LowerGanargua Creek Watershed Assessment

2012 - 2013

Wayne County Soil & Water Conservation District

10 Leach Road, Lyons, New York 14489

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Introduction and Background

A watershed can be defined as any land area in which water drains to a common point. When beginning to look at how land is managed and the resulting impacts upon the landscape, it becomes increasingly clear that what is done on the land will ultimately affect the receiving waterbody. The concept of *Watershed Management* is to look broadly at the multiple land uses (agriculture, development, etc.) to determine their impacts and to find ways to mitigate them to protect these waterbodies.

Through a combination of field work, resource evaluation, and mapping, an assessment of the watershed can help determine and outline upland issues that affect water quality. This *Watershed Assessment* then serves as the basis for finding appropriate funding opportunities to address sources of pollution within the watershed.

The resulting document will expectantly serve as a guideline for restoration and improvements within the watershed, which will ultimately improve the water quality and ecology.

Stream and Watershed Characteristics

Lower Ganargua Creek (0704-0026) originates at Swift's Landing Park in Palmyra, New York, where it outfalls from the NYS Barge Canal and combines with Red Creek West (0704-0033). The Park is located at 4100 Hogback Hill Rd, Palmyra. The creek flows east through the towns of Arcadia and Lyons, emptying into the NYS Barge Canal at Abbey Park, 177 Water St., in the village of Lyons. Lower Ganargua Creek has numerous tributary streams including its largest, Red Creek East (0704-0015) which empties into it just north of the "T" intersection of Whitbeck and Tellier Roads near the hamlet of East Palmyra. Not including Red Creek East, Lower Ganargua Creek and its smaller tributaries are approximately 71.5 miles (380,000 ft.) in length. The Lower Ganargua Creek watershed, excluding Red Creek East, is approximately 28,500 acres in size. Information regarding Red Creek West and Red Creek East can be found in the reports Makarewicz et al. 2010 and Makarewicz et al. 2011.

Lower Ganargua Creek Watershed

Stream Morphology and Classification

The main stem of Lower Ganargua Creek is a fourth order stream with its main tributaries entering from the northern portion of the watershed. Based on aerial photography examination, the main channel width from bank to bank ranges from 50 to 140 feet as it meanders through the watershed. Using USGS Quadrant topographic maps, the slope of the main channel of Lower Ganargua Creek was found to be approximately 0.02 percent, which is common for main stems of riparian waterbodies. The slopes of the tributaries to this stream range from approximately 0.20 to 0.55 percent.

New York State Department of Environmental Conservation (NYS DEC) *2008 Oswego River/Finger Lakes Basin Waterbody Inventory/Priority Waterbodies List* report classified Lower Ganargua Creek as a C stream with *minor impacts* that stress aquatic life. For class C waters, the best usage 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" (Chapter X – Division of Water, Section 701.8). Waterbodies with 'Minor Impacts' are waters with "less severe water quality impacts are apparent, but uses are still considered fully supported." The Waterbody Inventory Data Sheet for Lower Ganargua Creek states that the pollutant type is known to be ‘Nutrients’ (phosphorus), suspected to be ‘Silt/Sediment’, and possibly ‘Dissolve Oxygen/Oxygen Demand.’ The Data Sheet states that the major known sources of the pollutants are ‘Construction (development)’ and ‘Urban/Storm Runoff’ while ‘Municipal (Newark Wastewater Treatment Plant)’ contributes a lesser portion. ‘Agriculture’ is also a suspected source of the pollutants. The Data Sheet indicates the resolvability of the impairment requires the evaluation of possible solutions and/or the development of management action. The Data Sheet continues with the assumption that most details about the problem are known and sufficiently documented and that a management strategy to address the situation and restore the designated use of the waterbody needs to be developed. The Resolution Potential noted is Medium, meaning the resources necessary to address the problem are beyond what are currently available. The ‘Further Details’ section of the Data Sheet continues discussing that a macroinvertebrate survey (1996) at multiple sites on Lower Ganargua Creek indicated slightly impacted water quality conditions across most of the stream but noted that moderate impacts were observed in Mud Mills below the Newark Wastewater Treatment Plant (Bode et al., 1996). A previous sampling in 1980 indicated that there were only slight impacts found in this section of the stream and this may indicate a worsening of conditions. According to the Waterbody Inventory data sheet, the Newark Wastewater Treatment Plant experiences high plant flows resulting from inflow/infiltration problems in the collection system and a constriction in the effluent line also restricts the ability to handle wet weather event flows. It is noted that resolution to these problems are being discussed.

<u>Water Quality</u>

Historical water quality data for Ganargua Creek is limited. This project was designed to assess and further identify potential sources of pollution that impact Lower Ganargua Creek. The nine sampling sites were chosen based on location along the main channel, at the outlet of sub-watersheds, and ease of access (bridges, culverts, etc.). Samples were collected twice per month at the nine locations from May 2012 to October 2012, and May 2013. Samples were collected once per month for November 2012 and from January 2013 to April 2013. Samples were transported on ice to the Water Chemistry Laboratory at The College at Brockport, State University of New York, for water chemistry analysis of total phosphorus (TP), total Kjeldahl nitrogen (TKN), nitrate + nitrite, and total suspended solids (TSS). Variability existed in the concentrations of nutrients from the nine sampling sites. This is due to differences in land uses as well as point and nonpoint sources across the watershed. Lower Ganargua Creek is often noted to be fairly turbid. It is locally known that this is due to its mixing with the Erie Canal as it flows through Palmyra.

Water quality sampling locations

Total Phosphorus

Phosphorus as phosphate is one of the major nutrients required for plant growth and is often considered the ‘limiting’ nutrient in New York freshwaters. Sources of phosphorus include animal wastes, sewage, detergent, fertilizer, disturbed land, and road salts. U.S. Environmental Protection Agency recommended water quality standard for flowing waters entering a lake is 50 µg/L and 100 µg/L for all other streams (USEPA, 2012). Wisconsin Department of Natural Resources established a phosphorus water quality standard for flowing waters entering lakes at 75 µg/L and 100 µg/L for all other streams and rivers (Wisconsin, 2010). The NYS DEC Stream Biomonitoring Team, in conjunction with the University of Albany, Department of Biological Sciences, suggests a phosphorus threshold limit of 65 µg/L between mesotrophic and eutrophic conditions in flowing streams (Smith et al., 2006).

Site 5, considered the west branch of Fairville Creek (0704-0032), had the highest mean concentrations of total phosphorus for both non-event and event conditions (Table 1). A majority of the sites monitored exceeded the DEC Biomonitoring Team’s suggested threshold value for non-event and event conditions. There was little variation between event and non-event phosphorus concentrations at Site 2, locally known as Butternut Run, possibly due to a limited number of event based samples.

Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen is the combination of organically bound nitrogen and ammonia. Sources of these forms of nitrogen include sewage effluent and runoff from land where manure has been applied or stored.

Site 4, considered the east branch of Fairville Creek (0704-0032), had the highest mean concentrations of total Kjeldahl nitrogen for both non-event and event conditions (Table 1). Compared to TKN data from other streams within Wayne County (Makerawicz et al. 2010 and 2011), Lower Ganargua Creek's TKN concentrations were noticeably less.

Nitrate + Nitrite

Nitrate is the form of nitrogen that is most readily available for plant uptake. It is more easily detected as Nitrate + Nitrite, or NO_x (Nitrite is not commonly found in surface waters but is created as nitrate converts to nitrogen gas during denitrification). Nitrate sources include soil, animal wastes (including birds and fish), sewage and septic systems, fertilizers and decaying vegetation. The NYS DEC water quality standard for nitrate is 10 mg/L. The United States Geological Survey (USGS) states that background nitrate concentrations for undeveloped watersheds is 0.6 mg/L (USGS, 1999).

Site 7, located west of the Village of Newark, had the highest non-event concentrations of nitrate, 1.1 mg/L, (Table 1) and were higher than concentrations observed in other Wayne County streams (Makerawicz et al. 2010 and 2011). Site 5 had the highest mean concentrations of nitrate under event conditions, 1.8 mg/L.

Total Suspended Solids

Total suspended solids (TSS) is a measure of soil particles and other materials suspended in water. Water-borne sediments act as an indicator, facilitator and agent of pollution (Makerawicz et al. 2011). As an indicator, TSS adds hue to water. As a facilitator, sediments transplant other pollutants such as nutrients and toxic substances. As an agent, sediments smother organisms and cover habitats used by some species for spawning.

