What is a TMDL?

A Total Maximum Daily Load (TDML) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. TMDLs are governed by the Clean Water Act (CWA) under Section 303. More specifically, the EPA regulations define a TMDL as the sum of pollutant loads from point sources ("waste load allocations") and nonpoint sources ("load allocations").[1] Such loads shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety.

Water Quality Standard

A water quality standard on the other hand is based on use. It is either a narrative standard or numeric criteria set by states that focus on uses of the waterbody.[2] A narrative standard would be swimming or fishing. Setting numeric criteria states the allowable amount, or calculation, of a pollutant in the implementing regulation.[3] The use is then backed by calculations of pollutant loads which must be met in order to meet the designated use for a waterbody. Each entity that must discharge a categorized pollutant into a waterbody is able to discharge only a certain amount. This amount is known as its "allocation." The allocation of each industry or discharger is directed by a permit. Permits are guided by the National Pollution Elimination Discharge System (NPDES). New York State has its own federally-approved program known as the State Pollution Elimination Discharge System (SPDES). The process is governed by Article 17 of the Environmental Conservation Law (ECL) and administered by the New York State Department of Environmental Conservation (NYSDEC or DEC). The allowable amount of discharge outlined in a permit is informed by two main factors: Water Quality Standards (WQS) and effluent limitations.

Both WQS and effluent limitations are intended to limit the amount of a pollutant or effluent that enters a waterbody. A water quality standard states the intended use of a waterbody while an effluent limitation dictates the amount of a pollutant which may be loaded into a waterbody per discharger. An effluent limitation is the specified level of discharge reduction achievable by the best available technology ("BAT") through the use of Technology based effluent limits or ("TBEL") or other related standards for various sources of water pollution, such as a Water Quality Based Effluent Limitation ("WQBEL"). The intent of the TBEL is to require a minimum level of treatment of pollutants, for point source discharges, based on available treatment technologies, while allowing the discharger to use any available control technique to meet the limits. For industrial (and other non-municipal) facilities, technology-based effluent limits are derived from the following:

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[1] 40 CFR § 130.2(i),(g) &(h)

[2] New York's Water Quality Standards can be found at: 6 NYCRR 703. Note, 6 NYCRR §§ 700-06 are currently under revision as of Nov. 2016, per federally mandated triennial review requirements. Specific information on each section under revision is available on NYSDEC's website.

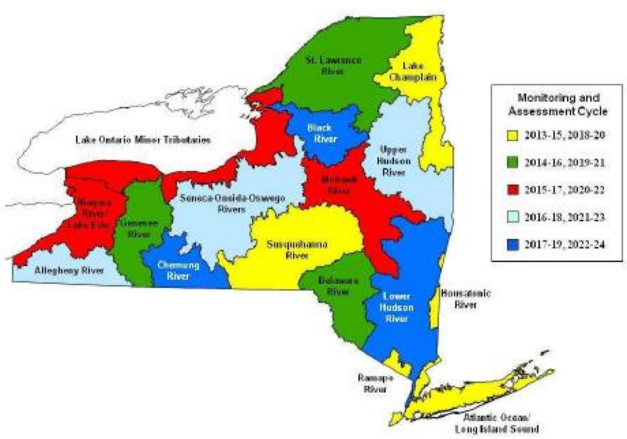
[3] *National Pollutant Discharge Elimination System (NPDES) Permit Writers' Manual*, U.S. ENVTL. PROTECTION AGENCY (Sept. 2010), https://www.epa.gov/sites/production/files/2015-09/documents/pwm_chapt_05.pdf.

- Using national effluent limitation guidelines and standards established by the EPA, and/or
- Using best professional judgement on a case-by-case basis in the absence of national guidelines and standards.
- For municipal facilities (publicly owned treatment works or POTWs), technology-based effluent limits are derived from national secondary treatment standards.
- Chapter 5 of the U.S. EPA NPDES Permit Writers' Manual (PDF) provides overview of the process for establishing technology-based effluent limits.[4]

How to Set a TMDL

A TMDL on the other hand is a calculation of the total amount of pollutants that an entire waterbody, or a delineated segment of a waterbody, can sustain. In short, water quality standards are guided by use. Effluent Limits apply to each physical discharger and TMDLs apply to the waterbody receiving the pollutants. Under the Clean Water Act, States are required to test their waters and report the findings on impaired waters to the EPA. Under Section 305 of the Clean Water Act, New York monitors all 690,000 acres (not including the Great Lakes) of freshwater and over 400 miles of Great Lakes coastline. The Clean Water Act Section 303(d) list is a subset of the total list of waterbodies that do not meet water quality standards. These water bodies are considered “impaired.” The state maintains a list of impaired waterbodies, known as the 303(d) list. New York State regularly monitors the health of the state’s waterbodies by utilizing a rotating basin schedule for testing. Through this system, the state is able to test all the waters of the state on a five-year schedule.[5]

Statewide Monitoring and Assessment Schedule



This five year testing process is guided by the Consolidated Assessment and Listing Methodology (CALM) process. Note, the Rotating Integrated Basin Studies (RIBS) program is the mechanism through which the testing is done and the data resulting from RIBS testing can be used to inform assessments of the CALM Process.

