosphorus Removal in Wastewater Treatment Facilities: Adaptation of Existing Facilities*, Water Policy Working Paper #2005-011, F. Jiang, et. al., February 2005
2. *Technologies to Remove Phosphorus from Wastewater,* P. Strom, Rutgers University, August 2006

Water Quality Data

1. *Characterization of Eight Watersheds of Wayne County, New York, 2010 - 2011*, SUNY Brockport, J. Makarewicz, et. al., July 2011

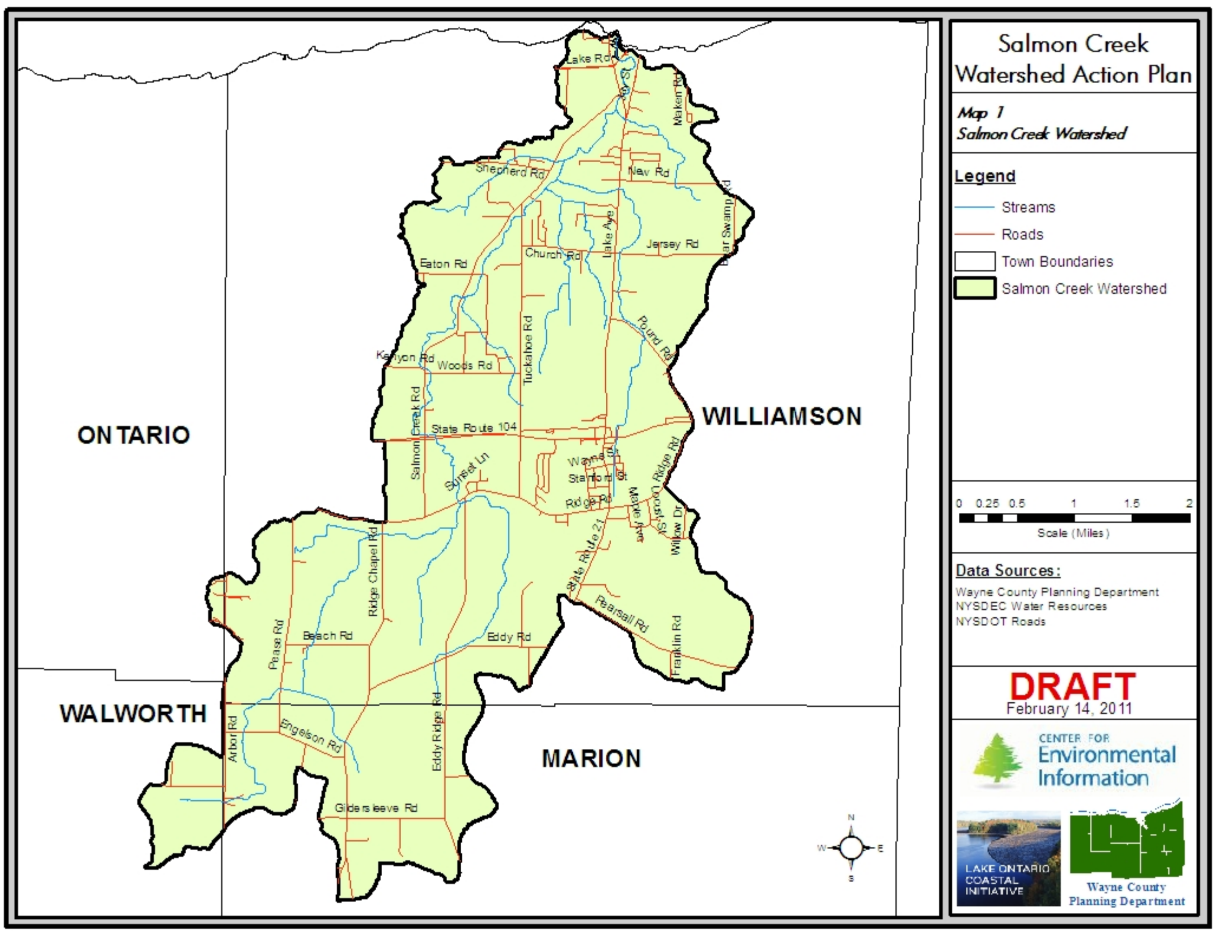
APPENDIX I: WATERSHED DESCRIPTION DETAILS

Natural Features and Boundaries

Lake Ontario is the most prominent natural feature in the Salmon Creek Watershed, with the shoreline comprising its northern-most boundary. In addition to Lake Ontario, approximately 90 small, unnamed lakes and ponds are also located within the watershed boundary.

Watersheds are delineated using a nationwide system based on surface hydrologic features. Developed by the U.S. Geological Survey (USGS), hydrologic unit boundaries (HUC) provide a hierarchical method for delineating and identifying drainage basins to ensure a working, seamless dataset across community lines. Each watershed is assigned a unique hydrologic unit code according to its size and location, with the larger 8-digit sub-basins (e.g., the Irondequoit-Ninemile watershed) subdivided into smaller 11-digit subwatersheds (e.g., the Salmon Creek subwatershed).

The Salmon Creek Watershed is located in the HUC – 8 classified Irondequoit-Ninemile Watershed, which drains directly into Lake Ontario. This watershed is further divided into eight HUC-11 watersheds, one of which is the Salmon Creek watershed.



Floodplains: The Federal Emergency Management Agency (FEMA) maintains digital mapping records of floodplains for all of the United States. According to FEMA's Flood Insurance Rate Mapping, approximately 491 acres of floodplains are located along the entire length of Salmon Creek. With the exception of a small area located just south of Gildersleeve Road in the Town of Marion, all 100 year floodplain areas are located in the Town of Williamson.

Floodplains provide a number of communal benefits and, as experience has shown, can be far more effective than many man-made structures (e.g., floodwalls, stream channelization, etc.) in reducing downstream flood peaks. First, floodplains provide flood and erosion control by storing and slowly releasing floodwaters, thus reducing the depth and velocity of flooding. Floodplain vegetation can also positively impact water quality, trapping sediments and capturing pollutants before they are carried off downstream. Floodplains also provide groundwater recharge by storing floodwaters and promoting aquifer infiltration.

Wetlands: The New York State Department of Environmental Conservation (NYSDEC) identifies and regulates all freshwater wetlands greater than 12.4 acres in size. The U.S. Fish and Wildlife Service also maps wetland areas through the National Wetlands Inventory (NWI). The National Wetlands Inventory identifies all wetlands, regardless of size and regulatory status, based on a combination of the interpretation of aerial photography and on-the-ground surveys. Given the difference in identification methodologies, significant overlap can occur between those wetlands identified by the NYSDEC and those identified by the NWI. Based on data provided by the NYSDEC, there are 532 acres of state regulated wetlands in the Salmon Creek Watershed. NWI data indicates there are 875 acres of federally regulated wetlands within the watershed. Many of the federal wetlands overlap state wetlands.

In addition to providing food and habitat for a wide range of plant and animal species, wetlands contribute significantly to water quality. By impeding drainage flow from developed land, wetlands can filter out pollutant and sediment-laden run-off before it enters streams, thus improving water quality. Riparian wetlands located along streams and rivers also provide valuable flood protection, acting as storage basins and reducing the amount of downstream flow. This temporary storage of water results in decreased runoff velocities, reduced flood peaks, and delayed distribution of storm flows, all which cause tributaries and main channels to peak at different times. In some instances it has been found that wetlands provide more cost-effective flood control than man-made measures such as reservoirs or dikes.

Topography

While the topography of the Salmon Creek watershed is predominately gently rolling to flat, areas comprising steeper slopes do occur, particularly in areas along Salmon Creek and its associated tributaries. The northern portion of the watershed is located in an area commonly known as the lake plains and is generally flat. The terrain becomes gently rolling as you move south, with drumlins appearing in and near the watershed area located in the Town of Marion.

Climate

The climate of the Salmon Creek watershed in the Town of Williamson, Wayne County is classified as humid continental with cool summers. The region is marked by a highly variable climate and the possibility of rapid, frequent and extreme weather changes. A weather station located at Sodus Center, about seven miles distant collects weather data for the area.

Average annual precipitation is 36.41 inches and about 50% falls during the growing season. Precipitation is well distributed through the months and adequate for most crops on most soils. In the late fall and winter, snow squalls (lake effect) are frequent and snowfall can be heavy. Average seasonal snowfall is 88 inches. Because winter precipitation often arrives as snow and ice stored in the watershed, there is often a strong pulse of runoff to the lake in the early spring of each year.

Areas of the watershed closest to the lake, such as the hamlet of Pultneyville, are buffered by the lake water temperature, especially during the summer months.

Actual annual evapotranspiration is measured as 21.5 inches per year, with most occurring between June and September.

Rare Species and Ecological Communities: CEI applied to the New York Natural Heritage Program for an assessment of the presence of species or communities in the Salmon Creek watershed that would require special care if actions were pursued to affect the water quality of the Salmon Creek watershed area or its immediate vicinity. NYNHP warns, “The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions.”

NYNHP Information Services provider Tara Salerno identified two species of concern as being located in the Salmon Creek watershed area:

3. Podilymbus podiceps, or Pied-bill Grebe, whose NYS status is S3B,S1N- Vulnerable. Its Global Rank is G-5- Secure. The Pied-bill Grebe was noted in the vicinity of the watershed but not in it. The Pied-bill Grebe may breed in New York but rarely winters here.
4. Notropis heterodon, or Blackchin Shiner, whose NYS status is S1- Critically Imperiled. Its Global Rank is G-5- Secure. The Blackchin Shiner was last seen in Salmon Creek in 1939. It is a small stream fish, one of about fifty in the Family Cyprinidae that occur in New York.

Any actions carried out in the watershed as a result of this report would need to address impacts on these species of concern in applications for permits.

Soils

A mantle of glacial till (material detached, transported, processed and deposited by glaciers) averaging forty feet in thickness covers the Ordovician and Silurian bedrock of the watershed area. The most recent glacial period (Wisconsin Stage 65,000 – 11,500 years ago) featured many advances and retreats of the ice in response to global climate. Most of the modern soil has developed in the intervening time.

The four dominant mineral soil associations of the Salmon Creek watershed are (from north to south):

- Williamson-Elnora-Collamer, deep, moderately well-drained, medium and coarse textured soils found on lake plains;
- Appleton-Lockport, deep and moderately deep, somewhat poorly drained, moderately fine and medium textured soils found on glacial till plains;
- Madrid-Bombay, deep, well drained and moderately well-drained, moderately coarse textured soils found on glacial till plains; and
- Ontario-Hilton, deep, moderately well drained and well drained, medium textured soils found on glacial till plains.

Glacially caused soil features include kames, eskers, terraces and outwash plains made of coarser sediments transported by, washed out and sorted by the glaciers. Most of the Salmon Creek watershed is covered by soils deposited in the waters of the glacial Lake Iroquois that covered the area for hundreds of thousands of years during the last glacial retreat.

Drumlins are common just south of the Salmon Creek watershed, and several drumlins form the high points delineating the south end of the watershed and separating the Salmon Creek watershed from Red Creek.a tributary of Ganargua Creek and the Barge Canal.

The beach ridge formed on the edge of Lake Iroquois bisects the Salmon Creek watershed. Salmon Creek breaks through this ridge near the intersection of Ridge and Eddy Ridge Road. Water flowing into Lake Iroquois from the south deposited deltas of silts and fine sands. The swamps (wooded wetlands) that exist in the Salmon Creek watershed are often remnants of former glacial lakes and arms of Lake Iroquois. They contain organic deposits mapped as “muck “soils.