Seven of the nine sampling sites had mean non-event concentrations of TSS in excess of 10 mg/L, ranging from 11.2 mg/L at Site 1 to 18.7 mg/L at Site 7. The highest mean concentrations of TSS under event conditions were found at Site 1, 33.9 mg/L, and Site 3, 28.8 mg/L. Seven of the nine sampling sites had mean TSS event concentration of 20 mg/L and higher. Concentrations of TSS was noticeably higher throughout the spring and summer months, which is most likely due to the lock activity during popular tourism seasons.

Table 1. Mean non-event and event concentrations of total phosphorus (TP), Nitrates, total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) observed in Lower Ganargua Creek and other Wayne County tributaries.

Mean Non-event Concentrations				
Ganargua Creek Sampling Sites, May '12 - May '13				
	TP (μg/L)	Nitrate (mg/L)	TSS (mg/L)	TKN (μg/L)
Site 1	61.38	0.79	11.16	448.18
Site 2	54.90	0.32	5.40	584.29
Site 3	75.06	0.69	18.62	433.64
Site 4	95.08	0.59	13.26	710.83
Site 5	148.98	0.58	4.61	507.00
Site 6	71.63	0.82	15.53	374.00
Site 7	87.39	1.08	18.70	459.09
Site 8	77.77	0.70	13.31	385.45
Site 9	91.09	0.75	13.08	358.00
Wayne County Tributaries				
	TP (μg/L)	Nitrate (mg/L)	TSS (mg/L)	TKN (μg/L)
Canandaigua Outlet '09 - '10	47.75	1.03	2.97	590.18
Glenmark Creek '09 - '10	39.25	0.77	3.23	535.88
Crusoe Creek '09 - '10	103.45	0.11	3.39	1201.86
Black Brook '09 - '10	55.32	0.46	10.96	848.69
Red Creek East '09 - '10	127.66	0.28	4.44	939.85
Red Creek West '09 - '10	98.48	0.24	3.16	710.40
Salmon Creek West '10*	N/A	N/A	N/A	N/A
Maxwell Creek '10	252.30	0.34	2.00	754.00

Table 1 Continued.

Mean Event Concentrations				
Ganargua Creek Sampling Sites, May '12 - May '13				
	TP (µg/L)	Nitrate (mg/L)	TSS (mg/L)	TKN (µg/L)
Site 1	106.27	0.91	33.89	430.00
Site 2	52.25	0.72	3.48	365.00
Site 3	99.40	0.68	28.78	506.67
Site 4	111.17	0.95	8.42	776.67
Site 5	237.37	1.80	20.60	543.33
Site 6	94.07	0.91	26.44	396.67
Site 7	109.93	0.87	27.64	446.67
Site 8	81.40	0.76	21.48	336.67
Site 9	91.90	0.56	23.51	430.00
Wayne County Tributaries				
	TP (µg/L)	Nitrate (mg/L)	TSS (mg/L)	TKN (µg/L)
Canandaigua Outlet '09 - '10	72.28	1.80	13.55	1449.00
Glenmark Creek '09 - '10	91.38	0.79	20.50	800.78
Crusoe Creek '09 - '10	138.47	0.17	7.46	1067.94
Black Brook '09 - '10	70.26	0.83	17.66	968.60
Red Creek East '09 - '10	132.58	0.49	9.76	842.41
Red Creek West '09 - '10	110.53	0.35	7.08	743.03
Salmon Creek West '10	162.20	2.13	4.60	990.00
Maxwell Creek '10	222.40	1.26	8.40	802.00

Hydrologic Soil Groups

Hydrologic soil group (HSG) is a group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. Wetness characteristics, water transmission after prolonged wetting, and depth to slowly permeable layers are properties that influence runoff potential. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. Hydrologic soil groups are important in the planning watershed-protection and flood-prevention projects as well as for planning or designing structures for the use, control, and disposal of water.

The four hydrologic soil groups (HSGs) are described as:

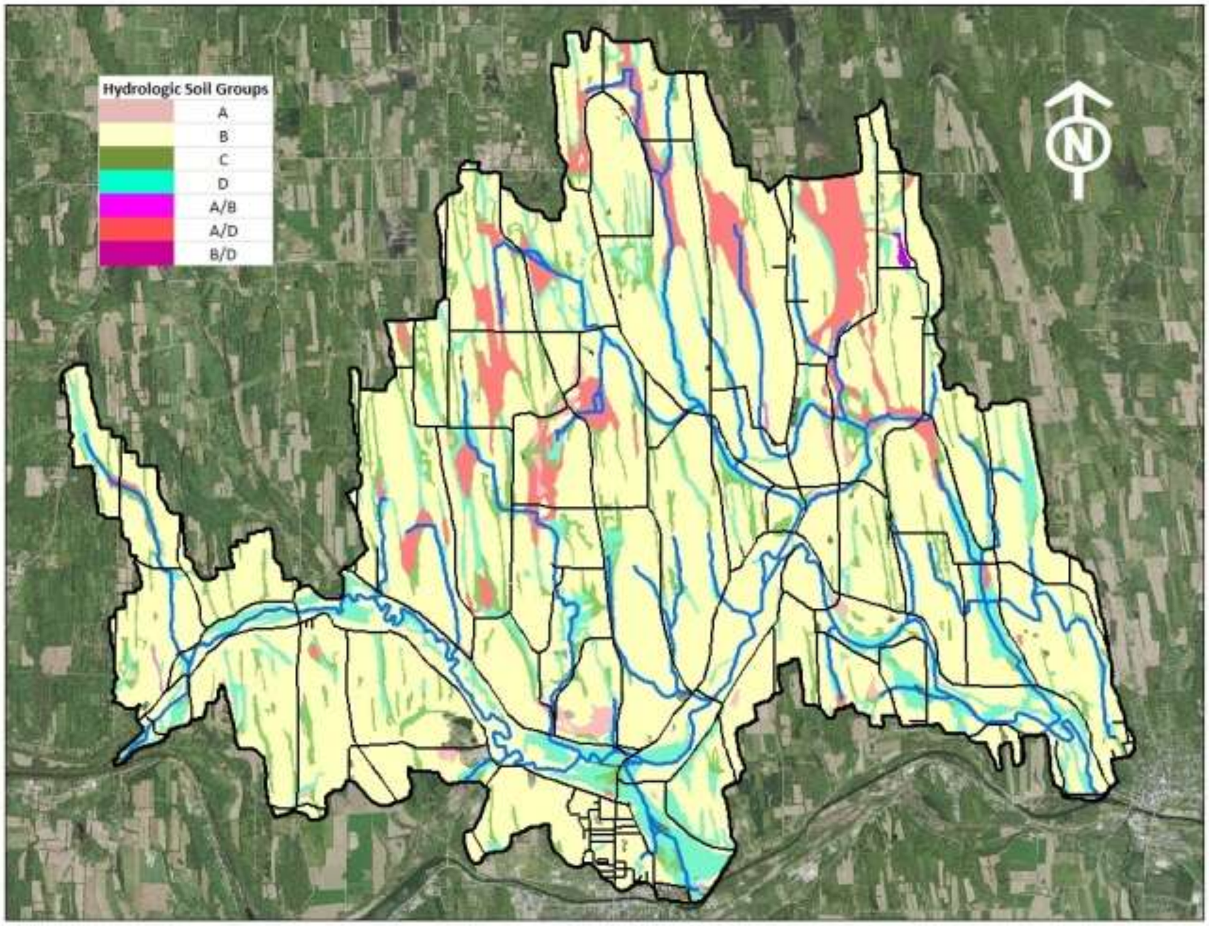
Group A—Soils in this group have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 in/hour).

Group B—Soils in this group have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hour).

Group C—Soils in this group have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hour).

Group D—Soils in this group have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hour).

Dual hydrologic soil groups—Certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the ease with which pores of a saturated soil permit water movement may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their ability to allow water movement and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition.