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[4] ENVIRONMENTAL PROTECTION AGENCY, NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) http://water.epa.gov/polwaste/npdes/basics/Water-Quality-and-Technology-Based-Permitting.cfm-

New York then submits its list of impaired waters to the EPA every five years. It is important to note that not all impaired waterbodies are on the 303(d) list. The list includes only those waterbodies that cannot meet their designated uses and may require a TMDL to be set in order to lessen the amount of priority pollutants going into the waterbody. Specifically, there are three categories of impaired waters that are not listed on the 303(d) list:

- Category 4a Waters - TMDL development is not necessary because a TMDL has already been established for the segment/pollutant.
- Category 4b Waters - A TMDL is not necessary because other required control measures are expected to result in restoration in a reasonable period of time.
- Category 4c Waters - A TMDL is not appropriate because the impairment is the result of pollution, rather than a pollutant that can be allocated through a TMDL.

These examples show the potential flexibility of the system. Allowable alternatives exist to meet the metrics set by New York State. The sections below outline some of the hurdles with TMDL implementation and provide examples where a process other than a TMDL was successfully utilized.[6]

TMDL Mechanics

A. Cost: What is the cost of implementing a TMDL?

Setting, monitoring and maintaining a TMDL can be cost prohibitive. A 1995 study conducted by the EPA compared fourteen case studies on the cost of TMDL implementation. Project implementation costs ranged from: $4,039 to $1,023,531. Adjusted for inflation this would be $6,220- 1.58 Million in 2015. These costs were affected by a number of factors outlined below.[7] The study found the following to be the major factors affecting cost:

a. Modeling and data collection/monitoring are, on average, the most costly components of developing a TMDL
b. Types of waterbody and geographic features
c. Complexity of the water quality problem
d. Number and type of pollutants
e. Availability of data
f. Complexity of the model used
g. Number and Type of sources
h. Political sensitivity & level of public involvement

[6] NYS Consolidated Assessment and Listing Methodology, 16 (May 2009).

[7] *NYS Section 303(d) List of Impaired/TDML Waters*, N.Y. ST. DEPT'T ENVTL. CONSERVATION. (last visited June 13, 2017), http://www.dec.ny.gov/chemical/31290.html.

The cost of implementing a large-scale TMDL can be significant but is generally spread amongst a number of dischargers and producers. The cost can be borne by a municipality and thereby passed onto the consumer. The Long Island Sound is an example of a costly, large-scale implementation. In that instance, the TMDL analysis for Dissolved Oxygen alone cost $650 Million for Point Source Treatment. This figure is markedly less than the $2.5 billion needed for the full Limit of Technology (LOT) alternative; the most comprehensive and stringent alternative presented in the Long Island Sound case study. The total cost of implementation can be defrayed by the different control technologies and spread across agencies and polluters. The changes suggested by the above example included ways to reduce nitrogen and in-water sources of pollution. Control measures for these included, $250 million for boat based alterations and $500 million - $1 Billion dollars to introduce gates to reduce tidal flow. The Long Island Sound serves as one small example of the exorbitant cost that can be associated with implementing a large TMDL. To make implementation feasible, the cost was broken down into its component parts and spread across the cost of individual control technologies for each producer. Specifically, boat owners would be responsible for boat based alternations, whereas the Department of Transportation took on the cost of gates to reduce tidal flow.[8]

B. Duty: When a state doesn't set a TMDL

Under the Federal Clean Water Act, States have a mandatory duty to monitor the water bodies of their state. If a state finds that a waterbody is impaired, they have a duty to consider a TMDL or other strategy to reduce the inputs of pollutants into a state waterbody. What if a state does not set a TMDL for a waterbody listed on the Section 303(d) list as "Impaired"? For example, the Niagara River and some of the tributaries in the watershed have been listed for up to ten years, yet no TMDL has been implemented. The Clean Water Act does not expressly address what duty, if any, the EPA bears under such circumstances.[9]

In New York, The District Court for the Southern District has grappled with this issue. Courts have read into the Act a requirement that EPA treat such state inaction, when the state does not set a TMDL or take other action to offset pollution loadings, as a so-called "constructive submission" of a deficient TMDL.[10] This triggers the EPA's explicit mandatory duties under the Act to disapprove the "submission," and to establish TMDLs for the state.[11]

[8] U.S. ENVTL. PROTECTION AGENCY, TMDL DEVELOPMENT COSTS ESTIMATES: CASE STUDIES OF 14 TMDLS 23 (MAY 1996)

http://www2.bren.ucsb.edu/~keller/courses/esm223/tmdl_cost.pdf

[9] See Clean Water Act § 303(d); 33 U.S.C §1311(d)

[10] *See* Clean Water Act § 1313(d)(2),

[11] *Nat. Res. Def. Council, Inc. v. Fox*, 909 F.Supp. 153, 157 (S.D.N.Y. 1995).