Bedrock: The nearly horizontal bedrock that appears in the Salmon Creek watershed is sedimentary in nature and originated in the seas of the Ordovician and Silurian Ages. The Salmon Creek watershed sits atop four bands of bedrock, each of several miles extent north to south.

At the lakeshore, Salmon Creek runs over Medina and Queenston shale (Ordovician). Sodus shale underlies the area immediately north of NYS Rte. 104. South of 104, there is band of Rochester shale, and the watershed originates in a band of Lockport dolomite (Silurian).

Normal weathering of this bedrock was interrupted 2.5 million years ago by an Ice Age brought about by global cooling. Many successive retreats and advances of the continental ice sheet over 2.5 million years erased the evidence of prior actions. Deposits of glacial till were left on the hilltops, hillsides and valley bottoms, depending on the depth of ice, slopes, sequences of advance/retreat, and water impounded against the glacier.

All features of the topography and soils of the Salmon Creek watershed should be considered "young" since the end of the Ice age was only 11,500 years ago. Kames (mounds or hummocks), strandlines (abandoned shorelines such as the Ridge), and outwash deltas are visible on the valley floor as part of recessional moraine left from the last glacial retreat.

<u>Gravelly Loam:</u> This group of soils includes Cazenovia, Hilton, Massena, Ontario, Palmyra and Phelps series soils. These soils are predominately deep, well drained to excessively drained soils located on outwash plains, remnant beaches, terraces, kames, eskers and till plains. Massena series soils are the only exception, as they are somewhat poorly drained to poorly drained soils on till plains. The slope ranges from 0 to 50 percent but is dominantly 3 to 8 percent. The solum averages 24 to 41 inches thick. Depth to bedrock in all soils is greater than 40 inches and greater than 60 inches in many areas. Where not limed, the solum ranges from strong acid to neutral and the substratum neutral to moderately alkaline. Coarse fragments average 7 to 30 percent in the solum and 24 to 50 percent in the substratum. Gravelly loam soils account for 26 percent of the soils in the watershed, a majority of which are located south of Ridge road.

<u>Gravelly Sandy Loam:</u> Includes Alton, Bombay, Ira, Madrid, Newstead and Sodus series soils. These soils are deep, moderately well drained soils on till plains, moraines and drumlins. Slope can be anywhere from 0 to 45 percent, but is dominantly 0 to 8 percent. The solum averages 30 to 50 inches thick and where not limed can be strongly acid to neutral. Coarse fragments make up an average of 10 to 35 percent of the solum. Bedrock is deeper than 60 inches everywhere except for Newstead series soils, where it can be found between 20 and 40 inches deep. The substratum can be slightly acidic to moderately alkaline and consists of 22 to 45 percent coarse fragments. Gravelly sandy loam soils account for 20 percent of the soils within the watershed. These soils are scattered throughout the watershed relatively evenly.

<u>Loam:</u> Appleton, Fredon and Joliet series soils comprise this group. Appleton and Fredon series are deep, somewhat poorly and poorly drained soils on till plains, outwash plains, remnant beaches and terraces. Joliet series are shallow, poorly drained soils located on bedrock controlled till plains. Slope ranges from 0 to 5 percent for these soils. The solum for these soils averages 18 to 30 inches thick, contains 0 to 15 percent coarse fragments and can be medium acid to neutral in reaction. The substratum can be anywhere from neutral to moderately alkaline. Coarse fragments can consist of up to 70 percent of the substratum for these soils. Bedrock is deeper than 60 inches for Appleton and Fredon soils. Bedrock is located only 10 to 20 inches below the surface fro Joliet series soils. These soils make up 9 percent of the watershed. Small pockets of these soils are scattered mainly to the south of Ridge road, with only a few areas north of the Ridge.

<u>Loamy Fine Sand:</u> This group of soils consists of Colonie, Elnora and Oakville series soils. These soils are deep, well drained to excessively well drained soils on lake plains, remnant sand bars, deltas, remnant beaches, outwash plains, beaches and sand bars. Slope is dominantly in the 0 to 6 percent range but can be as high as 25 percent in areas of Colonie soils. The solum averages 28 to 46 inches is depth and bedrock is deeper than 60 inches throughout these soils. Coarse Fragments are almost absent in the solum and substratum. Un-limed reaction ranges from very strongly acid to slightly acid in the solum and medium acid to neutral in the substratum. These soils make up 10 percent of the watersheds soils and lie almost completely north of Ridge

road.

Muck: Adrian, Carlisle, Chippeny, Edwards, Martisco and Palms series of soils make up this group. These are moderately deep to deep, very poorly drained soils in bogs or marshes. Slopes range from 0 to 3 percent but are dominantly less than 1 percent. Adrian, Edwards and Palms soils have an organic layer that ranges from 16 to 50 inches thick. The organic layer for Carlisle is greater than 51 inches and between 8 and 16 inches for Martisco soils. Chippeny soils have an organic layer that is 20 to40 inches and is restricted by bedrock that can be anywhere from 20 to 51 inches deep. Bedrock is deeper than 60 inches for all the other soil types. These soils can be strongly acidic to mildly alkaline. All of the muck soils are located south of Ridge road in the watershed.

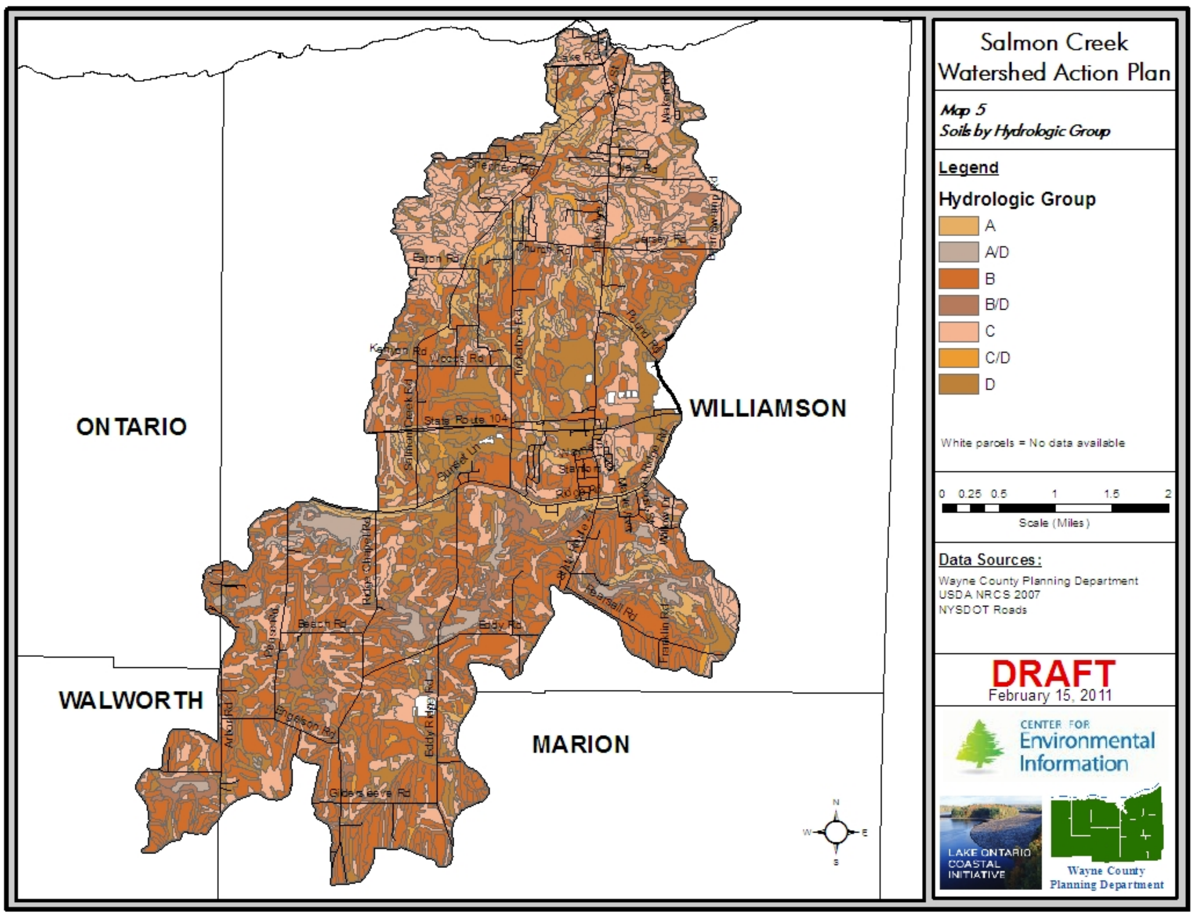
Silt Loam: These soils are split into two distinctive groups based on their major characteristics. The first group contains Canandaigua, Halsey, Lyons, Niagara, Ovid, Wallington and Wayland series soils. These soils are all deep, poorly and very poorly drained soils on lake plains, outwash plains, depressions and remnant beaches. This group has an average solum thickness of 24 to 40 inches, depth to bedrock is greater than 60 inches in all areas and reaction can range from very strong acid to mild alkaline depending on exact soil type. Coarse fragments consist of 0 to 30 percent of the soil by volume. The substratum for these soils can be neutral to moderately alkaline and consists of 0 to 50 percent coarse fragments. Areas of these soils are dominantly 0 to 3 percent slopes.

The second group of silt loam soils includes Cazenovia, Collamer, Dunkirk, Farmington and Wassaic series of soils. Cazenovia, Collamer and Dunkirk soils are deep, well drained to moderately well drained soils located on till plains and lake plains. Farmington and Wassaic soils are shallow and moderately deep, well drained soils on bedrock controlled till plains. The average solum depth is 20 to 40 inches, except where limited by bedrock. Depth to bedrock is generally greater than 40 inches, except Farmington and Wassaic soils, where is can be as shallow as 10 inches. These soils can consist of 0 to 35 percent coarse fragments and have a reaction ranging from strong acid to neutral. The substratum can also consist of 0 to 35 percent coarse fragments with a reaction ranging from slightly acid to moderately alkaline. These soils are dominantly 0 to 8 percent slopes, except for Dunkirk series soils, which are dominantly 15 to 45 percent. The silt loam soils are located throughout the watershed; however, they dominate the very northern part of the watershed.

Silt Clay Loam: These soils have also been split into two groups with similar characteristics. The first group includes Lockport, Brockport, Lakemont, Madalin and Rhinebeck series soils. Soils in this group are moderately deep and deep, somewhat poorly drain to very poorly drain soils on lake plains and bedrock controlled till plains. The Lockport and Brockport soils have a shallow depth to bedrock, at 20 to 40 inches. They also contain 2 to 35 percent coarse fragments in the solum and substratum, which is much higher than the other soils in this group. The remainder of the soils are made up of no more than 3 percent coarse fragments and have a depth to bedrock over 40 inches. All of the soils in the group have an average solum depth between 20 and 36 inches and can have a reaction from medium acid to mildly alkaline. Slopes for these soils can be between 0 and 8 percent.