Lower Ganargua Creek – Hydrologic Soil Groups

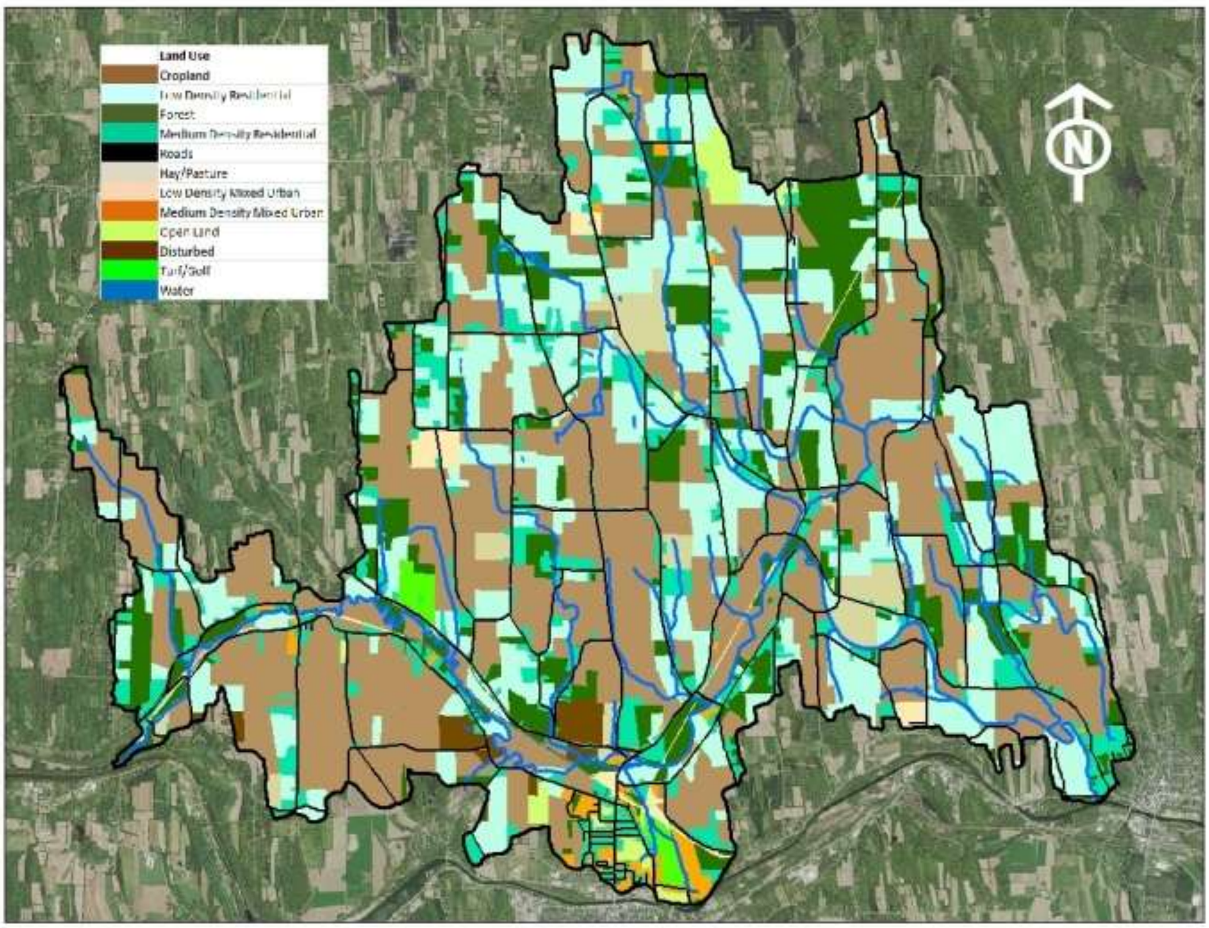
Land Use

The land use and land cover patterns (permeability) in a watershed have a significant impact on the overall quality of the receiving waterbody. Knowing the extent of development in a watershed and where the development is located can play a key role in the contaminant loading to a waterbody. In general, as land uses occur, stream systems and overall waterbody health can become diminished through changes in runoff and other human impacts.

Land use categories observed in the Lower Ganargua Creek watershed categorized as:

- *Water* – includes lakes, ponds, and streams
- *Hay/Pasture* – includes plant and tree nurseries, fruit orchards, livestock grazing areas
- *Cropland* – includes mucklands, field crops, and dairy products
- *Forest* – includes various vacant lands, public parks, and private forests
- *Disturbed (land)* – includes mining and quarry operation and a dirt motorsports track
- *Turf/Golf* – includes golf courses and country clubs
- *Open Land* – includes outdoor recreation facilities, skiing center, cemeteries, landfill

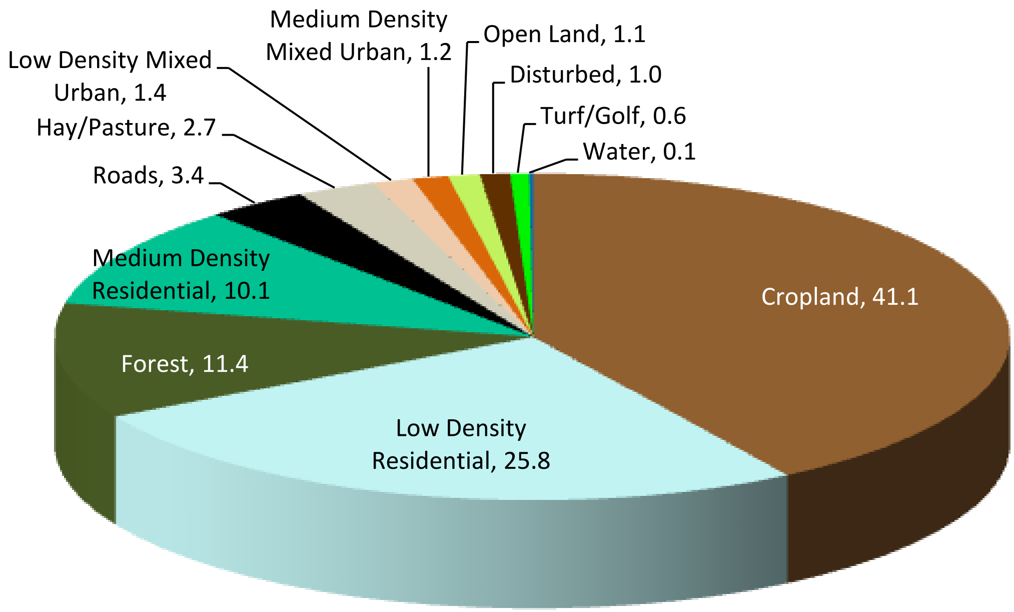
- *Low Density Residential* – includes rural, primary residence with acreage including agricultural land
- *Medium Density Residential* – includes multi-family residence, mobile homes, and residence with commercial uses
- *Low Density Mixed Urban* – includes small commercial operations and mobile home parks
- *Medium Density Mixed Urban* – includes commercial operations such as shopping centers, office buildings, downtown row-type structures, apartments buildings, inns and lodging; community services such as schools, hospitals, emergency services, religious and cultural facilities; industry such as light and heavy manufacturing process; and public services such as electric, gas, telephone, and sewages treatment



Land uses in the Lower Ganargua Creek Watershed

Figure 1 provides a fairly accurate representation of current land uses within the Lower Ganargua Creek watershed. It is important to note that the Low Density Residential category has a high probability of containing agricultural lands. With that in mind, in combination with Cropland and Hay/Pasture, approximately 70% of the watershed is made up of some form of agricultural land. This information can be used in conjunction with water quality data to determine potential areas of concern and aide in prioritizing implementation efforts to reduce pollution loading.

Figure 1. Percent Land Use, Lower Ganargua Creek



Wetlands

As per NYS DEC, wetlands "are areas saturated by surface or ground water sufficient to support distinctive vegetation adapted for life in saturated soil conditions." Wetlands provide flood and storm water control by absorbing, storing, and slowing the movement of runoff. They provide erosion control by slowing water velocity, filtering sediment, and by buffering streambanks and shorelines. Wetlands treat pollution and cycle nutrients back into the environment by filtering out natural and manmade pollutants, which are then broken down or immobilized. Wetlands provide important habitat for feeding, nesting, and spawning fish and wildlife including rare and endangered species. Lastly, wetlands give humans areas for recreation, education, and research opportunities.

The Lower Ganargua Creek watershed has approximately 4,200 acres of NYS DEC regulated wetlands consisting of forest/shrub wetlands, ponds, emergent wetlands, and riverine wetlands. Wetlands in NYS are protected by the Freshwater Wetlands Act (1975) "with the intent to preserve, protect and conserve freshwater wetlands and their benefits, consistent with the general welfare and beneficial economic, social and agricultural development of the state."

Water Quality Issues and Recommendations

The purpose of this assessment is to serve as a guideline for restoration and improvements within the watershed. By identifying potential and current water quality problems, watershed management recommendations can be made and implemented.

Stormwater Runoff

Stormwater Runoff is considered one of the top ten (10) water quality issues in New York State. Runoff transported by precipitation or snow melt carries pollutant (such as nutrients and sediment in the case of this report) to waterbodies, causing negative impacts and impairments. Sources of excessive nutrients and sediment can originate from both rural and urban land uses. As evident when viewing the water quality data, Lower Ganargua Creek has elevated nutrients levels and extremely high concentrations of sediment throughout the stream.