The Court above found that under the Act, the EPA retains discretionary authority, clearly stating that NY's failure to act would *eventually* trigger the EPA's duty under to Act to declare a constructive submission, thus having to set a TMDL. However, the Court made clear that there is no required timeline within which the EPA must act. The Court had found that although the waterbody has been listed for ten years the EPA was within is discretionary duty because the CWA does not require the EPA to take such action by a date certain or within a particular time frame. Thus, the court concluded that it was not yet required to find a constructive submission. Therefore, the EPA was not yet required to step in and set a TMDL due to state of New York inaction.[12]

C. Alternatives to Setting a TMDL

When a TMDL has not been set, and the State of New York courts have shown that the EPA must act, there is no set deadline within which they must do so. There are, however, feasible alternatives. As noted above, the Clean Water Act provides other means that can limit pollutant loadings. New York State sought to delist two water bodies by showing how implementing alternate control measures were sufficient. First, New Yorkers have utilized voluntary consent decrees. To address CSO issues in New York City and impairments to fish consumption in the upper reaches of the Hudson River, a consent decree was agreed upon between the NYSDEC and the New York City Department of Environmental Protection. A second example utilized dredging of sediments to show the EPA that other means to meet water quality standards were feasible. In both cases the EPA agreed that the implementation of a TMDL in light of the other control measures implemented would provide little additional value. However, leery of whether alternate control measures would be sufficient, the EPA would not delist the above water bodies or segments of water bodies. Instead, the parties reached a compromise. The EPA is allowing NYS to implement alternative control measures at both sites but the sites are remaining "listed" under Part 3c, "Waterbodies for which TMDL Development May be Deferred Pending Implementation/Evaluation of Other Restoration Measures." This compromise enabled New York to test alternative remediation techniques while still allowing the EPA oversight to reevaluate the waters and implement a TMDL should the alternative approaches be ineffective.[13]

Foreseeable Challenges

There are a number of other hurdles that can prevent the effective implementation of a TMDL. These can include cost, as discussed above, as well as the type of waterbody and pollutant sources. For example, the nature of a waterbody can make identifying pollutant loadings exceedingly difficult.

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[12] *Id*.

[13] N.Y. ST. DEPT. ENVTL. CONSERVATION, NEW YORK STATE CONSOLIDATED ASSESSMENT AND LISTING METHODOLOY. (MAY 2009).

The Niagara River for example is deep, fast flowing and leads to Niagara Falls. Moreover, not only do the physical attributes of the river make pin pointing what pollutants are stemming from what sources difficult, but it is further complicated because it is an international waterbody. The American Federal law cannot regulate foreign sources. How can pollutants be regulated such that a waterbody can be rehabilitated when the law only applies to half the sources? In addition, sources of loadings may come from nonpoint sources. These are sources of pollutants that are not as easily discernable as the end of a pipe, for example nutrient run off from farmland, or pollutants entering waterbodies from impervious surfaces, such as road salt from highways. Since these sources are not regulated under the Clean Water Act, and the quantities and precise source location can be difficult to identify, they cannot be regulated using the CWA and would not fall under pollutants that must be limited by a TMDL.

Nine-Element Watershed Plans

For comparison, the paragraphs below will briefly explain the mechanics of a nine element Watershed Plan or 9e Plan and how it may be different than a state-implemented TMDL. The New York State Dept. of Environmental Conservation highlights the similarities by explaining that both TMDLs and nine element watershed plans are watershed-based plans that identify and quantify sources of pollutants and set pollution reduction targets needed to meet water quality goals. In fact, TMDLs and 9(e) plans are almost interchangeable, however, there are a couple of key differences. See the chart on next page.[14]

First, the New York State Department of State funds the development of watershed plans through the Environmental Protection Fund. Whereas a municipality, state agency or private actors are often the funding sources for TMDL implementation, the 9(e) plan focuses on tapping a larger array of public funding options. For example, the Black River Watershed Plan development was funded by NYSDEC. That watershed plan lists potential funding options to implement a 9(e) plan. The funding sources and alternatives proposed include state and federal grants, organized into agriculture and non- agriculture Nonpoint source funding opportunities as well as Natural Resource Conservation Service programs, regional opportunities and Wastewater infrastructure funding options.[15]

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[14] *Nine Element Watershed Plans*, N.Y. ST. DEP'T ENVTL CONSERVATION (last visited June 13, 2017), http://www.dec.ny.gov/chemical/103264.html.

[15] N.Y. ST. DEP'T ENVTL. CONSERVATION, BLACK ROCK NINE ELEMENT WATERSHED MANAGEMENT PLAN, APPENDIX II (June 3, 2016). Available at http://www.dec.ny.gov/docs/water_pdf/9eblackriver.pdf.

Comparison of 9E plans and TMDLs		
Attribute	9E Plan	TMDL
Pollutant sources	Better for nonpoint sources	Better for point sources
Implementation plan	Required	Optional*
Public comment period	No (public participation is conducted throughout plan development)	Required
Agency approval	NYS DEC	EPA
Funding eligibility	State and federal opportunities	State and federal opportunities

Another critical difference is the inclusion of quantifiable reductions in pollutants. Such a calculation is a required element of a TMDL but does necessarily have to be included in a 9(e) plan.