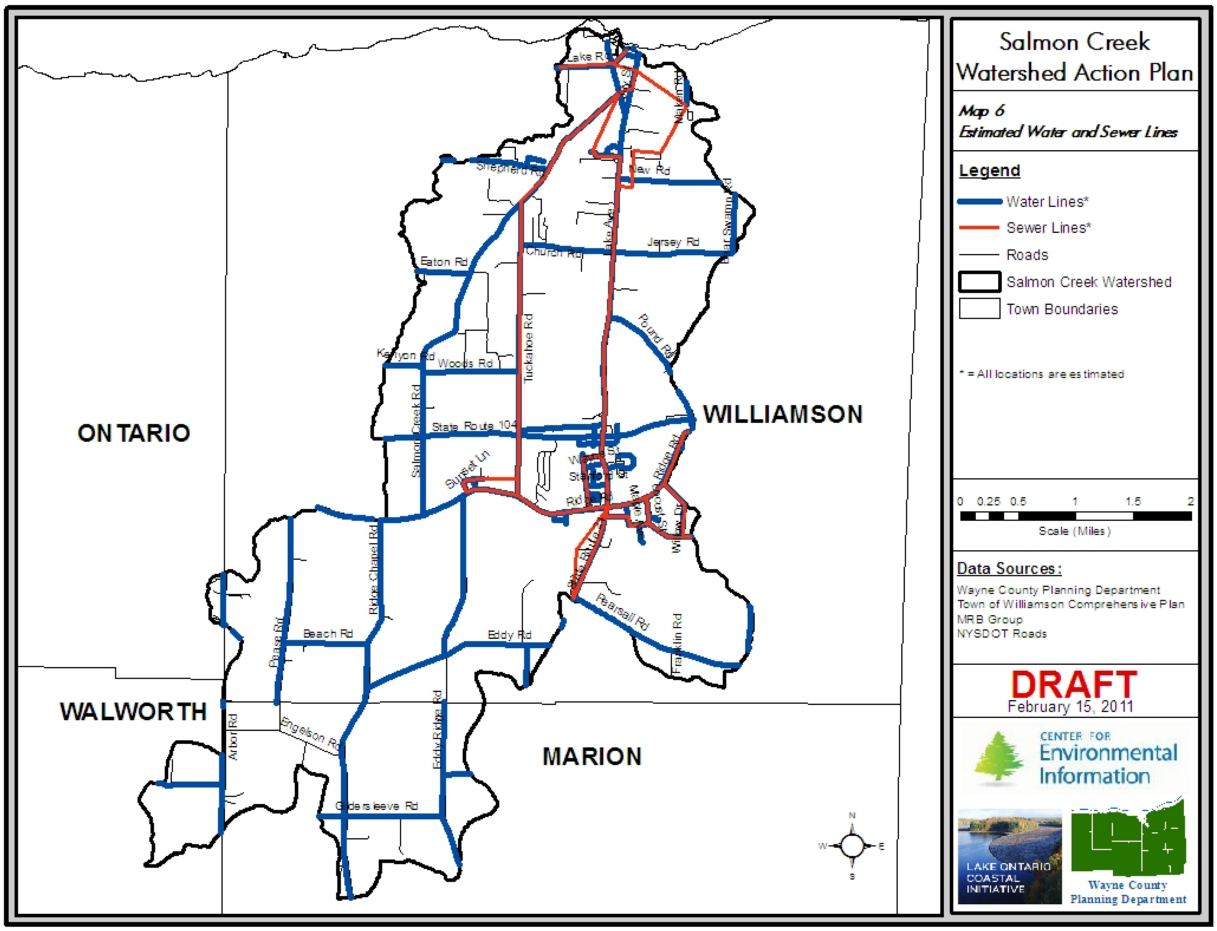
The second group of soils is comprised of Lairdsville and Riga soils. These soils are moderately deep, well drained to moderately well drained soils located on bedrock controlled till plains. Although the slope can be anywhere from 2 to 25 percent, it is dominantly 2 to 6 percent. The solum is 18 to 36 inches thick with depth to bedrock anywhere from 20 to 40 inches. Coarse fragments range from 2 to 25 percent by volume in the solum and 10 to 35 percent in the substratum. Reaction ranges from medium acid to mildly alkaline in the solum and from neutral to moderately alkaline in the substratum. Almost all of the silty clay loam soils are located in the middle of the watershed along both sides of route 104, with only a few small areas elsewhere in the watershed.

<u>Very Fine Sandy Loam:</u> This group contains Lamson and Minoa series soils. These soils are deep, somewhat poorly to very poorly draining soils on lake plains and deltas. Slopes range from 0 to 3 percent. The solum is 26 to 40 inches thick and depth to bedrock is greater than 60 inches. Coarse fragments range from 0 to5 percent in the solum and substratum. Reaction in Lamson soils ranges from slightly acid to mildly alkaline in the solum and mildly alkaline to moderately alkaline in the substratum. Reaction in Minoa soils ranges from strongly acid to neutral in the solum and medium acid to mildly alkaline in the substratum. Small areas of these soils are spread across the entire watershed.



Sewer Districts

Wastewater is typically treated in one of two ways within a community – through municipal sanitary sewer service or individual septic tanks. In densely populated areas there usually exists a network of pipes that carry sewage from residences and commercial facilities to one or more treatment plants. At the plant, wastewater is separated into liquids and solids, with the solids being removed. The separated water is then treated and discharged into waterways. This is generally referred to as a municipal sewer system. The Town of Williamson currently operates approximately 21 miles of municipal sewer pipes, most of which are concentrated in the two hamlet centers and along Lake Avenue, Tuckahoe Road, and Ridge Road. These pipes are connected to three pumping stations, located in East Williamson and the hamlet area of Williamson, and two wastewater treatment facilities located in Pultneyville. The system commonly used in rural communities consists of septic tanks. Solids are collected into tanks and periodically removed to sewage treatment plants, while the liquids are drained into a leach field. All Town residents outside the service areas noted above have septic tanks.

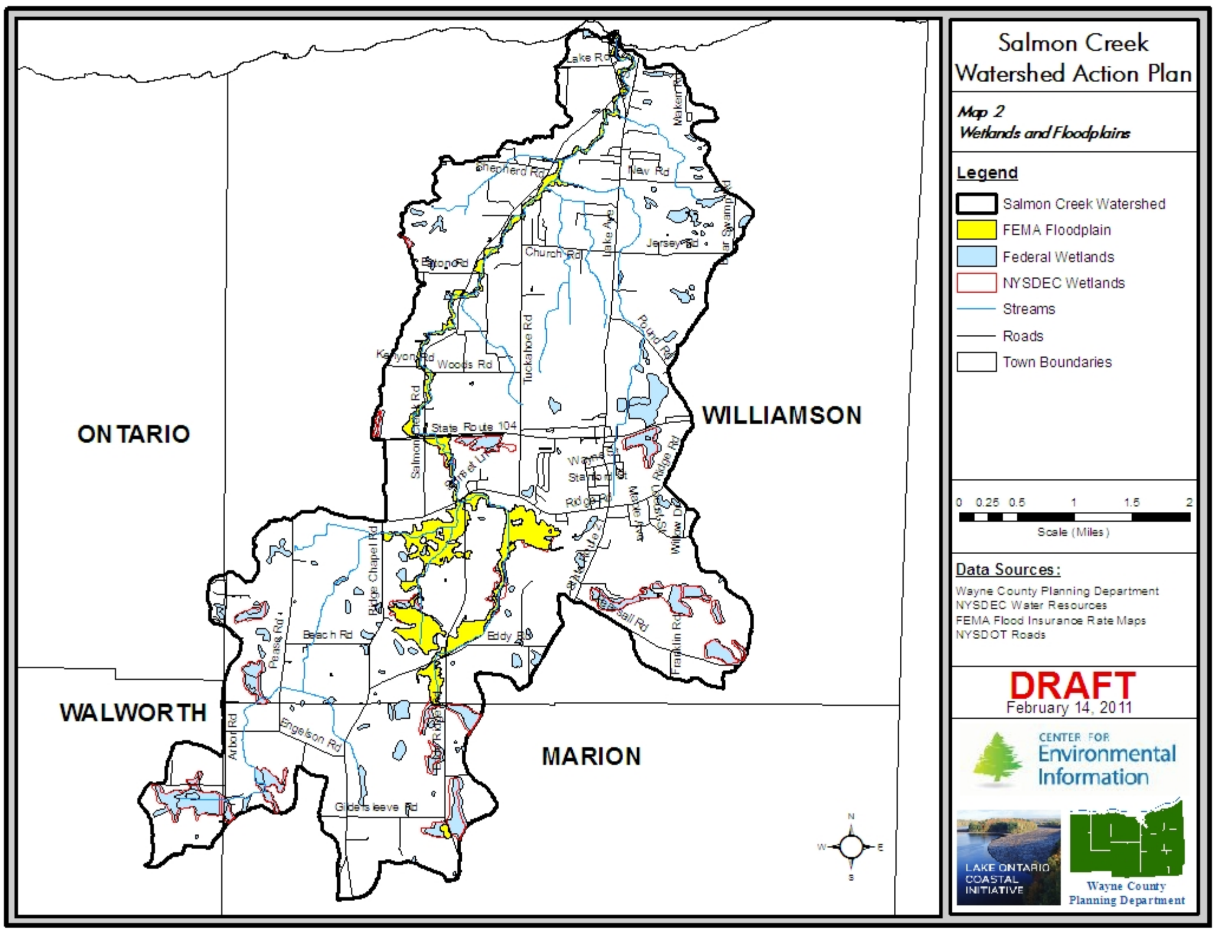


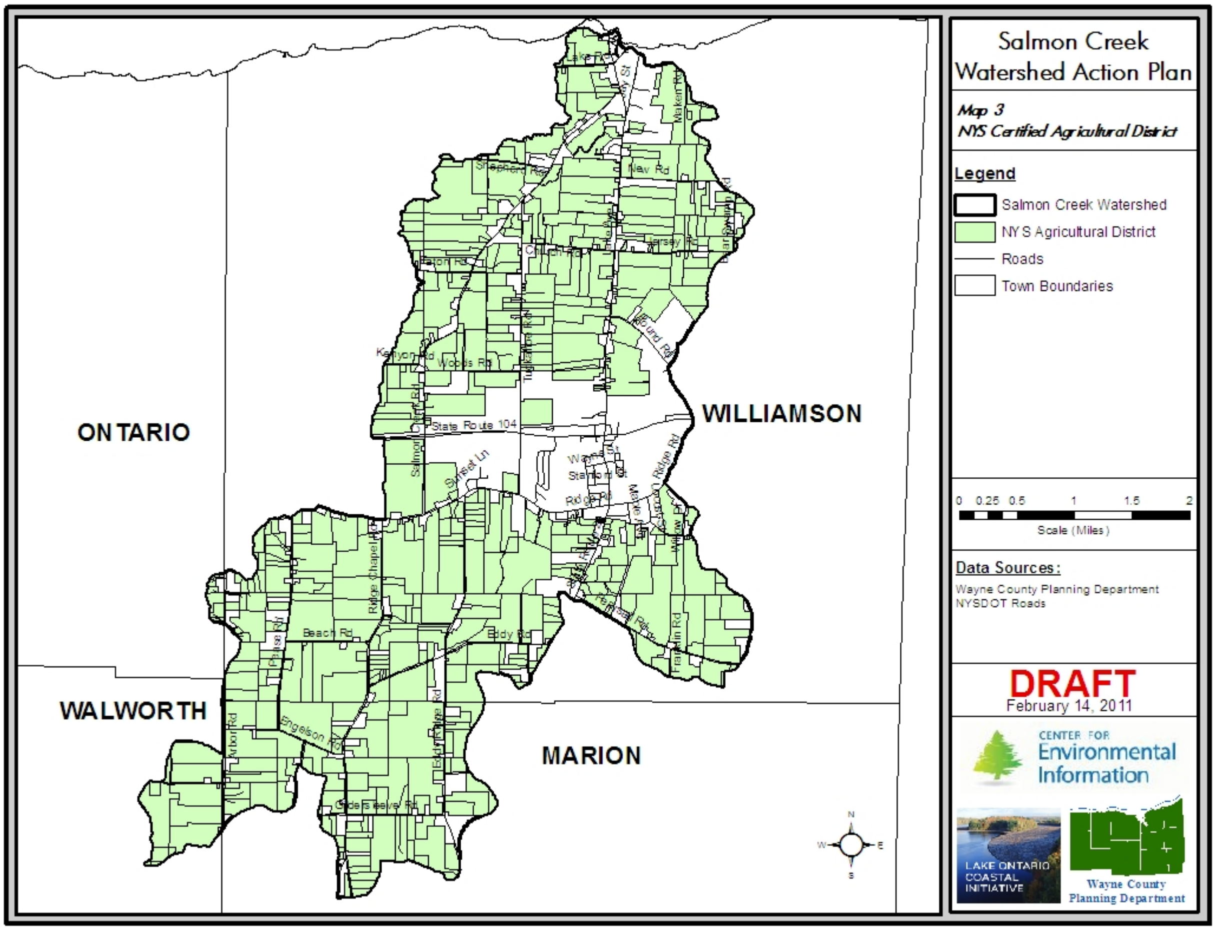
Streams, wetlands and flood plains

Lake Ontario is the most prominent natural feature in the Town of Williamson, with approximately 6.5 miles of shoreline comprising its northern-most boundary. In addition to Lake

Ontario, approximately 63 acres of small, unnamed lakes and ponds are also located within the Town boundaries. Two named streams – Salmon Creek and Mink Creek – and their tributaries flow for more than 40 miles through the Town as they drain into Lake Ontario.