Being that a significant portion of the watershed is considered agricultural land, strong emphasis should be place on controlling stormwater pollution sources from these areas. NYS Department of Agriculture and Market's *Agricultural Environmental Management* (AEM) program and USDA Natural Resource Conservation Service's *Environmental Quality Incentives Program* (EQIP) are specific programs that address nonpoint source pollution associated with agriculture. Both are voluntary, incentive-based programs that provide farmers with technical, and in the case of EQIP, financial assistance to help plan and implement conservation practices to meet business objectives and that address natural resource concerns.

More detailed information regarding AEM and EQIP can be found at:

http://www.agriculture.ny.gov/SoilWater/aem/index.html

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

Wayne County Soil & Water Conservation District (SWCD), the local AEM resource professional, has 23 agricultural operations within the Lower Ganargua Creek watershed enrolled in the AEM program at various 'Tiers' of the process. These operations consist of dairy, beef, other livestock, cash crop, fruit and vegetables, and grain production. Seven (7) of the operations fall under Tier 3A of the AEM program meaning that they have developed conservation plans addressing environmental concerns and opportunities tailored to farm goals. Thus, the operations are awaiting available financial, educational, and technical assistance to implement the conservation plan.

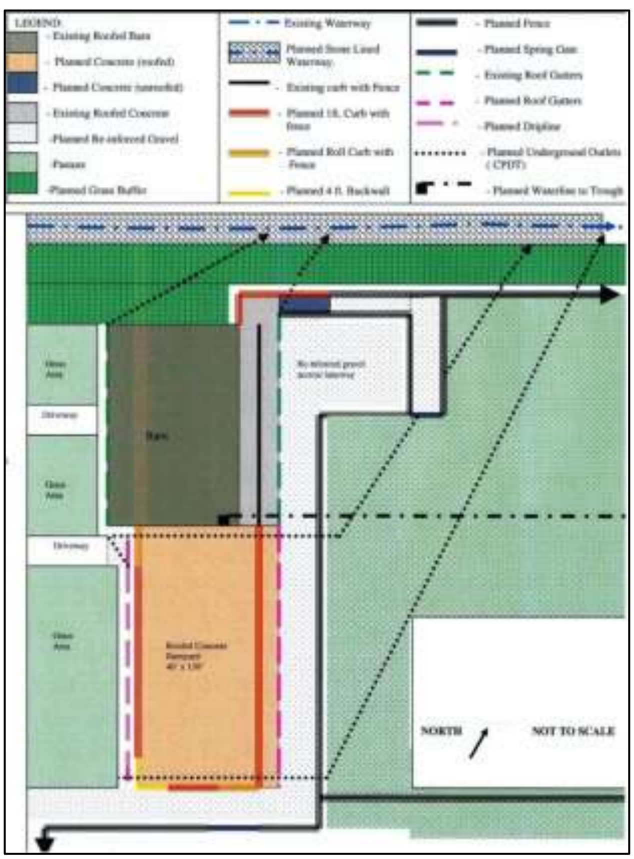
The primary concerns addressed by the conservation plans are: **erosion and sediment control, barnyard management, pasture management, manure/nutrient management, and buffers/filters**. Best management practices (BMPs) selected to address these concerns are aimed to mitigate stormwater pollution. Recommended practices to be implemented to address erosion are:

- use seasonal cover crops,
- tillage management or direct seeding,
- diversions to transport water away from sensitive areas,
- grassed waterways to slow velocity of water,
- upgrades to equipment access roads and animal trails,
- heavy use area stabilization for people, animals, and vehicles, and
- critical area planting to stabilize erodible sites.

Recommended BMPs to manage barnyard issues include:

- roof runoff structures to collect and transport clean water away from livestock areas,
- heavy use area stabilization for people, animals, and vehicles,
- exclusion fencing,
- manure management structures,
- sloped concrete surface with retaining wall to a screen collection box, and
- conveyance system to vegetated treatment area.

Barnyard area in need of runoff structures, heavy use stabilization, and manure management structures.



Left: Example of a barnyard management plan designed to contaminated runoff. Below: Installed barnyard management

Pasture management practice recommended are:

- animal exclusion fencing,
- forage harvest management,
- prescribed grazing,
- livestock watering pipeline and facility,
- improve and increase livestock forage with compatible biomass planting, and
- animal trails and access roads.

Animal trails and access roads in need of stabilization.

Manure and nutrient management suggestions for implementation include:

- developing a comprehensive nutrient management plan,
- liquid and solid waste management system,
- animal waste storage facility,
- conservation crop rotation,
- nutrient application rate, source, placement, and timing management, and
- crop residue and tillage management.

Practices to implement buffers and filter strips consist of:

- contour buffer strips to reduce erosion and prevent sediment and nutrient transport,
- herbaceous vegetation filter strip to intercept runoff, and
- riparian forest buffer along watercourses to improve wildlife habitat and intercept runoff.

Lack of adequate buffer/filter between the crop field and the stream. Photo taken during high flow conditions.

The effectiveness of the stated BMPs has been made evident through numerous studies. Cover crops have been estimated to reduce soil erosion by as much as 50% (NRCS Practice Code 340). Tillage management can reduce sediment loss by 75%, nitrogen loss by 55% and phosphorus loss by 45% (US EPA, 2003). By implementing barnyard runoff management, phosphorus loss from the site can be reduced by 60 – 90 % (Parsons, 2005; Sharpley et al., 2001). Losses of sediment, nitrogen, and phosphorus can be reduced by 60%, 80%, and 90%, respectively, by implementing animal waste management structures (US EPA, 2003). By discharging contaminated water to a vegetated treatment area, sediment, nitrogen, and phosphorus concentrations can be reduced by 60-65%, 70%, and 75-85%, respectively (US EPA, 2003). Livestock exclusion and fencing can reduce TKN concentrations by 78%, TP concentrations by 76%, and TSS by 82% (Watzin et al., 2003). Implementing nutrient management plans can reduce phosphorus by 41-71% and nitrogen by 6-55% (Watzin et al., 2003; Parsons, 2005). Total phosphorus, total nitrogen, and sediment concentrations can be reduced by as much as 45%, 55%, and 75%, respectively, by implement crop residue management (Parsons, 2005; US EPA, 2003).

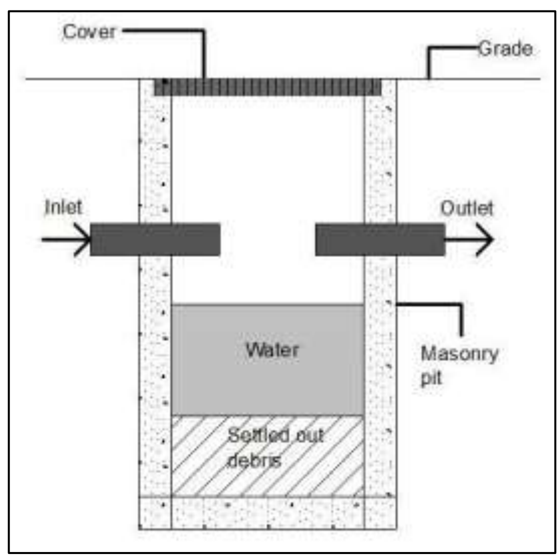
The implementation of these BMPs would have a significant impact on the reduction of nutrient and sediment pollution entering Ganargua Creek through stormwater runoff.

Stormwater runoff derived from urban areas is also a significant concern warranting attention in the Lower Ganargua Creek Watershed. NYS has found that urban stormwater is a major contributor of pollution in 37% of the state's impaired waterbodies. Urban stormwater is caused when precipitation and snowmelt water flow over impervious surfaces, such as paved streets, parking lots and rooftops, and does not infiltrate into the ground. If the runoff is not captured or is discharged without treatment, it can adversely affect the receiving waterbody.

Waters that are impaired or impacted by urban stormwater runoff occur throughout NYS, but are typically associated with major metropolitan areas such as New York City, Buffalo, Rochester, Syracuse, Albany and other highly populated centers. Stormwater control has become a significant NYS DEC initiative, most notably through the implementation of the Phase II stormwater regulations. These require urban areas to file stormwater discharge permits for Municipal Separated Storm Sewer Systems (MS4s).

The Lower Ganargua Creek watershed does not currently have any urban areas that require stormwater discharge permitting, but the importance of stormwater control should not be overlooked. Medium density populations can be found in the Villages of Newark and Lyons within the watershed. These areas have significant amounts of impervious areas and the importance of stormwater treatment and conveyance systems become essential. The Village of Newark maintains more than 35 miles of storm sewer pipe which transports stormwater, collected through catch basins, to a wastewater treatment plant.