The 9(e) Plan elements are:

A. Identify water quality target or goal and load reductions needed to achieve goal;
B. Identify the best management practices (BMPs) that will help to achieve reductions needed to meet water quality goal/target;
C. Describe the financial and technical assistance needed to implement BMPs identified in Element C;
D. Describe the outreach to stakeholders, how their input was incorporated, and the role they then played to implement the plan;
E. Estimate a schedule to implement BMPs identified in plan;
F. Describe the milestones and estimated time frames for the implementation of BMPs;
G. Identify the criteria that will be used to assess water quality improvement as the plan is implemented; and
H. Describe the monitoring plan to collect water quality data to measure water quality improvement against criteria in H.

While a TMDL and a 9 element plan may be similar, their creation, focus, and implementation can vary. The TMDL is outlined in federal statutes and implemented by states. The 9(e) Plan is bolstered by the NYSDEC and while it can be difficult to meet all 9 elements and require a very detailed level of analysis, it can potentially be funded by a broader array of sources.

Suggested Conclusions

Some of the smaller tributaries that Riverkeeper sampled and collected data are listed on the 303(d) list such as: Tonawanda Creek, Bowen Creek, Black Creek, Ransom Creek and Gott Creek. For these more manageable waterbody or waterbody segments, a TMDL could be a viable option provided there is an entity to bear the cost of implementation and oversight. For larger bodies of water, such as the Niagara River itself, however, a TMDL may not be the most efficient or cost effective solution. As with the cases noted above, the Niagara River is extremely large and plagued with numerous different types of pollutants from varying sources. It has been on the 303(d) list for about a decade and NYS has yet to set a TMDL. As case law has shown, the EPA does not have a predetermined time limit denoting when they must step in on behalf of the state.

Furthermore, in order to have a waterbody removed from the 303(d) list through alternate means, the applicant must show that, "Delisting of a previously listed water *prior* to the development of a TMDL can occur only if: (1) The water is shown to be meeting all applicable water quality standards, or (2) If, upon re-examination, the original basis for listing the water is determined to be inaccurate."[16] If a waterbody requires a segment specific TMDL and that TMDL is under development by NYSDEC, or scheduled for future development by NYSDEC, an alternate strategy may be developed. Specifically, according to New York State guidance document, "If an alternative strategy other than a TMDL is identified as appropriate to address waterbody impairments, then that waterbody may be considered for delisting to IR Category 4(b)." A 4(b) delisting is a powerful tool, for it pulls the decision making authority from the top and puts it at a more local level, where water quality attainment goals can be achieved through cooperative agreements and best management practices.

Therefore, the most plausible solution for the Niagara River may be to limit the amount of pollution through best management practices implemented at the local level. This option is particularly feasible because New York is a Home Rule state which means local municipalities can create and enforce laws regarding property at the local level.[17] The Niagara River, or any of the smaller tributaries that are listed, could be delisted to IR Category 4(b) and then meet the water quality goals through identifying and implementing an alternate strategy.

[16] *See* NYS CONSOLIDATED, *supra* note 11.

[17] *See generally* N.Y. MUN. HOME RULE LAW; ART. IX NYS CONST.