The Federal Emergency Management Agency (FEMA) maintains digital mapping records of floodplains for all of the United States. According to FEMA's Flood Insurance Rate Mapping, approximately 568 acres of 100-year floodplains exist within the Town of Williamson, of which 488 acres are located along the entire length of Salmon Creek. The remaining 80 acres of 100-year floodplains occur at the mouths of the Bear and Mink Creeks.





Population and Demographic Characteristics

General demographic statistics for the Salmon Creek Watershed were derived from block level data supplied by the US Bureau of the Census. The most recent Census information available is from 2000. Data from the 2010 Census of the Population will not be available until April of 2011. Preliminary 2010 Census figures released for the communities comprising the Salmon Creek Watershed demonstrate little change in total population. Because of this, the numbers used in this report should be considered relatively accurate.

<u>Population Characteristics:</u> Socioeconomic characteristics are presented for the census block groups that most closely correspond to the borders of the Salmon Creek Watershed. According to the 2000 Census, this area had a total population of 2,855 persons. Of that number, 46 persons were African American, or 1.6 percent of the total population. Approximately 1.3 percent of the population is Hispanic. American Indian and persons of Asian descent comprise 3.5 percent of the population of the watershed. The remainder of the population is classified as white. The population density for the Salmon Creek watershed is 154 persons per square mile.
The highest population densities exist in the hamlets of Williamson and Pultneyville. The areas directly to the west and south of the Hamlet of Williamson, as well as along the western half of the lakefront have population densities of 250 to 500 people per square mile.

Age and Household Characteristics: According to the 2000 Census, only 9 percent of the Salmon Creek Watershed population was 65 or older. A total of 12.1 percent of Wayne County residents were over 65 years old. The median age for the watershed is 40 years old while the median age for all of Wayne County is 37.6 years old.

Approximately 31 percent of the population is under the age of 19 and 40 percent of the population is between the ages of 35 and 54 years old. For the under 19 category, this age breakdown is consistent with Wayne County where 29.8 percent of the total population is under the age of 19. Approximately 32 percent of Wayne County's population is between the ages of 35 and 54 while the Salmon Creek watershed has a significantly higher 35 to 54 year old population at 40 percent. The average household size in the watershed is also higher than the County as a whole, at 2.94 and 2.64, respectively.

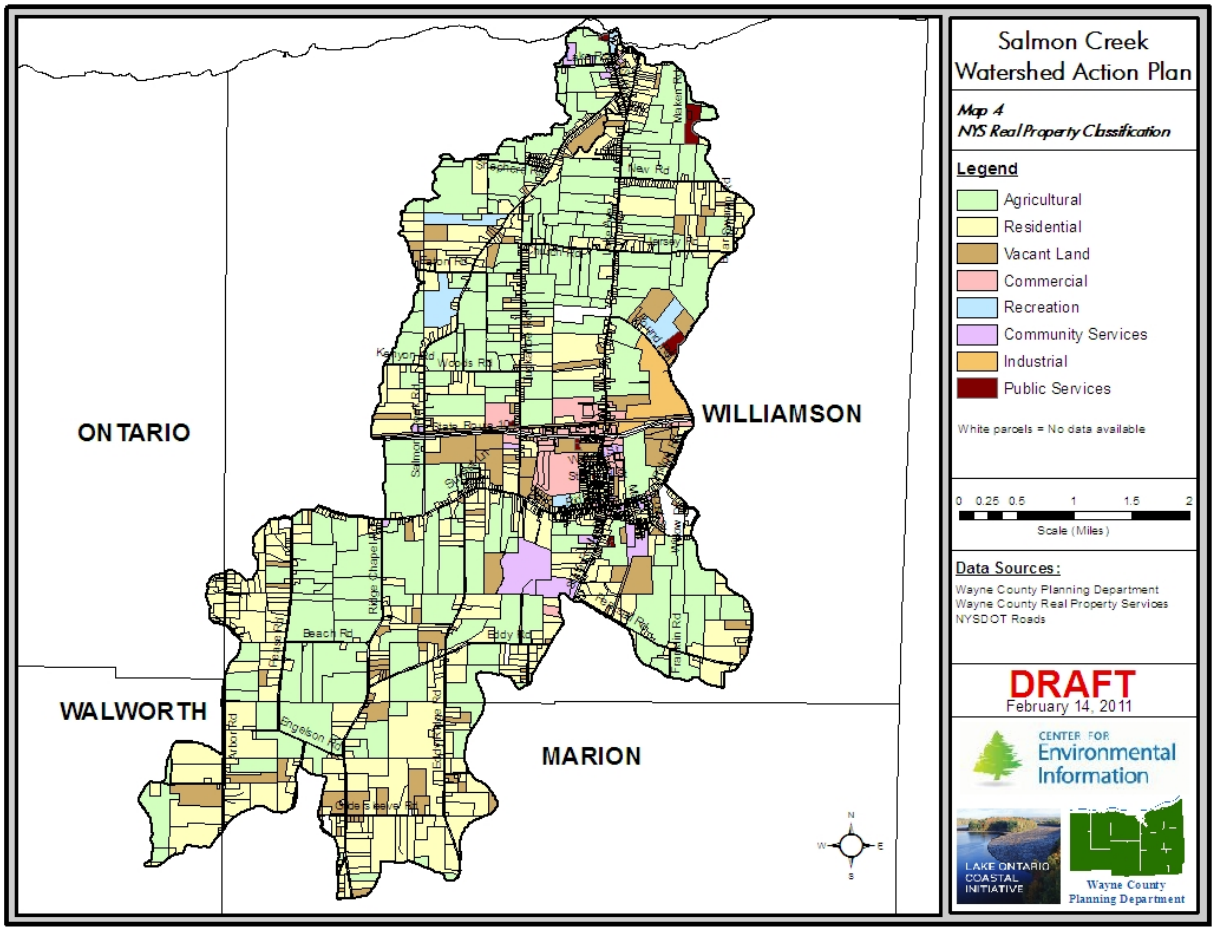
Housing: Housing within the Salmon Creek Watershed is principally single family residential. One large subsidized multi-family apartment complex is located on Route 21 just south of Route 104 in the Hamlet of Williamson. A large manufactured home community is situated on land between Route 104 and Ridge Road, west of the Hamlet of Williamson. The park is populated by 169 single family manufactured homes on rented lots. There are a total of 807 housing units within the watershed area. The vacancy rate is a relatively low 4.7 percent.

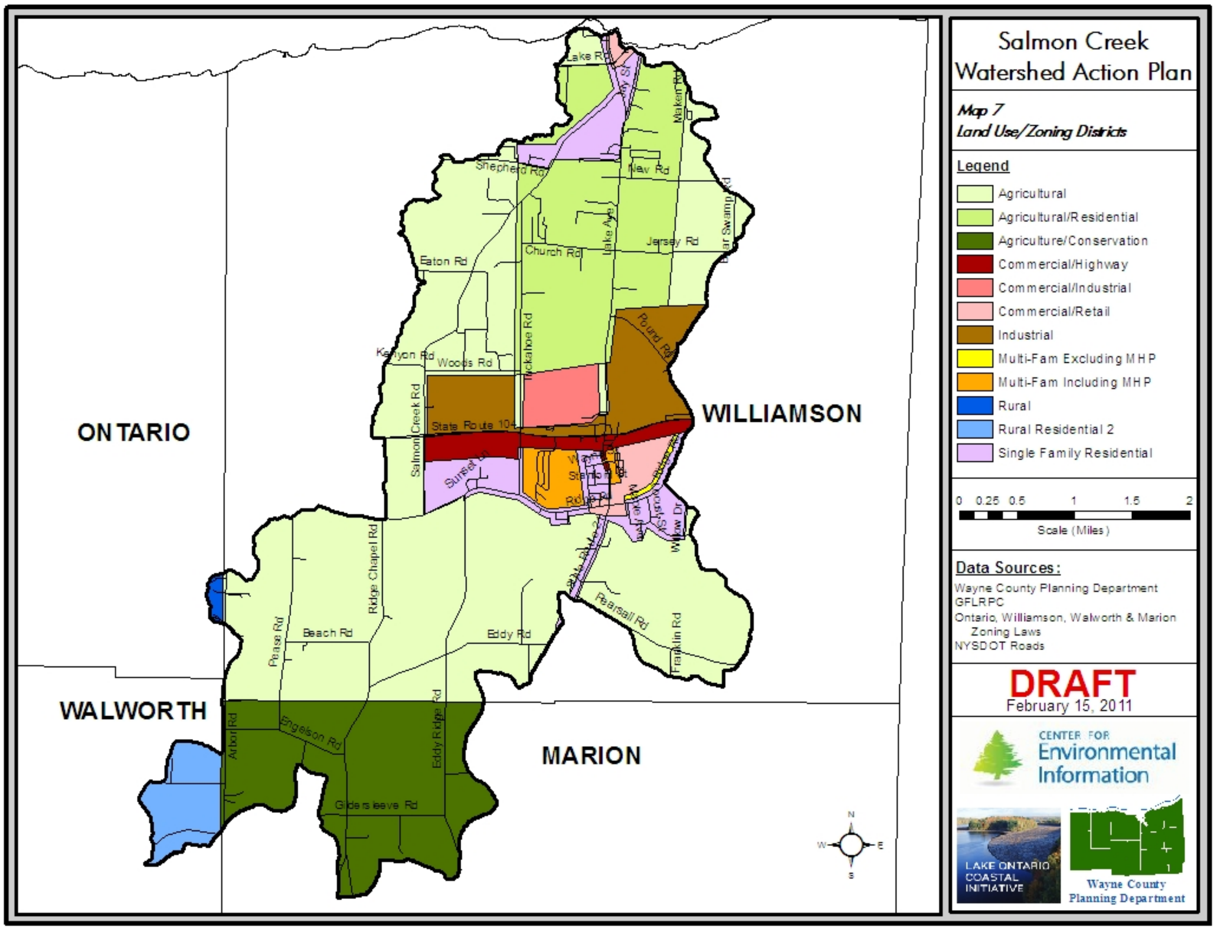
Development Patterns: The Salmon Creek Watershed is characterized by a predominance of agricultural land uses. The northern area near the Lake Ontario shoreline is primarily fruit trees, especially apples and cherries. Field crops and livestock farms are interspersed further south within the watershed. Because the Town of Williamson has public water service available on every road, single family residential development predominates along the road frontage with agricultural land in rear parcels. This same development pattern is evident in the area of the watershed that extends into the Town of Marion.