All structural erosion and sediment control practices implemented for stormwater runoff measures must be properly maintained in order to remain functional. In the case of the Villages of Newark and Lyons, drop inlets and catch basins separate sediment and water from runoff. Inspections for sediment accumulation in catch basins should be performed on a quarterly basis and sediment and debris should be kept under 50% of the depth from the bottom of the pipe to the bottom of the basin. Grates associated with catch basis should be inspected quarterly as well as during or after major storm events, for trash accumulation which can impede water flow. Stormwater 'Ponds' associated with developed sites should be inspected annually by the site owner/operator for inlet erosion, side slope erosion, storage area sedimentation, berms/dikes condition, and overflow/spillway condition.



Example of a catch basin design cross-section

The potential for further residential and commercial development within the Lower Ganargua Creek watershed is a likely possibility, as in all watersheds. An appropriate practice in these situations is to incorporate Low Impact Development (LID). LID is an approach to develop land in a way that works with nature to manage stormwater. It employs the preservation and recreation of natural landscape features, minimizing impervious areas, and creating site drainage that addresses stormwater as a resource rather than a waste product. Practices that follow LID principles include bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. Implementing LID practices can promote natural movement of water in developed areas and can maintain/restore a watershed's hydrologic and ecological function. LID is very versatile in that it can be applied to new development, redevelopment, and as retrofits to existing development.

Maintenance of open stormwater conveyance systems, such as ditches and swales, is also important in the control and treatment of stormwater runoff. Miles of ditches crisscross throughout a watershed to drain roads and intercept runoff from adjacent slopes, effectively capturing approximately 20 percent of the runoff. Ditches rapidly move water, along with road salts, fertilizers, and viable pathogens from lawns and farms, to waterbodies where they discharge. Unprotected (non-vegetated or non-rocklined) ditches can be a significant source of suspended sediment in waterbodies, increasing turbidity and damaging wildlife habitat.

Unseeded roadside ditch observed in the Lower Ganargua Creek Watershed.

The management practices for roadside ditches have been implemented for a number of decades, many of which were put into place without consideration of impacts on downstream waterbodies. Problems associated with roadside ditch maintenance and management include:

- exposed soil during cleaning washes into waterbodies,
- ditches dug too deep, v-shaped, or have steep slopes increase water velocity and erosion,
- ditches can contribute to downstream flooding and decreases groundwater recharge, and
- stormwater runoff from residential yards, farm field, and impervious surfaces is transported directly to waterbodies without any 'treatment' for excessive nutrients, pesticides, and pathogens.

Optimal practices that protect water quality that should be taken when maintaining ditches include:

- remove as little material as possible during cleaning,
- seed immediately after cleaning,
- hydroseeding will re-establish vegetation quickly,
- reshape ditches to a shallow, trapezoidal or rounded profile that allows routine mowing,
- establish rock check dams to slow water velocities and capture sediment along steep roads,
- disconnect ditch-to-stream systems using infiltration basins, retention basins, constructed wetlands, or forested areas, and
- decrease landscape routing of stormwater to ditches using rain gardens and infiltration basins.

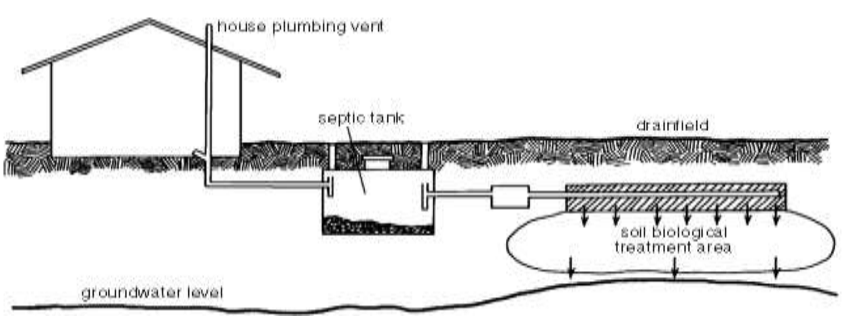
Considering the downstream impacts of ditch management, implementing the best possible practice would help significantly improve the conditions of the receiving waterbodies. With Lower Ganargua Creek's elevated levels of nutrients and sediments, implementing stormwater runoff control and protection practices in developed and rural areas would drastically improve the conditions of the creek.

Wastewater Management

As stated in the Land Use section of this report, a significant portion of the Lower Ganargua Creek watershed can be considered rural. This means that the household residences of the area have onsite wastewater treatment systems, or septic systems. About one-quarter of all New York residences have septic systems. Although the water quality concentrations for nitrate and TKN (human waste being a source) can be considered normal, the importance of sewage management should not be overlooked. The lack of an adequate system, lack of routine maintenance, increased density of homes served by septic systems, undersized/overused systems, and the installation on unacceptable land conditions can lead to onsite system failure and water quality impacts.

A typical septic system consists of a septic tank and a drainfield, or soil absorption field. The following are signs that a septic system is failing:

- wastewater backing up into household drains,
- bright green, spongy grass on the drainfield, even during dry weather,
- pooling water or muddy soil around your septic system or in your basement; and
- a strong odor around the septic tank and drainfield.



Typical household septic system.

Successful upkeep of a septic system should include:

- Inspect and pump frequently: The average household septic system should be inspected at least every three years by a septic service professional and is typically pumped every three to five years.
- Water efficiency: Efficient water use can improve the operation of a septic system and reduce the risk of failure.
- Proper waste disposal: Septic systems are designed to process only human waste and bath tissue. Disposing of chemicals and/or pharmaceuticals via toilets or drains can damage the living organisms that digest and treat septic system waste.
- Drainfield maintenance: Avoid driving across or parking on the drainfield. Avoid planting trees near the leach lines. Keep roof drains, sump pumps, and other rainwater drainage systems away from the drainfield area.

A higher density population concentration may restrict the amount of space available for septic systems. Therefore, wastewater is conveyed offsite to be treated. The Village of Newark Wastewater Treatment Plant (WWTP) is the major sanitary sewer collection system in the urbanized areas of the Lower Ganargua Creek Watershed. The WWTP currently has two outfalls to Ganargua Creek located between the Route 88 and Mud Mills Road bridge crossings, north-northeast of the village. Water quality data from sampling Site 6 and 7 can be used to represent any environmental impacts associated with the WWTP effluent. The data obtained for this report indicates natural levels of nitrogen concentrations, so it can be considered that the WWTP is not contributing excessive amounts of nutrients to Ganargua Creek. Sites 6 and 7 recorded some of the highest concentrations of TSS observed in the stream, but this does not provide conclusive evidence that the WWTP is a major contributor. Further, more localized analysis would be required to determine if there is an associated impact. The plant effluent is monitored daily and the results are reported monthly to the NYS DEC. It is believed that the Village of Newark WWTP currently performs well within requirements of the SPDES permit. Eventually, over time, there will be a need for improvements to equipment and structures. Clean Water Act effluent limits of TSS for a WWTP are as follows:

- 30-Day Geometric Mean: 30 mg/L
- 7-Day Geometric Mean: 45 mg/L

The Village of Newark wastewater system covers a service area of 5.4 square miles and 55 linear miles and is comprised of eight (8) pump stations. The importance of mentioning the WWTP in this report is that in 2010 the Newark Village Board approved a capital improvement project for the facility. The project will include the following improvements to the plant located of Murray Street:

- piping modification,
- sludge dewatering and composting,
- improved aeration control,
- rehabilitation to the raw sewage pump station,
- replacing the digestion cover, and
- eliminating infiltration.

Also, the pump station located in eastern Newark will be replaced and the outfall to Ganargua Creek from the WWTP will be rehabilitated and/or replaced. As of the furnishing of this report, this pump station has been replaced as well as upgrades to three (3) other pump stations and the addition of a ninth. The village is pursuing land acquisition for the construction of a clarifier and dewatering/composting facility. The WWTP's discharge outfall is planned to be changed to the NYS Barge Canal. The proposed modifications to the Newark WWTP will ultimately be beneficial to Lower Ganargua Creek, although there may be no current impact.

Stream Corridor Conditions

In the process of water moving through a watershed, a stream disperses energy and transports sediment. These processes lead to the formation of a stream channel that balances the stream's energy, termed dynamic equilibrium. Changes within the watershed and/or the stream channel can create an 'imbalance' which cause the stream to establish and maintain a new balanced condition. Many watershed activities, such as development and agriculture, change the amount of water available to a stream (hydrology) and how the water moves through the stream channels (hydraulics).