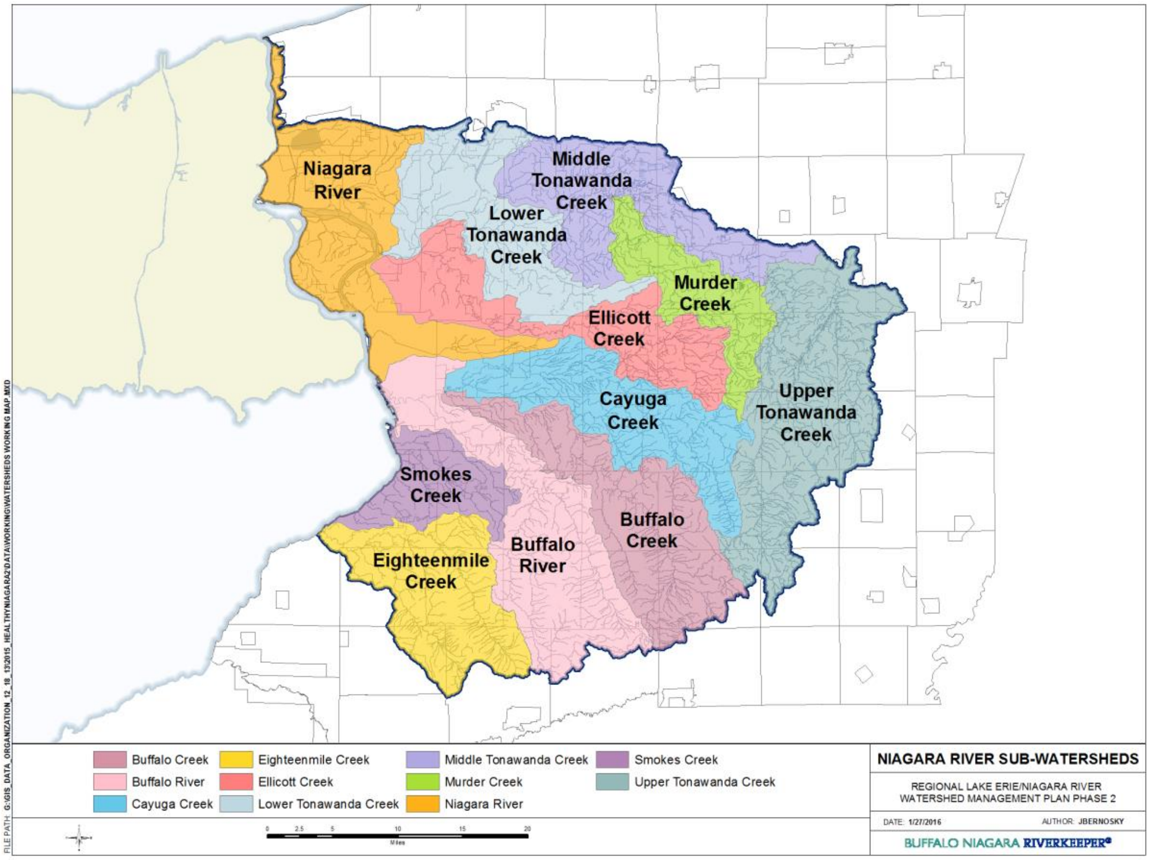
Appendix B – Stationary Sampling Sites

Site	Y-Coordinate	X-Coordinate
UT01	42.928973	-78.23485
UT02	42.952751	-78.184763
UT03	42.93693	-78.28825
UT04	42.84347	-78.27549
UT05	42.791755	-78.234227
UT06	42.70471	-78.311967
LT04	43.05897	-78.837129
LT05	43.06581	-78.822542
LT06	43.08616	-78.727514
LT07	43.112956	-78.738457
LT08	43.050065	-78.731085
LT09	43.0503	-78.711498
SC01	42.75513	-78.8773
SC02	42.74848	-78.8096
SC03	42.74894	-78.770026
SC04	42.75192	-78.720611
SC05	42.81869	-78.780839
SC06	42.8207	-78.8102
EMC01	42.58968	-78.7917
EMC02	42.68424	-78.77791
EMC03	42.711585	-78.823997
EMC04	42.59025	-78.79124
EMC05	42.68048	-78.87798
EMC06	42.71163	-78.96659
CC05	42.627624	-78.528384
CC06	42.756652	-78.622602
CC07	42.61574	-78.655305
CC08	42.68231	-78.685911
CC09	42.74523	-78.655432
TB01	42.76966	-78.607877

Appendix C – 2015 Technical Data Report

Regional Niagara River/Lake Erie Watershed Management Plan – Phase 2:

2015 Technical Data Report



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This document was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund Act.