Industrial and larger commercial development is located along the Route 104 corridor. The Hamlet of Williamson is characterized by smaller, locally owned businesses in historic buildings within a traditional main street setting. A large portion of the Hamlet of Pultneyville is listed on the National Register of Historic Places. Many of the homes in this area have been preserved and authentically restored. Commercial development of an appropriate scale includes a restaurant, boutique art gallery, an antique and gift barn, and several bed and breakfasts.

Economic Profile: The Salmon Creek Watershed is situated in a heavily agricultural area. In addition to a robust fruit growing industry, the watershed hosts a major food processing corporation employing a total of 353 full time employees, with another 80 temporary employees hired during harvest season. Two cold storage facilities collectively have 35 full time and 2 part time employees. The industrial profile of the watershed also includes a large chemical company with 22 full time employees and a high tech company with 90 full time employees. Other businesses include retail (grocery, pharmacy, clothing, hardware, and specialty stores); restaurants, car repair shops and dealerships; school district and town government.

Land Use


Salmon Creek
Watershed Action Plan
Map 4
NYS Real Property Classification
Legend
Agricultural
Residential
Vacant Land
Commercial
Recreation
Community Services
Industrial
Public Services
White parcels = No data available
0 0.25 0.5 1 1.5 2
Scale (Miles)
Data Sources:
Wayne County Planning Department
Wayne County Real Property Services
NYSDOT Roads
DRAFT
February 14, 2011
CENTER FOR Environmental Information
LAKE ONTARIO COASTAL INITIATIVE
Wayne County Planning Department
ONTARIO
WILLIAMSON
WALWORTH
MARION



According to parcel data obtained from Wayne County, the Salmon Creek Watershed has 2,036 parcels encompassing approximately 11,491 acres of land. Another 370 acres are predominantly roads and their associated rights-of-way. Land use is determined by the New York State Office of Real Property Services (NYSORPS) based on property assessments. NYSORPS has identified nine land use categories which are used to classify lands within New York State. Eight of the nine land use categories are present within the watershed. The Conservation & Parks land use category is not present in the watershed. Since the land use data from NYSORPS is based on assessments, which may not be updated on a regular basis, there may be a small margin of error associated with land use information. As an example, agricultural parcels that also serve as a farmer's primary residence can be assessed as residential even though the majority of the parcel is in production. The Williamson Town Park is classified as an Agricultural parcel, likely due to the fact that the property was at one time used for farming. A breakdown of the land uses, parcels, and acreages of land within the watershed are summarized in Table 1.

TABLE 1: NYSORPS LAND USE CLASSIFICATION
Salmon Creek Watershed

LAND USE CLASSIFICATION	NUMBER OF PARCELS	TOTAL ACRES	PERCENT OF WATERSHED
Agricultural	155	5293	44.5
Residential	1529	4209	35.5
Vacant Land	189	1025	8.6
Commercial	97	287	2.5
Recreation	7	167	1.5
Community Services	29	223	1.8
Industrial	7	132	1.2
Public Services	14	53	0.45
Subtotal	2027	11,389	96.05
Non-classified	9	102	0.85
Roads and Rights-of-Way	N/A	370	3.1
Grand Total	**2036**	**11,861**	**100**

Agriculture: Agricultural land uses are defined by NYSORPS as "properties used for the production of crops or livestock." Within the watershed, agriculture is the largest land use category, accounting for 5,292 acres or 44.6 percent of the total land area. While agricultural uses account for almost half the land within the watershed, the actual number of parcels comprises only 7.6 percent of the total number of parcels. On average agricultural parcels are much larger than other land use classifications. Agricultural land uses are spread uniformly throughout the watershed, with the exception of limited agricultural parcels in Pultneyville, the Hamlet of Williamson, and along Route 104, particularly east of Tuckahoe Road.

Residential: Residential land uses are defined by NYSORPS as "properties used for human habitation, but excluding hotels, motels, and apartments." Residential uses are the second largest land use in the watershed, accounting for 4,209 acres, or 35.5 percent of the watershed, on 1,529 parcels. The average residential parcel size is 2.8 acres. Smaller parcels and higher density residential development are concentrated in each of the three hamlet areas, and along Lake Avenue and Salmon Creek Road to Route 104.

Industrial: Industrial land uses are defined by NYSORPS as "properties used for the production and fabrication of durable and non-durable man-made goods." There are 7 Industrial parcels in the watershed, accounting for 132 total acres (1.2 percent of total land area). Industrial land uses are primarily located along Route 104 between Lake Avenue and Pound Road in the Town of Williamson.

Commercial: Commercial land uses are defined by NYSORPS as "properties used for the sale goods or services." There are 97 commercially classified parcels in the watershed, with an average parcel size of 3 acres. Commercial properties occupy approximately 287 acres, or 2.5 percent of the watershed's total land area. The majority of commercial parcels are concentrated along Route 104 in the Town and Hamlet of Williamson.

Recreation and Entertainment: Recreation & Entertainment land uses are defined by NYSORPS as "properties used by groups for recreation, amusement, or entertainment." There are 7 parcels classified in the watershed under this land use category. All are located in the Town of Williamson. Recreation & Entertainment land use accounts for 167 acres, or 1.5 percent, of the total land area in the watershed, with an average parcel size of 23.8 acres. Parcels in this category are primarily situated along the lakefront, on Salmon Creek Road, on Pound Road, and at various locations along Route 104.

Community Services: Community Service land uses are defined by NYSORPS as "properties used for the well being of the community." There are 29 Community Service parcels occupying a total of 223 acres, or 1.8 percent of the total land area of the watershed. Community Service parcels include schools and the Williamson Town Hall and library. The majority of Community Service parcels are located south of Route 104 in the Town of Williamson.

Public Services: Public Service land uses are defined by NYSORPS as "properties used to provide services to the general public." There are 14 Public Service parcels in the watershed on a total of 53 acres. This land use category represents the smallest land use within the watershed, accounting for only 0.45 percent of the total land area.

Recreational Uses: The Williamson Town Park, which is owned and maintained by the Town of Williamson, is located to the west of and directly behind Williamson Central School. Established in 2001, it is a passive/active recreation park which currently offers a pond and fishing platform, several picnic shelters, a band shell, walking/hiking trails, 4 baseball diamonds, 6 bathrooms, 2 soccer fields, a volleyball court, and a bocce court. If funds can be raised, future improvements include a paved main parking lot, lighting, fenced-in basketball courts, a multi-purpose field, a concession stand, press box, and an all season enclosed shelter.

There are a number of additional facilities within the watershed that are available to the public, as listed in Table 2 below.

TABLE 2: ADDITIONAL RECREATION FACILITIES
Salmon Creek Watershed

LOCATION	SIZE (ACRES)	AMENITIES
Fire Dept north of Ridge, east of Tuckahoe Road	12	Mini track, baseball diamond, storage
Williamson High School, Route 21	38	Soccer fields, running track, baseball fields, tennis courts
Williamson Middle and Elementary School, Route 21	27	Soccer field, baseball fields tennis courts playground, basketball courts, kickwall

Historic Resources

Historical buildings and sites can be found throughout the Salmon Creek watershed, with concentrations of historic structures in the hamlets of Pultneyville and Williamson.
The Pultneyville Historic District, located along Lake Road and Jay Street in Pultneyville hamlet, includes the original hamlet that was laid out in 1806. The Pultneyville Historical Society Museum is located within the historic district and features displays of local artifacts and archives. The museum is open during the summer on Saturday and Sunday. One of the most recognized historic structures in the Town is Gates Hall. Gates Hall was built in 1825 as the Union Church and has served as a church, meeting hall, and community playhouse since that time. In 1967 it was designated as the second oldest little theatre in the United States by the Library of Congress. It has since been listed on the New York State and National Registers of Historic Places.

APPENDIX II: BEST MANAGEMENT PRACTICES

BMPs are structural and non-structural approaches used to reduce pollutant loads in watersheds draining both urban and rural areas. When considering options for BMP implementation, it is often useful to know how effective such BMPs might be in terms of reducing various types of pollutants such as sediment, nitrogen, and phosphorus. There are a very wide range of BMPs that could potentially be employed, as well as a wide range of associated costs and inherent pollutant reduction efficiencies. At the farm scale, it is critical that the most cost-effective BMP be implemented to address the pollutant(s) of concern at specific geographic locations given the marginal economies of this industry. Conversely, when addressing general water quality concerns within a watershed, it is not as important to identify specific BMPs for implementation at exact locations (at least at the planning stage). However, it is very useful to have a good sense of whether or not general types of BMPs would be potentially beneficial in reducing pollutant loads within a watershed in which non-point source pollutants are of primary concern.

Most of the pollutant reduction effectiveness information discussed below was obtained from the documentation of Penn State Institutes of Energy and the Environment's *PRedICT* model. This model was originally going to be used to evaluate scenarios but the software did not work as described in the documentation. Subsequent discussions with Penn State led CEI to scrap the use of *PRedICT* for this purpose. CEI did however use the pollutant reduction efficiencies to evaluate scenarios as described later. These values essentially reflect the average values for the individual BMPs that comprise each BMP option. Consideration was also given to the BMP efficiencies provided by the Chesapeake Bay Program.

As with the reduction efficiency values, the costs associated with implementing the various individual BMPs in *PRedICT* were drawn from several sources. The primary one used, however, was the Conservation Catalog prepared by the Pennsylvania Conservation Partnership (2000). In addition to a description of various agricultural conservation practices currently used in Pennsylvania, the publication also has average costs for these practices at the time the document was written. These costs were assumed to be generally equivalent to New York. Overall costs have likely escalated in 10 years since the referenced costs were derived. Consideration was also given to the BMP costs provided by the Chesapeake Bay Program.

The five-year costs associated with initial BMP implementation and construction are considered; long-term operational and maintenance costs are not included. In calculating the cost for any given BMP system, the separate costs for each individual BMP are calculated and subsequently summed according to the set of individual BMPs comprising each system.

NOTE: The numbers after some of the BMPs below, such as BMP1, are the designations assigned by the AVGWLF model and *PRedICT.*

AGRICULTURAL BMPS

Agricultural BMPs are chosen for implementation by farmers (with the assistance of their consultants) on a farm-by-farm and field-by-field basis. Practices are chosen to protect the productivity of the farm and to alleviate conditions that would damage the farm's productivity. Practices are sometimes chosen and installed by farmers because of stewardship concerns. New practices may be recommended by a variety of experts too. Below is a discussion of a variety of BMPs both from *PRedICT* and the Chesapeake Bay Program. Some of them are widely adopted by farmers. It is against this background of stewardship that the discussion which BMPs should be further considered to reduce phosphorus loadings in the watershed were evaluated.