A characteristic of a well-balanced stream is that the streambed elevation remains relatively constant over a long time span. Too much energy could scour out the bed (degradation), while insufficient energy causes the stream to deposit excess sediment onto the bed (aggradation). Lower Ganargua Creek has a deeply cut channel that is disconnected from its past floodplain. Its high streambanks no longer have sufficient support and are subject to erosion. These conditions are characteristics of stream degradation. Under high flow conditions, the water is not able to spread across its floodplain where it slows down and dissipates energy. The stream's energy will then go into cutting the streambanks until it has established a new, lower elevation. This, in turn, causes excessive sediment deposits which are evident in concentrations of total suspended solids observed in the water quality analysis for this report.

The width of a stream is the most easily altered characteristic impacted by flowing water. Bank erosion is a result of a change in the water-sediment interaction. Before attempting to 'fix' an eroding streambank, it is important to investigate if the situation is caused by a system-wide or localized condition. Once the cause has been determined, then strategies to address the problem can be evaluated. Unfortunately, the natural movement of streams is often incompatible with human development, such as bridges, roads, buildings, and agriculture. Determining whether or not to expend resources on remediating a stream is most often dependent on what is at stake. Through field investigation of Lower Ganargua Creek by SWCD staff, streambank failures were commonly associated with degradation (deep channel, high banks) and a lack of vegetative buffer. Streambank impairments that occur in heavily forested areas would not pose as much of a threat compared to one adjacent to road foundations or agricultural operations. Streambank stabilization issues observed on Lower Ganargua Creek were most commonly adjacent to agricultural production fields. Further investigation of each individual site is necessary to determine the appropriate remediation strategies. These strategies must also meet the needs of the landowner. With the most suitable strategies in place, the overall stability of Lower Ganargua Creek can be maintained and improved.

As previously stated, the implementation of buffers and filter strips along watercourses are important in erosion control, but they also provide other benefits. Vegetation along a stream acts as a filter between the adjacent land and the flowing water. Vegetated buffers function in a way that they:

- slow water movement,
- stabilize streambanks,
- reduce bank and upland erosion,
- moderate the stream's water temperature,
- provide wildlife habitat, and
- enhance the landscape.

Well-established riparian areas are generally the most effective, cost efficient long-term protection for a stream system. A common misconception is that grass along a stream is sufficient enough to protect a streambank from erosion. Replacing native plant communities with agricultural crops or residential lawns can significantly affect a stream's stability. Riparian buffers provide the greatest benefit when they contain a variety of plant types; including trees, shrubs, and grasses. Different plant types provide a variability of root depths and strengths that aid in soil stabilization. Trees and shrubs slow floodwater and diminish stream energy that is available to erode soils.

While stream buffers physically protect the stream, they also aid in water quality runoff control. Researchers at the Stroud Water Research Center in Pennsylvania studied the function of a designed riparian buffer on water quality. The study used a comparison between a reference and riparian buffer system watershed over 15 years. Upland groundwater concentrations were referenced between streamwater and subsurface water. Streamwater nitrate concentrations in the riparian buffer system watershed declined relative to the reference stream. This study displayed that the average nitrate removal by the riparian buffer system was 26% of the upslope inputs. There was no conclusive evidence that the riparian buffer effected streamwater phosphorus concentrations, but phosphorus concentrations in groundwater declined within the buffer. Overland runoff entering and exiting the riparian buffer was analyzed for total suspended solids concentrations and showed that an average of 43% of TSS was removed.

Top: Lack of buffer along field. Bottom: well established riparian buffer along Lower Ganargua Creek tributary, sampling site 4.

Recreational Usage

Lower Ganargua Creek has been recognized as a high priority recreational opportunity for the residents of Wayne County and for people that visit. The creek in enjoyed by numerous canoes and kayakers who can access it from any one of its three (3) car-top launching sites located at Swift's Landing Park (Palmyra), Norsen Bridge Park (Arcadia), and Abbey Park (Lyons). Trails.com "Flatwater Paddling and Canoeing" characterizes Lower Ganargua Creek as a "paddler's paradise" with a few "small chutes and white water patches to make it interesting. At the time that the trails.com summary was written, the author(s) noted a number of downed trees creating a "slalom course." Through the SWCD staff field investigation for this report, areas with downed trees have become impassable log jams with limited ability to portage watercraft around them. SWCD staff took GPS coordinates and photographs of the log jams for reference. It would be beneficial to the users of the stream to remove these log jams to improve access and the experience of paddling Lower Ganargua Creek. The goal would not be to completely remove the jam, but to open a portion for paddlers to pass through. Keeping large woody debris in place is extremely important to providing habitat to fish and wildlife.

Conclusion

Water is one of our most precious natural resources. As populations increase and development expands, it puts a negative strain on our waterbodies. It is imperative that these natural systems are maintained in a way where it can continue to support the ecosystem that it has developed. Watershed management is a tool to evaluate and address how a waterbody responds to human activities.

Development and agricultural practices within the Lower Ganargua Creek are not likely to end in the near future. Therefore it is extremely important to manage the land uses in the best interest of the stream. Irresponsible management of lands can further degrade the water quality and aquatic ecosystem of Lower Ganargua Creek and its tributaries. Protection of water resources is dependent on not just a single entity but an entire watershed community. It is vital that the residents and visitors of this watershed be vigilant in protecting this stream for the future. This assessment is intended to summarize water resource issues within the watershed and to improve awareness of them. It is the duty of landowners within the watershed to be stewards of this stream so that future generations may enjoy it.

References

Bode, Robert W., Margaret A. Novak, Lawrence E. Abele. 1996. Biological Stream Assessment, Ganargua Creek, Ontario and Wayne Counties, New York. New York State Department of Environmental Conservation, Division of Water, Stream Biomonitoring Unit.

Makarewicz, Joseph C., Theodore W. Lewis. 2010. Characterization of Six Watersheds of Wayne County, New York. The Department of Environmental Science and Biology, The College at Brockport State University of New York.

Makarewicz, Joseph C., Theodore W. Lewis, Blake J. Snyder. 2011. Characterization of Eight Watersheds of Wayne County, New York, 2010-2011. The Department of Environmental Science and Biology, The College at Brockport State University of New York.

New York State Department of Environmental Conservation. 1992. New York State Register and Official Compilation of Codes, Rules and Regulations of the State of New York, Division of Water.

New York State Department of Environmental Conservation. 2008. Oswego River/Finger Lake Basin Waterbody Inventory/Priority Waterbodies List.

Newbold, J. Denis, Susan Herbert, Bernard W. Sweeney, Paul Kiry, and Stephen J. Alberts, 2010. Water Quality Functions of a 15-Year-Old Riparian Forest Buffer System. Journal of the American Water Resources Association (JAWRA) 46(2):299-310.

Parsons, R. (2005). Unpublished report:University of Vermont, Department of Community Development and Applied Economics.

Sharpley, Andrew N., Peter Keinman, R. McDowell. 2001. Innovative management of agricultural phosphorus to protect soil and water resources. Community Soil Science Plant Analysis, 32(7&8), 1071-1100.

Smith, A.J., R.W. Bode, and G.S. Kleppel. 2006. A Nutrient Biotic Index (NBI) for Use with Benthic Macroinvertebrate Communities. Elsevier Science.

Trails.com. 1999. Flatwater Paddling & Canoeing, New York Trails, Flatwater Paddling & Canoeing New York: Ganargua Creek (Palmyra to Lyons) – Summary. http://www.trails.com/tcatalog_trail.aspx?trailid=XFP006-006.

United States Geological Survey. 1999. The Quality of Our Nation's Waters, Circular 1225, Nutrients and Pesticides.