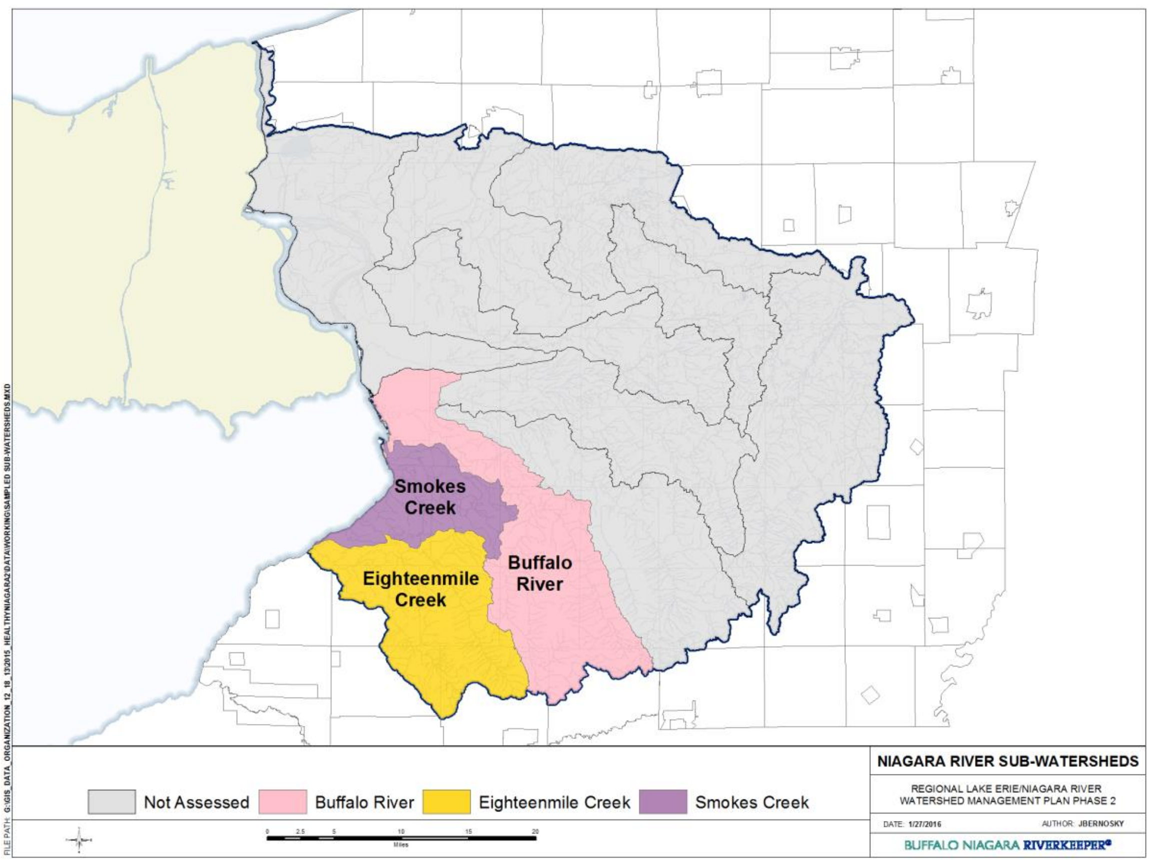
Table of Contents

1 Introduction

The purpose of this document is to report data collected during year one of the multi-year Regional Niagara River Lake Erie Watershed Management Plan - Phase 2 project (Healthy Niagara Phase 2).

Stream Visual Assessment Protocol (SVAP) and water quality data were collected to define baseline conditions of streams in three sub-watersheds of the Niagara River. Data collection occurred from May 18, 2015 to September 1, 2015. Approximately 58 miles of stream were assessed in three of the five prioritized sub-watersheds. The sub-watersheds assessed in 2015 were Smokes Creek Sub-watershed (approximately 14 miles assessed), Eighteenmile Creek Sub-watershed (approximately 17 miles assessed), and Buffalo River Sub-watershed (approximately 26 miles assessed). The three assessed sub-watersheds can be seen below in Figure 1. The remaining two prioritized sub-watersheds, Upper Tonawanda Creek, and Lower Tonawanda Creek, will be assessed in 2016, as part of data collection for year two of this study.

Figure 1 2015 Prioritized Sub-watersheds



2 Methods

2.1 Stream Visual Assessment Protocol

The SVAP is tool developed by the Natural Resources Conservation Service (NRCS, 1998) to be used to quickly and easily qualify a stream's condition by assessing several elements indicative of overall stream health. SVAP provides a "snapshot in time" of qualitative stream conditions, which are helpful for gauging the apparent health of a stream. For this study, the SVAP was slightly modified, and included (if applicable) the following elements:

- Channel Conditions
- Riparian Zone (Left and Right Bank)
- Bank Stability (Left and Right Bank)
- Water Appearance
- Nutrient Enrichment
- Instream Fish Cover
- Pools
- Invertebrate Habitat
- Riffle Embeddedness
- Canopy Cover
- Manure Presence

Individual element scores are averaged to provide an overall SVAP score for each reach assessed. Overall SVAP scores for each stream reach were calculated by dividing the sum total of each reach's assessed elements by the number of elements collected. Sub-watershed element averages were calculated by taking the average of each element over every assessed reach within the sub-watershed.

Teams of three-person field crews were trained and assigned to collect SVAP data in a series of reaches chosen to best represent the sub-watershed's baseline conditions. Stream reaches were located a standard 200 feet apart from each other, and sampling was conducted while moving upstream in the stream segment. Each sub-watershed was broken down into segments, and each segment was then divided into reaches, where individual assessments occurred. Each reach received an SVAP score based on observed elements.

SVAP scores are defined by NRCS as:

- 1.0-6.0 poor;
- 6.1 – 7.4 fair;
- 7.5 – 8.9 good;
- 9.0-10.0 excellent.

In addition to standard SVAP elements, the presence of invasive vegetation, aquatic vegetation, and barriers to fish movement were noted. Each stream reach was documented by a hand-drawn site diagram noting any stream features that may affect stream conditions or health such as pipes, culverts, tributaries, etc. Photos of each site were also taken, along with latitude and longitude reading, taken with a Garmin eTrex handheld GPS unit.

2.2 General Parameters and Water Quality Methods

General Parameters (GPS location, stream depth, bankfull width, baseflow width, substrate type, and stream velocity), were collected at every stream reach as appropriate.

General water quality measurements were measured and recorded at every other stream reach that SVAP was applied. Water quality was measured *in situ* using a YSI Pro Plus Multiparameter Instrument for dissolved oxygen, conductivity, pH, total dissolved solids, and temperature. YSIs were calibrated no longer than 24 hours in advance of sampling, as per manufacture specifications.

If water quality sampling was unable to be performed resulting in data gaps, due to equipment malfunction or dangerous conditions, it was noted on the field data sheets.

Grab samples were taken and stored on ice to later to analyze phosphorus, nitrate, and turbidity using a YSI 9500 Photometer and a HACH 2100 Q Turbidimeter once the samples were back in the lab.

Additional water quality sampling was performed at 24 sites within four of the five prioritized sub-watersheds (Buffalo River, Smokes Creek, Eighteenmile Creek, and Lower Tonawanda Sub-watersheds) assessed in 2015.

Water quality was measured *in situ* for dissolved oxygen, conductivity, pH, total dissolved solids, and temperature at 24 sites in four of the targeted sub-watersheds from June through November using a YSI Pro Plus Multiparameter Instrument.