<u>Vegetated Buffer Strips:</u> Vegetated buffer strips (also called conservation buffers, buffer zones, or filter strips) are examples of structural BMPs. Such strips are areas of land maintained in some type of permanent vegetation (i.e., grasses, shrubs, and/or trees) for the purpose of trapping pollutants contained in surface runoff from adjacent land areas. Buffer strips are commonly utilized to attenuate surface runoff from cropland or confined animal facilities. Vegetated buffer strips can take many forms including: 1) permanently vegetated strips located between larger crop strips on sloping land, 2) bands or strips of permanent vegetation established at the edge of agricultural fields, and 3) areas of trees, shrubs, and/or grasses adjacent to streams, lakes, ponds or wetlands. Pollutants are removed to varying degrees via the processes of filtration, infiltration, absorption, adsorption, uptake, volatilization, and deposition, with the predominant processes tending to be the infiltration of dissolved pollutants and deposition of sediment-attached pollutants.

<u>Contour Farming/Strip-cropping (BMP3):</u> Contour farming refers to the practice of conducting tillage, planting and harvesting operations perpendicular to the gradient of a hill or slope in order to reduce erosion. This practice is usually most effective on moderate slopes of 3-8% when there are measurable ridges left from tillage and/or planting operations that serve as miniature terraces, retarding runoff and increasing infiltration. Contour farming is often more effective where some form of tillage is employed, and is typically used on moderate slopes when land is intensively cultivated. This practice is also most effective on shorter slopes or on longer slopes with cropland terraces.

<u>Cover Crops (BMP1)</u>: This BMP refers to the use of annual or perennial crops to protect the soil from erosion during the time period between the harvesting and planting of the primary crop. The use of such crops can also improve soil health. Additionally, cover crops can store needed nutrients over the winter, prevent their loss, and act as a type of "green" fertilizer in the spring if the cover crop is left in the field or plowed under before planting the primary crop.

<u>Crop Rotation (BMP1)</u>: This particular conservation practice (often called conservation crop rotation) is defined as the use of different crops in a specified sequence on the same farm field, and is a typical BMP widely used on cropland. Crop rotations may be as simple as a 2-year rotation of corn and soybeans or an 8-year rotation of 4 years of silage corn and 4 years of hay. It could also be a more complex scheme involving a mixture of crops such as corn, small grain, soybeans and forages spread over 6-8 years or more.

Although this BMP can be used for several reasons, crop rotations are primarily employed to reduce soil erosion, thereby reducing the quantities of sediment and sediment-bound pollutants such as nitrogen, phosphorus, and pesticides. When addressing excess nutrients on agricultural land, cover crops (as discussed in the previous section) are often included in the rotation sequence. Similarly, crop rotations are often combined with other BMPs.

Crop Residue Management (BMP2): Conservation tillage refers to the planned use of crop residue to protect the soil surface. This is one of the most commonly-used BMPs, and includes the use of residue from corn or soybean stalks, small grain straw, or the residue from vegetables and other crops. There are many forms of this management practice including no-till planting, mulch tillage, and other tillage techniques that leave crop residue on the soil surface.

Other examples of crop residue management include strip tillage, ridge tillage, slit tillage, and seasonal residue management. Strip, ridge, and slit tillage refer to various methods used to till the field along the rows while minimizing the disturbance of crop residue between the rows. With seasonal residue management, the residue is left on the field during the period between harvest and planting. Immediately before planting, most of the residue is then tilled over.

Streambank Fencing: Streambank protection collectively refers to several practices that can be employed for the purpose of mitigating the effects that eroding or slumping stream banks have on adjacent streams. The most frequently used form of protection is fencing that prohibits cattle from trampling stream banks, destroying protective vegetation, and stirring up sediment in the streambed. In addition to reducing direct soil loss caused by stream bank degradation, fencing also reduces nutrient loads caused by defecation and urination of the animals in the stream. Animal water facilities will be a necessary part of fencing projects.

Streambank Stabilization: Streambank protection also often involves the use of stable crossings and/or streambank stabilization measures. Stable crossings allow for the movement of animals across streams while at the same time reducing impacts to streambanks. With streambank stabilization, rip-rap, gabion walls, or a “bio-engineering” solution of some type are installed along the edges of a stream to protect the banks during periods of heavy stream flow, thereby reducing direct stream bank erosion. With this approach, the banks are often covered with rocks, grass, trees, shrubs, and other protective surfaces to reduce erosion as well.

As with other BMPs, streambank protection is often implemented in combination with other BMPs to reduce overall sediment and nutrient loads. For example, a prescribed grazing system that limits livestock access to streams for short periods of time (e.g., 24 hours or less) can provide similar benefits as fencing. Additionally, a buffer zone of vegetation adjacent to the stream can filter out excess sediment, nutrients and chemicals from overland runoff.

PRedICT documentation provides estimates of BMP reduction efficiencies and implementation costs for phosphorus as listed below.

BMP	Effectiveness	Cost
Vegetative buffers	52%	$1,500 per mile
Streambank fencing	78%	$15,000 per mile
Streambank stabilization	95%	$25 per linear foot

<u>Nutrient Management (BMP6):</u> This particular BMP refers to the planned use of organic and inorganic sources of nutrients to sustain optimum crop production while at the same time protecting the quality of nearby water resources. The implementation of this practice usually entails the development of a farm-wide nutrient management plan that is based on established criteria. An important objective of such a plan is to optimize forage and crop yields while minimizing nutrient loss to surface and ground water resources. This approach often involves using other BMPs such as providing adequate cover crops and devising appropriate crop rotations to reduce (or augment) overall nutrient loads on a farm.

<u>Terraces and Diversions (BMP8):</u> Terraces and diversions are essentially earthen channels that intercept runoff on sloping land parcels. These structures act to transform long slopes into a series of shorter ones, thereby reducing runoff velocities and allowing soil particles to settle out. Terraces are cross-slope channels that control erosion on cropland, and are usually constructed to permit crops to be grown on the terrace. They are designed to handle areas of concentrated flow where ephemeral gullies might otherwise form. Diversions are also cross-slope channels; however, unlike terraces, they are permanently vegetated. These structures are often used on slopes where a terrace would be too expensive or difficult to build, maintain, or grow crops on. Diversions may also be used on adjacent non-cultivated land to prevent unwanted surface runoff from flowing across a farmstead or barnyard.

<u>Retirement of Agricultural Land (BMP5 & BMP4):</u> Various programs and financial incentives are occasionally made available to take actively cultivated, erosion-prone land out of production. Typically, such retirement involves letting the cultivated land revert back to a “natural” state of vegetative cover to reduce the export of sediment and nutrients due to agricultural activities. Two BMP options considered in addressing this type of activity include the conversion of agricultural land to forest, and the conversion of agricultural land to wetlands.

<u>Grazing Land Management (BMP7):</u> Grazing land management refers to the utilization of practices that ensure adequate vegetation cover in order to prevent excessive soil erosion due to over-grazing and other forms of overuse. It is becoming more common for farmers to reduce feeding costs by establishing rotational grazing systems on improved pastureland or by planting hay or legumes to use as feed for their livestock. In addition to providing feed for livestock, establishing grasses and legumes as part of crop rotations also protects land areas from excessive soil erosion and adds needed nitrogen to the soil base. Fields can become overloaded with nutrients too.

One form of rotational grazing used in dairy production systems is referred to as intensive rotational grazing. In this approach, cows are periodically moved among fenced pastures or paddocks. This practice prevents the overuse of any feeding area and allows forages to recover between periods of intensive feeding.

FARM ANIMAL-RELATED BMPS

The nutrients and organic matter contained in animal waste, properly used, is important to maintaining the long-term fertility and health of farms. Losing nutrients and organic matter to runoff is a loss to the overall productivity of the farm as well as a source of pollution to nearby waterbodies. Large concentrations of animals produce large amounts of manure which must be carefully collected, stored, processed, spread and incorporated into farmland to maintain its productive and beneficial function.

AVGWLF Version 7.2.3 estimates nutrient loads associated with farm animal populations. More specifically, these load calculations are made based on the assumption that nitrogen and phosphorus produced by farm animal populations can be transported to nearby water bodies via three primary mechanisms:

1. Runoff from barnyards, feedlots and similar confined areas,
2. Runoff from crop and pasture land where livestock wastes have been applied for fertilizing and/or waste management purposes, and
3. Losses that occur as a result of animal grazing. This includes runoff from grazing land (similar to #2 above), as well as "direct deposits" to streams where unimpeded access is available.

To take advantage of the added animal-related load data now provided by AVGWLF, CEI considered potential reductions in nutrient loads that might be achieved via the implementation of various farm animal-related BMPs. The specific BMPs that were considered include:

1. Animal waste management systems (AWMS) for livestock;
2. Animal waste management systems (AWMS) for livestock in Karst soil areas;
3. Runoff control in confined feeding areas;
4. Alternative manure use; and
5. Nutrient Management Plans (NMP)

AWMS Livestock and AWMS Runoff Control: These measures apply mostly to barnyards and similar confined feeding areas. Consequently, it is only those loads originating from these areas that are reduced by using any of the BMPs in the list above. *PRedICT* documentation provides estimates of BMP reduction efficiencies for phosphorus as listed below.

The per-unit costs associated with the animal-related BMPs are shown below. In contrast to other BMP costs discussed in this document which are typically based on the level of implementation per unit area or per unit distance, these costs are based on implementation per animal equivalent unit (AEU). In this case, an AEU is equal to 1000 pounds of any given animal.

BMP	Effectiveness	Cost
AWMS/Livestock	75%	$1,250 per AEU
AWMS Runoff Control	15%	$300 per AEU

Alternative Manure Use - Anaerobic Digester Gas to Energy: Anaerobic digestion of manure and generation of electricity offers dairy farmers another alternative for managing manure and process water in a way that controls odors and protects the environment. Biogas recovery systems can help them meet this challenge. The environmental benefits provided by these systems exceed those supplied by conventional manure management systems such as storage tanks, ponds and lagoons. The benefits include operational cost savings, tax incentives for producing green energy, odor control, improved air and water quality, improved nutrient management flexibility, and the opportunity to reduce greenhouse gas emissions. Waste to energy conversion with a digester that captures biogas can be a useful source of energy to provide heat and/or electricity.

The improved nutrient management aspect of applying this technology is related to the ability to more readily move digested manure and bedding out of the watershed to be used by other farms. Keeping some or most of the digested manure out of the watershed will reduce local phosphorus loadings and improve water quality. Digested manure also has a higher fraction of inorganic phosphorus than undigested manure, thus promoting better absorption in the soil and plants.

US Department of Agriculture reports indicate that this technology costs between $1,100 to $1,400 per dairy cow to design and install. Table 5 in Section VI of this report provides the costs for on-going operation and maintenance.

Alternative Manure Use - Composting: Composting is the biological decomposition and stabilization of organic material. The process produces heat that, in turn, produces a final product that is stable, free of pathogens and viable plant seeds, and can be beneficially applied to the land. Composting is an alternative manure management practice that reduces the volume of manure. The land base required to apply manure compost may stay the same but the producer can economically haul compost further than manure.

The improved nutrient management aspect of applying this technology is related to the ability to more readily move composted manure and bedding out of the watershed to be used by other farms. Keeping some or most of the composted manure out of the watershed will reduce local phosphorus loadings and improve water quality.

Manure Incorporation in Soil: Manure incorporation represents a compromise between BMPs for soil erosion control and manure management. Manure can be incorporated into the soil to maximize nutrient availability, especially nitrogen, and to minimize odors and potential degradation of surface water quality through manure runoff. Incorporation typically involves use of conventional soil tilling equipment with some type of tank spreader or towed hose system that simultaneously apply and incorporate liquid or slurry manure into the soil.