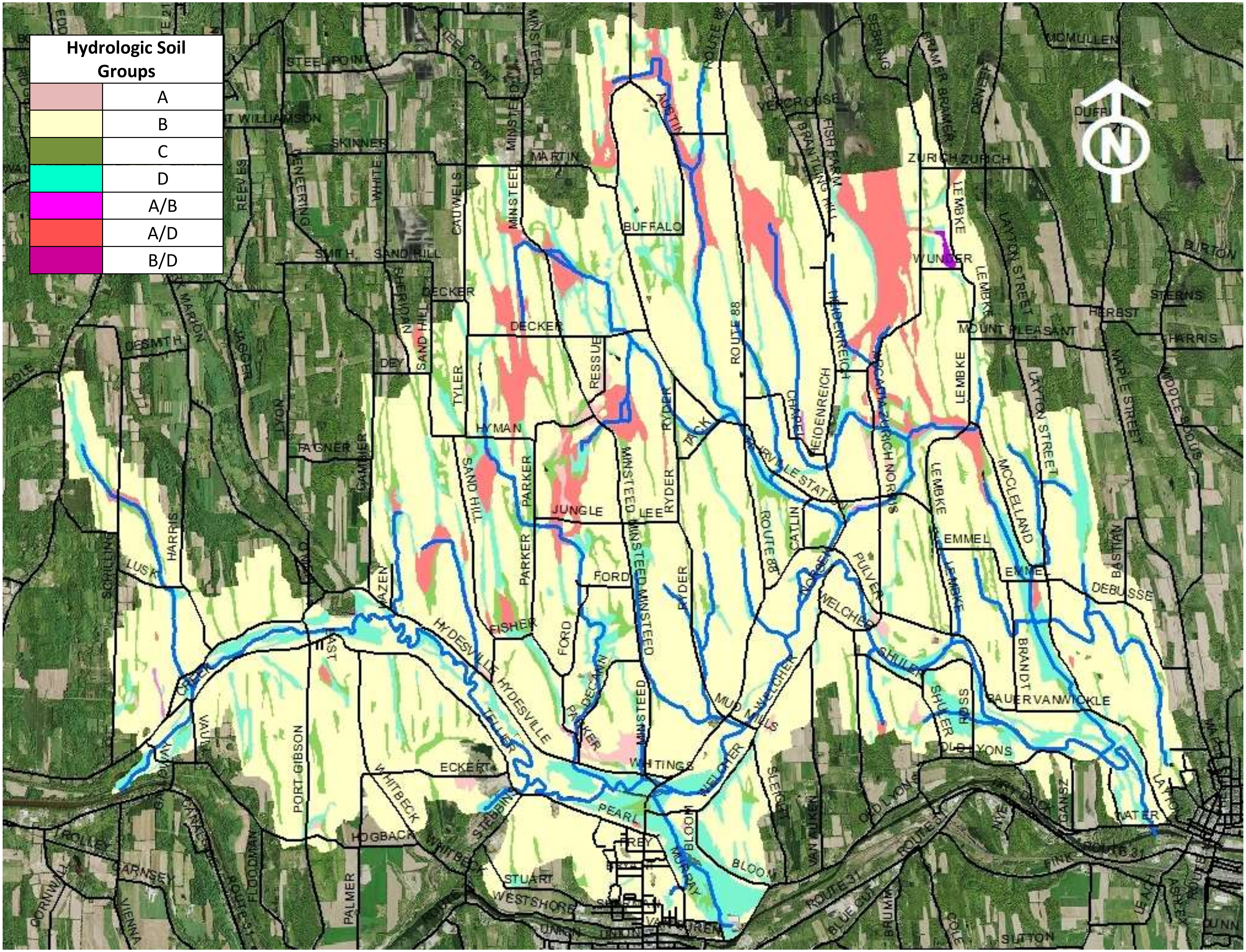
United States Environmental Protection Agency. 2003. National management measures to control nonpoint source pollution from agriculture. U.S. Environmental Protection Agency, Office of Water. EPA-841-B-03-004.

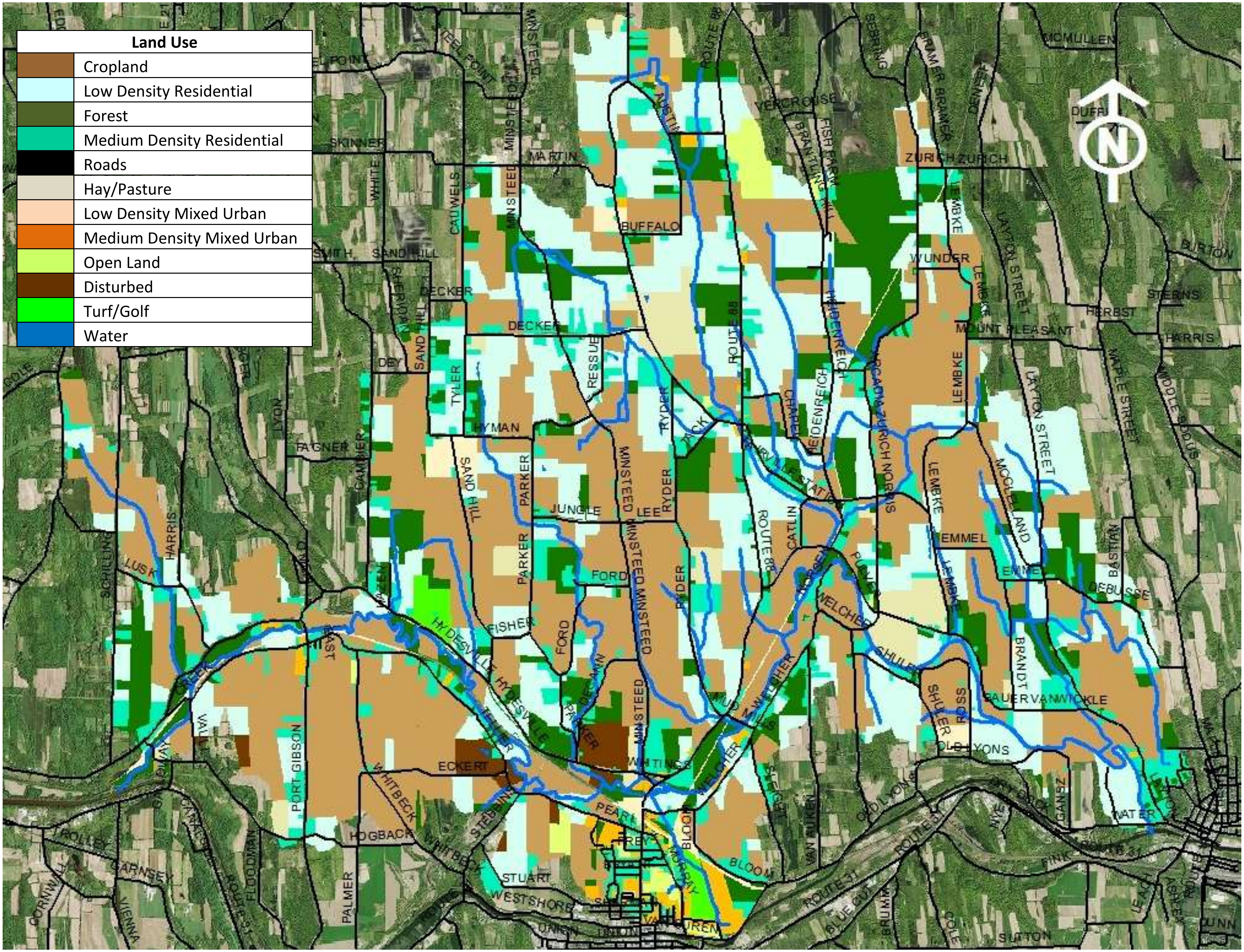
United States Environmental Protection Agency. 2012. Chapter I, Subchapter D – Water Programs, Part 131 – Water Quality Standards.

Watzin, M. C., A. E. Cassell, D. W. Meals. 2003. Analyzing effects of conservation practices using network modeling. University of Vermont, School of Natural Resources.

Wisconsin Department of Natural Resources. 2010. Water Quality Standards for Wisconsin Surface Waters, NR 102.04.

Appendix I. Detailed Maps


Hydrologic Soil Groups
A
B
C
D
A/B
A/D
B/D
N


Land Use
Cropland
Low Density Residential
Forest
Medium Density Residential
Roads
Hay/Pasture
Low Density Mixed Urban
Medium Density Mixed Urban
Open Land
Disturbed
Turf/Golf
Water
N