Grab samples were collected for nitrate, phosphorus and turbidity at these same sites and were analyzed using a YSI 9500 Photometer and a HACH 2100 Q Turbidimeter.

During the months of June through September, grab samples for *Escherichia coli* were collected and analyzed at the Erie County Health Department Lab. The sites were sampled regardless of weather or stream flow conditions with the exception of several extreme storm events where sampling was postponed due to safety concerns.

3 Results

3.1 Buffalo River Sub-watershed

Approximately 26 miles of the Buffalo River Sub-watershed were assessed from May 18, 2015 to August 4, 2015. 525 reaches were assessed in three stream bodies. The streams assessed were Graff Brook, Cazenovia Creek (main, west, and east branches), and Sprague Brook. Each stream was broken up into segments, and assigned a unique identifier based on location (MCAZA, MCAZB, GRF, SECAZ, NWCAZ, NECAZ, MECAZ).

3.1.1 Physical Properties

As seen in Table 1, the Buffalo River Sub-watershed had an average depth 8.7 inches for the five streams assessed. The average bankfull width for the sub-watershed was measured as 50.1 feet, while the average baseflow width was measured as 38.4 feet, the largest average baseflow width of the three sub-watersheds that were assessed in parallel.

Table 1 Buffalo River Sub-watershed Physical Properties

Stream	Average Depth (in)	Average Bankfull Width (ft.)	Average Baseflow Width (ft.)
Cazenovia Creek Main Stem	11.1	102.6	83.3
Cazenovia Creek South Branch	8.1	58.7	40.1
Cazenovia Creek East Branch	13.4	47.2	28.2
Graff Brook	4.8	21.0	18.0
Sprague Brook	6.3	40.9	22.6
Sub-watershed Average	8.7	50.1	38.4

3.1.2 General Parameters

Substrate in the sub-watershed is predominantly cobble, with 49% of assessed reaches having a cobble substrate. Bedrock was observed to cover 14% of the sub-watershed's assessed substrate. Gravel comprised 10% of the assessed substrate, while sand, silt, and clay comprised 2%, and boulders made up 1% of the sub-watershed's assessed substrate.

Japanese Knotweed was observed in 43% of all stream reaches, Phragmites was observed at 12% of sites, and Purple Loosestrife was observed at 7% of all assessed sites.

3.1.3 SVAP Results

The average SVAP score for the entire Buffalo River Sub-watershed was 7.3 (Fair). The lowest assessed SVAP score for an individual reach was 3.7 (Poor), while the highest score was 9.6 (Excellent). A Standard Deviation of 1.05 for SVAP reach scores suggests that the sub-watershed does not have a large discrepancy or variety in terms of stream condition or health.

Within the sub-watershed, the MCAZB stream segment in Cazenovia Creek had the highest average SVAP score, 8.3 (Good). The lowest score recorded in the MCAZB stream segment was 6.6 (Fair) and the highest score was 9.3 (Excellent). The least-healthy assessed stream segment was the MCAZA segment in Buffalo River with an average SVAP score of 6.4 (Fair), a low score of 3.7 (Poor), and a high score of 8.1 (Good).

The SVAP score summary for The Buffalo River Sub-watershed can be seen in Table 2 below.

Table 2 Buffalo River Sub-watershed SVAP Element Summary

	Channel Conditions	Riparian Zone left bank	Riparian Zone right bank	Bank Stability left bank	Bank Stability right bank	Water Appearance	Nutrient Enrichment
# of scores *average*	506 8.9	508 8.5	506 8.3	502 7.3	498 7.0	510 8.9	509 6.6
	Instream Fish Cover	Pools	Invertebrate Habitat	Canopy Cover	Manure Presence	Riffle Embeddedness	
# of scores *average*	510 4.8	504 5.1	508 8	316 4.7	4 5	431 9.1	

Channel conditions for the sub-watershed were rated as Fair, having an average SVAP score of 8.9 over 506 assessed reaches.

Riparian zone scores for both the left and right bank were rated Good, having average scores of 8.5 and 8.3 over 508 and 506 reaches, respectively.

Bank stability for both the left and right sides (looking upstream) of the stream were rated fair, with respective scores of 7.3 and 7.0 assessed at 502 and 498 reaches.

Water appearance assessed at 510 reaches within the sub-watershed had an average SVAP score of 8.9 (Good).

Nutrient enrichment as assessed at 509 reaches within the sub-watershed had an average SVAP score of 6.6 (Fair). Nutrient enrichment within the sub-watershed was variable from reach to reach, as a standard deviation of 2.3 suggests. 19% of assessed reaches scored good or excellent, while 23% scored poor.

Instream fish cover within the sub-watershed was assessed to have an average SVAP score of 4.8 (Poor) from 510 assessed reaches.

Pools in the sub-watershed were assessed at 504 stream reaches, and were found to have an average SVAP score of 5.1 (Poor), indicating that pools are not highly prevalent within the streams assessed.

Invertebrate habitat was assessed as an average of 8 (Good) at 508 reaches within the sub-watershed. Invertebrate habitat includes woody debris, leaf packs, and submerged logs, among other debris.