Manure Injection in Soil: Manure injection is another form of incorporation that involves using a manure supply tube that is put below the soil surface rather than on the surface. This technique requires more specialized equipment but is also more effective in reducing runoff than manure incorporation.

Precision Feed Management (PFM): The Cornell University Cooperative Extension of Delaware County, New York describes PFM as doing a more precise job of balancing dairy cattle diets for animal requirements and utilizing homegrown feeds in an effort to reduce overfeeding and importation of purchased feed nutrients, particularly phosphorus (P), and accumulations of these nutrients in dairy farm soils. Due to the integration of forage production and feeding of dairy cows, PFM also includes management of forage production to allow for high levels of homegrown feed in the diet.

The Cooperative Extension of Delaware County's rationale is based upon their observation that most dairy farms import more nutrients than they export resulting in either an accumulation of nutrients in the farm soils over time and/or losses to the environment. Typically 2/3 of the imported nutrients remain on the farm. The largest source of imported nutrients is purchased dairy feed, mostly grains. Commonly 75-90% of the imported nutrients are in purchased dairy feed. Management of dairy feed nutrients to reduce nutrient imports and accumulations is a logical and necessary step to reduce nutrient accumulation.

A Cornell Cooperative Extension of Delaware County research and demonstration project in Delaware County in the Cannonsville Reservoir Basin determined what levels of phosphorus were being fed and what measures might be taken to reduce phosphorus feeding. Results of this project indicated that there was a wide range of phosphorus overfeeding in lactating dairy cattle diets, with an average of 41% overfeeding. Strategies to reduce phosphorus feeding were implemented on two farms, resulting in an average reduction in feed phosphorus intake of 25%, manure phosphorus excretions of 33%, and mass phosphorus balance (farm P imports minus farm P exports) of 50%.

Nutrient Management Plan (NMP): Nutrient management plans (or Comprehensive Nutrient Management Plans) are established to accomplish the following:

- Budget and supply nutrients for plant production;
- Properly utilize manure or organic by-products as a plant nutrient;
- Minimize agricultural non-point source pollution of surface and groundwater resources;
- Protect air quality; and
- Maintain or improve the physical, chemical and biological condition of soil.

These programs can be effective in reducing phosphorus releases to watersheds. However, they may not always be implemented on a regular basis as they are described in the specific NMP.

Inspection and monitoring of the implementation by a third-party individual can insure continued benefits.

FOREST/OTHER OPTIONS

Tree Planting: The New York State Tributary Strategy for Chesapeake Bay Restoration (2006) discusses tree planting as a management practice to reduce nutrient loadings. This report discusses land conversion from row crops and pasture to forest. Cost estimates were provided but no indication of their impact on reducing nutrient loads.

WASTEWATER DISCHARGE OPTIONS

Wastewater discharges considered include municipal and industrial wastewater treatment plants located within the watershed being evaluated. The specific wastewater reduction options evaluated include:

1. Upgrades of primary treatment plants to secondary treatment *;
2. Upgrades of primary treatment plants to tertiary treatment *;
3. Upgrades of secondary treatment plants to tertiary treatment; and
4. Source reduction to eliminate phosphorus use.

* Note: All municipal waste treatment plants in this watershed have secondary treatment.

Tertiary treatment could include wetland treatment or summertime groundwater discharge.

CEI used values for nutrient reduction efficiencies provided in the PRedICT documentation for each of the wastewater alternatives described above. These values are based on information provided in various wastewater technology textbooks. While these values are believed to be reasonable estimates, they are still only approximate since wastewater treatment technology can vary widely, and must be revised if necessary based on local treatment plant characteristics.

URBAN STORMWATER BMPS

Urban BMPs can also be structural or non-structural in nature. Typically, non-structural BMPs involve the preservation or enhancement of vegetative cover in selected areas (e.g., along streams) or the use of natural landscape features to act as filtration devices (e.g., as in the use of residential lawns to filter storm water runoff from roof tops). Urban BMPs can also be described in terms of their permanence over time. For example, some BMPs are primarily used during short-term construction activities (e.g., filter bags, silt curtains, and straw bale barriers), whereas others (e.g., infiltration trenches, filter strips, and constructed wetlands) are intended to be in service for much longer time periods.

Detention Basins: These generic structures are designed for the temporary capture and storage of surface runoff during storm events. They are sized based on the amount of water expected to be generated during specific (i.e., design) storm events. For example, a storm producing a given amount of precipitation during a specific period (e.g., day, week, etc.) over an urban landscape having an inherent infiltration capacity will generate an amount of surface water runoff that can be predicted using values estimated for a handful of critical watershed modeling parameters (e.g., hydrologic soil group, SCS curve number, land slope, and rainfall intensity and duration). The settling velocity for sediment and attached pollutants is also considered in determining basin size.

Constructed Wetlands: Constructed wetlands (or constructed treatment wetlands) are essentially artificial shallow water-filled basins that have been planted with emergent plant vegetation. They are typically designed to achieve specific water quality objectives before the water is released, and can be an efficient method for removing a wide variety of pollutants including suspended solids, nutrients, heavy metals, toxic organic pollutants, and petroleum compounds. Constructed wetlands are also an effective means of reducing peak runoff rates and stabilizing flow to adjacent natural wetlands and streams.

Low Impact Development: Low impact development practices collectively refers to the use of innovative design strategies within an urban setting with the goal of simulating pre-development landscapes with respect to hydrologic function. With such practices, the objective is to generally increase hydrologic storage, retention, infiltration, groundwater recharge, etc. to limit the effects of excessive runoff in urban areas. Although low impact development practices are typically used for controlling stormwater runoff, they often provide the beneficial secondary effect of reducing pollutant loadings to receiving waters as well. The approaches most commonly used and studied include bioretention areas, grass swales, permeable pavements, and vegetated roof tops.

BMP	Effectiveness	Cost
Detention basin (urban)	51%	$10,700 per acre
Constructed wetland	51%	$13,400 per acre
Bioretention area	61%	$8,000 per acre

Stormwater Management Practices: Stormwater management practices are designed to reduce the discharge of pollutants to the maximum extent practicable by promoting six control measures:

1. Public education and outreach on stormwater effects;
2. Public involvement and participation;
3. Illicit discharge detection and elimination;
4. Construction site stormwater runoff control;
5. Post-construction stormwater management; and
6. Pollution prevention and good housekeeping for municipal operations.

NYSDEC finalized their Stormwater Management Design Manual in August 2010 (http://www.dec.ny.gov/chemical/29072.html) in which they specify enhanced phosphorus removal standards for projects in phosphorus-impaired watersheds. This Manual addresses items 4 through 6 above. The standards described in this manual could be applied in the limited urban areas in this Upper Oak Orchard Creek watershed to prevent additional significant phosphorus loads from this source category.

SEPTIC SYSTEM OPTIONS

Wastewater discharges considered include on-site septic systems within the watershed being evaluated. The specific wastewater reduction options evaluated include:

1. Inspection and monitoring (with inspection done by excavating site);
2. System repairs;
3. Upgrade systems to tertiary treatment;
4. Connecting systems to secondary wastewater treatment plants; and
5. Connecting systems to tertiary wastewater treatment plants;

CEI used values for nutrient reduction efficiencies provided in the PRedICT documentation for each of the wastewater alternatives described above. These values are based on information provided in various wastewater technology textbooks. While these values are believed to be reasonable estimates, they are still only approximate since wastewater treatment technology can vary widely, and must be revised if necessary based on local treatment plant characteristics.

Table 2 summarizes all of the BMPs considered in development of the improvement scenarios discussed in this section. Many of the BMPs listed in the Agriculture Category are applicable to several Sub-Categories but are only listed once under the most appropriate Sub-Category.

Wetland Reserve: The following describes the practice of diverting stream flow through either existing or constructed wetlands to benefit from the natural attenuation of phosphorus in these systems.

Stormwater Drainage and Retention: Drainage has been a major means of land for generations, and it works. Massive amounts of private and public funds were invested in creating and improving drainage channels, and most private farmland in upstate New York contains at least some buried tile drainage.

Cropland, including orchards, was drained in order to improve soil conditions for tillage and planting, to allow deeper penetration of crop root systems, and to increase per-acre yields. Development land was also drained, to stabilize foundations, eliminate flooding, improve access, and eliminate pests.

Though much land was artificially drained (more than half of the wetlands in the Northeast were converted to other uses), soil conditions known as “hydric soils” remain as markers of soils that developed in oxygen-poor, wetland conditions.

In the Salmon Creek watershed, agricultural drainage ditches were created which straightened and deepened the natural stream system. The main stem of Salmon Creek was not directly altered, but the cumulative effect of many smaller changes to the stream system and the addition of underground drainage in the agricultural and development land caused instability in Salmon Creek's channel and banks. Eroded materials were swept into the harbor. In addition, wherever possible and feasible, wetlands were ditched, drained, and eliminated or converted to other uses. Undoubtedly, private landowners benefited from these changes.

But few large land use changes are entirely for the better. Many also have costs, though it may take years to recognize them. Excessive drainage of a watershed can lead to water quality and quantity problems.

In the Salmon Creek watershed, poor conditions in Pultneyville harbor are attributable to land use changes in the watershed. Eroded material carried from fields and stream banks would settle in the harbor, necessitating dredging to maintain boating access. Excessive drainage in the upstream portion of the watershed has led to a boom-and-bust hydrologic cycle: floods in the spring during periods of high runoff followed by lack of streamflow in the summer. Spring-time flooding and summer "gully-washers" damage adjacent properties. The lack of stream flow in summer impacts habitat for fish populations trying to use the stream for spawning. Sediments clog spawning grounds. Removal of forests and stream-buffering vegetation leads to higher water temperatures, lower oxygen levels and less diversity of aquatic life.

A boom-and-bust hydrologic cycle affects water quality by promoting the erosion of soil from the stream banks and by transporting pollutants such as nutrients more efficiently to the harbor.

Promoting longer retention of surface water runoff in the Salmon Creek watershed would improve both water quality and quantity.

1. Longer retention could be promoted by protecting the watershed's existing wetlands, especially the larger ones such as those north of NYS Rte. 104 near the intersection of Pound Road and those south of Ridge Road on both sides of the intersection with Eddy Ridge Road. Stormwater would be both detained and "cleaned" by longer retention in these natural wetlands.
2. Wetlands that have been reduced or damaged by previous activities should be assessed and, where possible, restored to function. The Wayne County Soil Map (USDA-NRCS, 1978) contains information on hydric soils and photographic records of earlier conditions. Federal aerial photography from 1938 and 1954 can be scanned to track land use changes. Restoration of wetland function usually involves the destruction of artificial drainage systems and the creation of dikes across previously drained areas.
3. Opportunities to store more of the watershed's runoff in wetlands and ponds should be pursued. The best sites for such storage will be flat, containing hydric soils, in rural locations, outside but near a stream channel, and on existing public or quasi-public property.
4. Detaining runoff in ponds constructed for that purpose would allow some treatment to improve water quality to take place, and metered flows from detention ponds, along with flows from restored wetlands and re-forested areas, would provide adequate flows for better fish habitat through the summer months.
5. Installation or improvement of buffering vegetation along stream banks in the watershed should be promoted. Domestic animals and their waste should excluded from streams by

fencing. Trees and shrubs should be planted to provide a seventy-five-foot buffer between the stream and other land uses such as plowed fields, development sites, and/or parking lots. Such buffer strips shade the stream, stabilize the stream banks, and intercept and "clean" nutrients from runoff and shallow groundwater.