AppendixII. Lower Ganargua Creek Water Quality Data

Date Collected	Site		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)	Date Collected	Site		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)
5/15/2012	1	Non-event	68.5	0.5	14.2	840	6/26/2012	4	Non-event	70.7	0.7	6.7	670
5/15/2012	2	Non-event	62.7	0.0	3.8	770	6/26/2012	5	Non-event	213.8	0.7	5.5	380
5/15/2012	3	Non-event	75.5	0.4	16.7	680	6/26/2012	6	Non-event	100.8	1.0	23.5	460
5/15/2012	4	Non-event	80.0	0.1	7.7	900	6/26/2012	7	Non-event	122.4	1.5	23.2	770
5/15/2012	5	Non-event	177.0	0.2	6.2	650	6/26/2012	8	Non-event	106.6	1.0	27.8	530
5/15/2012	6	Non-event	72.4	0.5	17.5	800	6/26/2012	9	Non-event	97.9	1.0	18.8	450
5/15/2012	7	Non-event	76.2	0.4	22.0	630	7/16/2012	1	Non-event	67.0	0.3	12.8	370
5/15/2012	8	Non-event	59.1	0.4	10.7	1070	7/16/2012	3	Non-event	74.5	0.3	20.2	310
5/15/2012	9	Non-event	73.6	0.4	17.8	490	7/16/2012	4	Non-event	148.0	0.5	37.2	470
5/30/2012	1	0.1 inch 5/29	96.3	0.6	16.4	420	7/16/2012	5	Non-event	232.7	0.5	7.5	430
5/30/2012	2	0.1 inch 5/29	94.8	0.1	4.5	680	7/16/2012	6	Non-event	83.0	0.3	24.5	250
5/30/2012	3	0.1 inch 5/29	98.9	0.6	26.9	810	7/16/2012	7	Non-event	96.2	0.5	21.0	400
5/30/2012	4	0.1 inch 5/29	157.1	0.3	11.7	1470	7/16/2012	8	Non-event	74.2	0.3	11.8	370
5/30/2012	5	0.1 inch 5/29	203.1	0.5	10.2	810	7/16/2012	9	Non-event	78.6	0.3	16.3	400
5/30/2012	6	0.1 inch 5/29	99.2	0.6	23.3	440	8/7/2012	1	1.7 in 8/5	76.2	0.3	15.7	380
5/30/2012	7	0.1 inch 5/29	128.9	0.8	32.0	480	8/7/2012	3	1.7 in 8/5	83.4	0.4	20.3	490
5/30/2012	8	0.1 inch 5/29	80.8	0.6	18.7	330	8/7/2012	4	1.7 in 8/5	111.3	0.1	7.3	480
5/30/2012	9	0.1 inch 5/29	104.7	0.8	32.0	450	8/7/2012	5	1.7 in 8/5	193.7	0.3	2.2	260
6/13/2012	1	0.9 inch 6/13	104.3	0.9	21.3	460	8/7/2012	6	1.7 in 8/5	73.5	0.3	17.5	360
6/13/2012	2	0.9 inch 6/13	86.2	0.7	1.8	470	8/7/2012	7	1.7 in 8/5	75.1	0.4	20.8	410
6/13/2012	3	0.9 inch 6/13	121.2	0.2	35.2	550	8/7/2012	8	1.7 in 8/5	60.2	0.3	9.3	260
6/13/2012	4	0.9 inch 6/13	158.8	0.5	13.3	1100	8/7/2012	9	1.7 in 8/5	71.9	0.3	14.2	310
6/13/2012	5	0.9 inch 6/13	360.5	0.9	52.6	740	8/28/2012	1	Non-event	55.4	0.2	15.0	820
6/13/2012	6	0.9 inch 6/13	123.4	0.9	35.5	430	8/28/2012	3	Non-event	67.2	0.2	23.1	190
6/13/2012	7	0.9 inch 6/13	149.5	0.7	41.3	520	8/28/2012	4	Non-event	254.2	0.2	62.0	1620
6/13/2012	8	0.9 inch 6/13	106.8	0.7	30.3	410	8/28/2012	6	Non-event	64.7	0.3	21.2	200
6/13/2012	9	0.9 inch 6/13	121.7	0.0	29.5	610	8/28/2012	7	Non-event	80.4	0.4	31.0	620
6/26/2012	1	Non-event	87.3	1.1	15.2	450	8/28/2012	8	Non-event	52.8	0.2	10.5	200
6/26/2012	2	Non-event	112.1	0.7	17.2	1100	8/28/2012	9	Non-event	61.4	0.2	14.8	250
6/26/2012	3	Non-event	139.5	0.7	65.2	770	9/19/2012	1	0.56 in 9/18	61.0	0.8	17.5	210

Date Collected	Site		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)	Date Collected	Site		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)
9/19/2012	3	0.56 in 9/18	67.7	0.7	27.6	240	1/14/2013	7	Thaw	105.2	1.5	20.8	410
9/19/2012	4	0.56 in 9/18	164.5	0.8	16.8	610	1/14/2013	8	Thaw	77.2	1.3	24.8	340
9/19/2012	5	0.56 in 9/18	113.8	0.4	3.0	310	1/14/2013	9	Thaw	82.1	1.3	26.8	370
9/19/2012	6	0.56 in 9/18	96.8	0.6	26.8	370	2/12/2013	1	Non-event	62.5	1.7	6.0	300
9/19/2012	7	0.56 in 9/18	78.5	1.3	23.5	280	2/12/2013	2	Non-event	22.4	0.5	3.1	200
9/19/2012	8	0.56 in 9/18	81.9	0.6	17.8	250	2/12/2013	3	Non-event	70.6	1.8	6.2	450
9/19/2012	9	0.56 in 9/18	67.0	0.6	14.5	160	2/12/2013	4	Non-event	24.3	0.9	1.9	460
10/15/2012	1	0.28 in 10/14	49.6	0.7	10.0	< 150	2/12/2013	5	Non-event	107.0	1.2	5.0	530
10/15/2012	3	0.28 in 10/14	47.8	0.6	9.7	< 150	2/12/2013	6	Non-event	68.2	1.7	8.0	350
10/15/2012	4	0.28 in 10/14	67.6	0.7	4.6	190	2/12/2013	7	Non-event	75.2	1.8	7.8	380
10/15/2012	5	0.28 in 10/14	121.0	0.1	1.1	< 150	2/12/2013	8	Non-event	186.9	1.7	4.8	280
10/15/2012	6	0.28 in 10/14	47.1	0.6	7.1	< 150	2/12/2013	9	Non-event	364.1	1.8	4.8	320
10/15/2012	7	0.28 in 10/14	62.4	1.4	9.6	< 150	3/18/2013	1	Non-event	34.6	1.2	5.3	310
10/15/2012	8	0.28 in 10/14	78.1	0.6	18.9	< 150	3/18/2013	2	Non-event	6.7	0.3	0.7	< 150
10/15/2012	9	0.28 in 10/14	45.9	0.6	10.7	< 150	3/18/2013	3	Non-event	35.4	1.2	5.8	380
11/26/2012	1	Non-event	36.1	1.0	3.4	140	3/18/2013	4	Non-event	44.8	1.0	3.3	430
11/26/2012	2	Non-event	9.8	1.0	0.6	350	3/18/2013	5	Non-event	92.1	1.4	2.1	560
11/26/2012	3	Non-event	48.3	0.6	6.6	300	3/18/2013	6	Non-event	34.8	1.3	4.4	190
11/26/2012	4	Non-event	50.6	1.3	3.0	690	3/18/2013	7	Non-event	59.6	1.8	4.9	260
11/26/2012	5	Non-event	85.1	1.0	3.0	630	3/18/2013	8	Non-event	35.3	1.1	5.9	260
11/26/2012	6	Non-event	40.1	1.6	4.7	< 150	3/18/2013	9	Non-event	34.9	1.1	3.2	320
11/26/2012	7	Non-event	49.7	0.8	4.4	210	5/1/2013	1	Non-event	67.2	0.6	7.9	730
11/26/2012	8	Non-event	44.4	0.8	6.1	220	5/1/2013	2	Non-event	83.9	0.0	9.7	500
11/26/2012	9	Non-event	44.1	1.1	6.0	< 150	5/1/2013	3	Non-event	107.5	0.5	8.9	380
1/14/2013	1	Thaw	138.3	1.5	64.7	450	5/1/2013	4	Non-event	51.2	0.3	2.5	560
1/14/2013	2	Thaw	18.3	0.7	5.2	260	5/1/2013	5	Non-event	145.2	0.2	4.7	370
1/14/2013	3	Thaw	93.6	1.4	30.8	480	5/1/2013	6	Non-event	72.9	0.6	12.0	420
1/14/2013	4	Thaw	63.4	2.2	4.7	750	5/1/2013	7	Non-event	132.6	1.2	23.8	660
1/14/2013	5	Thaw	157.9	4.1	7.0	630	5/1/2013	8	Non-event	64.0	0.5	13.3	360
1/14/2013	6	Thaw	85.3	1.6	26.3	400	5/1/2013	9	Non-event	57.2	0.5	9.7	290

Date Collected	Site		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)
5/15/2013	1	Non-event	51.1	0.69	10.2	340
5/15/2013	2	Non-event	46.8	0.04	3.6	490
5/15/2013	3	Non-event	67.8	0.61	6.6	260
5/15/2013	4	Non-event	28.0	0.39	1.8	460
5/15/2013	5	Non-event	148.0	0.25	2.4	400
5/15/2013	6	Non-event	79.6	0.64	13.4	260
5/15/2013	7	Non-event	86.6	1.06	21.1	360
5/15/2013	8	Non-event	69.1	0.62	13.3	370
5/15/2013	9	Non-event	63.7	0.66	8.4	450