6. The growth of impervious surfaces in the Salmon Creek watershed should be mitigated through municipal stormwater management regulations. New facilities should contain mitigative features such as green infrastructure that would guarantee post-construction runoff of the same quantity and quality as before construction.

Table 2: Summary of Best Management Practices (BMPs)

Category	Subcategory	BMP	Effectiveness
Agriculture	Cropland	Vegetative buffer strips	52%
		Contour farming / strip cropping (BMP3)	40%
		Cover crops (BMP1)	36%
		Crop rotation (BMP1)	36%
		Crop residue management (BMP2)	38%
		Streambank stablization	95%
		Nutrient management (BMP6)	28%
		Terraces and diversions (BMP8)	42%
	Cropland/Hay/Pasture	Ag land retirement to wetland (BMP5)	98%
		Ag land retirement to forest (BMP4)	94%
	Hay/Pasture	Streambank fencing	78%
		Grazing land management (BMP7)	34%
	Tile Drainage	Nutrient management (BMP6)	28%
	Farm Animals	AWMS Livestock (confined area)	75%
		AWMS Runoff control (confined area)	15%
		AWMS Karst Soils	Unknown
		Alternative manure use - composting	70%
		Alternative manure use - ADG to electricity	70%
		Manure incorporation in soil	25%
		Manure injection in soil	50%
		Precision Feed Management	35%
Forest/Other	Forest	Tree planting	Unknown
Wastewater	Point Sources	WWTP - Secondary to tertiary treatment	60%
		WWTP - Primary to secondary treatment	10%
		WWTP - Primary to tertiary treatment	60%
Urban Stormwater	LID/HID	Stormwater management practices	75%
		Bioretention area	61%
		Detention basin (urban)	61%
		Constructed wetland (urban)	51%
Septic Systems	Septic Systems	Inspection/Monitoring	5%
		Septic system repairs	80%
		Upgrade septic systems to tertiary treatment	60%
		Connect septic to sewer w/secondary treatment	10%
			:CEI Assumption

APPENDIX III: WATER QUALITY DATA

CEI Data, 2010

The tables below provide the results of the sampling and analysis conducted by CEI in 2010.

Sampling Location	Date	Total Phosphorus (µg/L)	Nitrate + Nitrite (mg/L)	Total Suspended Solids (mg/L)	Soluable Reactive Phosphorus (µg/L)	Total Nitrogen (µg/L)
P1	10/21/2010	180.5	0.63	1.0	92.7	1.22
P2 (SC3)		83.3	0.47	3.0	64	1.17
P3		115.2	0.27	0.1	97.2	1.08
P4		52.7	1.02	1.1	38.4	1.78
P5		305.6	0.17	4.4	202.2	1.10
P6 (SC2)		205.4	0.26	8.1	81.2	1.24
P1	11/8/2010	95.7	1.26	3.0	68.3	2.01
P2 (SC3)		89.4	1.14	1.4	62.7	1.98
P3		119.7	0.99	1.3	79.4	2.10
P4		52.6	1.42	1.1	33.7	2.44
P5		115.1	0.72	2.1	84.0	1.26
P6 (SC2)		109.2	0.67	3.4	55.2	1.42

Sediment samples were taken in Pultneyville Harbor by CEI. The results of the analysis of those samples is provided below.

Sample	Core	Depth (inches)	% Water	Sediment Lead (mg Pb/kg DW)
1	1A	0 - 1	46.1	13.8
	1B	2.5 - 3.5	49.0	17.6
	1C	5.5 - 6.5	35.4	17.5
2	2A	0 - 1	62.3	30.3
	2B	2.5 - 3.5	39.3	25.7
	2C	5.5 - 6.5	38.0	14.0

Wayne County Data, 2000

The Wayne County Soil and Water Conservation District (SWCD) took the only other water quality data that could be found. Their samples were taken in 2000 at eight locations, two of which (SC2 & SC3) were the same as CEI used in their 2010 sampling (P2 & P6). The results of both of those sampling events are summarized in the tables below.

Date	Location	TP (µg/L)	TKN (mg/L)	DO (mg/L)
7/17/2000	SC1	1063.9	370	7.25
8/2/2000	SC1	1329.4	760	5.77
8/14/2000	SC1	937.5	460	7.18
8/27/2000	SC1	2991.1	720	6.11
9/11/2000	SC1	2792.6	1180	6.25
	SC2	2229.5	970	
9/25/2000	SC1	724.4	900	7.25
	SC2	2968.1	1450	
10/10/2000	SC1	2634.2	820	8.70
	SC2	1229.2	1470	
	SC3	70.9	590	
10/23/2000	SC1	24.0	840	7.85
	SC3	70.7	840	
	SC4	1963.1	1140	
11/20/2000	SC1	361.0	710	7.59
	SC5	145.0	870	
	SC6	94.0	660	
12/4/2000	SC1	71.1	560	11.28
	SC7	35.6	720	
	SC8	83.9	210	
12/18/2000	SC1	167.9	530	10.00
	SC2	141.4	550	
	SC3	138.4	630	

SWCD Water Quality Data by Date

Date	Location	TP (µg/L)	TKN (mg/L)	DO (mg/L)
7/17/2000	SC1	1063.9	370	7.25
8/2/2000		1329.4	760	5.77
8/14/2000		937.5	460	7.18
8/27/2000		2991.1	720	6.11
9/11/2000		2792.6	1180	6.25
9/25/2000		724.4	900	7.25
10/10/2000		2634.2	820	8.70
10/23/2000		24.0	840	7.85
11/20/2000		361.0	710	7.59
12/4/2000		71.1	560	11.28
12/18/2000		167.9	530	10.00
9/11/2000	SC2	2229.5	970	
9/25/2000		2968.1	1450	
10/10/2000		1229.2	1470	
12/18/2000		141.4	550	
10/10/2000	SC3	70.9	590	
10/23/2000		70.7	840	
12/18/2000		138.4	630	
10/23/2000	SC4	1963.1	1140	
11/20/2000	SC5	145.0	870	
11/20/2000	SC6	94.0	660	
12/4/2000	SC7	35.6	720	
12/4/2000	SC8	83.9	210	

SWCD Water Quality Data by Sampling Site

CEI Data, 2011

Sample Location	Date Collected	TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	SRP (µg P/L)	TN (mg N/L)	Turbidity (NTU)	Coliform CFU/100ml
1	7/12/2011	219.7	3.43	1.1	201.8	4.08	2.99	18100
1	7/26/2011	498.4	1.52	3.3	409.7	2.10	2.08	15800
1	8/9/2011	494.0	0.87	21.4	398.3	1.68	11.2	14400
1	8/23/2011	202.1	1.29	3.8	186.1	2.03	2.92	13100
1	8/25/2011	185.8	0.73	21.3	108.0	1.44	23.3	78000
1	9/6/2011	188.9	1.27	4.6	150.1	1.92	3.18	33300
1	9/20/2011	156.7	0.86	6.0	115.9	1.41	2.71	11600
1	10/16/2011	139.3	1.34	6.6	106.3	2.21	6.12	4600
2	7/12/2011	181.1	0.26	1.2	169.7	0.89	1.61	5000
2	7/26/2011	318.2	0.25	5.1	261.7	0.81	3.07	12400
2	8/9/2011	363.2	0.65	24.7	218.7	1.44	9.5	14200
2	8/23/2011	161.7	0.91	4.3	132.2	1.60	3.44	9000
2	8/25/2011	225.2	3.24	16.7	149.5	4.89	8.3	72000
2	9/6/2011	235.9	1.00	6.4	168.5	1.79	4.05	25600
2	9/20/2011	102.4	0.57	2.0	68.0	1.21	2.42	6600
2	10/16/2011	163.7	0.95	2.4	122.4	1.91	2.96	2800
3	8/9/2011	315.9	0.30	13.4	216.2	1.35	6.02	76000
3	8/23/2011	281.4	0.87	3.2	242.2	1.93	4.43	2000
3	8/25/2011	338.2	0.58	8.7	233.4	1.83	4.75	35000
3	9/6/2011	278.0	0.57	5.9	200.0	1.46	2.91	13600
3	9/20/2011	198.3	0.45	0.1	152.3	1.31	0.95	6000
3	10/16/2011	161.3	0.65	3.0	111.1	1.77	2.53	2400
4	8/23/2011	572.0	0.22	61.0	98.9	1.86	33.0	NA
4	8/25/2011	316.2	0.17	26.7	115.0	2.03	11.4	26000
4	9/6/2011	155.5	0.20	4.9	98.8	1.20	2.04	16300
4	9/20/2011	173.6	0.20	12.8	97.3	1.13	2.35	16700
4	10/16/2011	114.2	0.72	8.0	52.8	1.64	3.71	2300
5	7/12/2011	2225.1	0.30	12.5	2154.3	1.79	6.51	46000
5	7/26/2011	1732.0	0.15	8.1	1349.6	1.23	3.61	96000
5	8/9/2011	732.6	0.27	13.7	398.1	1.23	8.86	36000
5	8/23/2011	203.7	0.51	4.5	170.2	1.27	3.35	16100
5	8/25/2011	168.3	0.43	11.2	133.1	0.96	8.72	90000
5	9/6/2011	153.0	0.92	2.4	130.0	1.46	2.38	34900
5	9/20/2011	164.5	0.51	10.4	102.4	1.11	3.87	26000
5	10/16/2011	92.4	1.10	2.3	77.1	1.73	2.45	8500
6	7/12/2011	2539.3	0.05	27.7	2323.2	1.85	16.3	48000
6	7/26/2011	2160.6	0.03	22.9	1793.7	1.18	15.4	132000
6	8/9/2011	1074.2	0.10	158.0	398.1	1.87	121	64000
6	8/23/2011	150.1	0.22	16.5	49.2	1.27	14.2	17200
6	8/25/2011	115.7	0.59	8.8	76.8	1.20	8.33	60000
6	9/6/2011	315.4	0.53	64.8	163.3	1.66	38.5	36200
6	9/20/2011	137.4	0.24	8.0	52.5	1.05	3.86	35400
6	10/16/2011	76.4	0.94	2.1	56.8	1.65	3.30	10400
7	7/12/2011	118.2	N.D.	7.0	90.6	0.68	3.49	5800
7	7/26/2011	251.2	N.D.	9.9	93.8	1.15	8.65	166000
7	8/9/2011	109.9	0.11	15.9	75.7	0.65	7.84	60000
7	8/23/2011	95.5	0.50	3.3	49.8	1.20	3.09	5600
7	8/25/2011	122.2	0.72	8.3	81.4	1.56	3.21	40000
7	9/6/2011	111.2	0.89	4.6	79.1	1.63	4.10	20400
7	9/20/2011	75.5	0.42	4.3	41.2	0.82	1.85	11000
7	10/16/2011	90.8	0.91	3.6	58.9	1.76	6.74	12100
8	7/12/2011	482.5	0.73	61.0	163.0	2.16	24.5	6700
8	7/26/2011	313.1	0.09	19.3	108.0	0.76	11.6	26300
8	8/9/2011	198.6	0.31	29.2	82.6	0.87	32.2	66000
8	8/23/2011	125.3	0.97	2.2	79.3	1.67	3.46	NA
8	8/25/2011	158.3	0.87	7.2	100.3	1.90	6.17	58000
8	9/6/2011	140.8	0.97	5.7	90.2	1.74	3.58	22100
8	9/20/2011	94.5	0.86	2.1	64.5	1.12	1.47	14800
8	10/16/2011	106.2	0.97	2.7	67.7	1.86	4.41	8300