Canopy cover was observed at 316 reaches, with an average score of 4.7 (Poor).

Manure presence was observed at four reaches, with a SVAP score of 5. Manure was observed in three stream reaches in Southeast Cazenovia Creek, and one stream reach in Graff Brook.

Riffle embeddedness was the highest scoring SVAP element measured within the sub-watershed was with an average score of 9.1 (Excellent).

3.1.4 Water Quality

Water quality data for the Buffalo River Sub-watershed was collected from May 18, 2015 to August 4, 2015. In Table 3 below, the data collected is compiled, along with number of measurements: lowest recorded value, highest recorded value, and overall average for each measured water quality criteria.

Table 3 Buffalo River Sub-watershed Water Quality Element Summary

	Temperature ºC	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	Phosphorus (µg/L)	Nitrate (µg/L)
# of meas.	136	111	111	120	120	120	242	236	235
low value	13.2	4.6	47.2	236.2	195	7.4	0.2	33	500
high value	25.9	12.8	154.6	409.5	409.5	8.7	20.9	1320	20,200
average	19.5	10.0	109.6	422.2	304.2	8.2	1.5	264	10,200

The average temperature for the sub-watershed was measured as 19.5ºC over 136 stream reaches. The lowest recorded temperature was 13.2ºC, while the highest recorded temperature was 25.9ºC.

Dissolved oxygen was measured as an average of 10.0 g/L and 109.6% for the entire sub-watershed. Dissolved oxygen levels over 100% can be a function of photosynthesis, rapid aeration, water temperature, or a lack of aquatic respiration. Organisms producing oxygen through photosynthesis contribute to a stream's dissolved oxygen level. In addition, cold water has the ability to hold more dissolved oxygen than warm water, and as water temperatures rise throughout the day, a stream may not quickly equalize its dissolved oxygen content with the atmosphere, resulting in a saturation level over 100%. The highest values recorded were 12.8 mg/L and 154.6%, while the lowest values recorded were 4.6 mg/L and 47.2%.

Conductivity was measured as an average 422.2 uS/cm, with low and maximum values of 236.2 and 573 uS/cm, respectively.

Total dissolved solids (TDS) were measured at an average of 304.15 mg/L, with a maximum value 409.5 mg/L. The lowest value recorded in the sub-watershed was 195 mg/L.

Average measured pH for the entire sub-watershed was 8.2, with the lowest value being recorded as 7.5, and the highest value being recorded as 8.7.

Turbidity was recorded as a sub-watershed average of 1.5 NTU, with a minimum value of 0.2 NTU and a maximum of 20.9 NTU.

Phosphorus levels were recorded as a sub-watershed average of 264 μg/L, a minimum of 33 μg/L, and a maximum of 1320 μg/L.

Nitrate levels were recorded as a sub-watershed average of 10,200 μg/L, a minimum of 500 μg/L, and a maximum of 20,200 μg/L.

3.2 Eighteenmile Creek Sub-watershed

Approximately 17 miles of streams within the Eighteenmile Creek Sub-watershed were assessed from July 30, 2015 to September 1, 2015. 331 reaches were assessed in three streams, Eighteenmile Creek (Main and South Branches), Hampton Brook, and Neuman Creek. Each stream was broken up into segments, and assigned a unique identifier based on location (18S, 18W 18M, SB, SSB, HAM, NEU).

3.2.1 Physical Properties and General Parameters

As seen in Table 4, the Eighteenmile Creek Sub-watershed had the deepest average depth of the three sub-watersheds assessed, with an average depth of 9.8 inches throughout the four streams assessed.

The sub-watershed also had the largest average bankfull width measured in each of the sub-watersheds at 84.9 feet, although none of the four streams assessed within the sub-watershed were measured to have the widest average bankfull width; that distinction belongs to Cazenovia Creek in the Buffalo River Sub-watershed, which was measured as an average width of 102.6 feet.

The average baseflow width for the sub-watershed was measured as 32 feet, the second widest baseflow width of the three sub-watersheds, with only the Buffalo River Sub-watershed having wider average baseflow width.

Table 4 Eighteenmile Creek Sub-watershed Physical Properties

Stream	Average Depth (in.)	Average Bankfull Width (ft.)	Average Baseflow Width (ft.)
Eighteenmile Creek Main Stem	10.3	85	55.3
Eighteenmile Creek South Branch	6.8	81	44.9
Hampton Brook	9.6	34.8	14.1
Neuman Creek	12.5	22.1	13.7
Sub-watershed Average	9.8	55.7	32

3.2.2 General Parameters

Substrate at assessed reaches within the sub-watershed was observed to be predominantly bedrock (39% of assessed reaches), cobble (32%), and gravel (23%), with sand, silt, silt/clay mix, and boulders making up only 6% of the substrate of assessed reaches, cumulatively.

Japanese Knotweed was observed at 66% of reaches assessed in the sub-watershed, and was evident in some capacity in every stream segment assessed within the sub-watershed. Purple Loosestrife was observed in 33% of assessed reaches, while Phragmites was observed in only 3% of all assessed reaches.

3.2.3 SVAP Results

The average SVAP score for the entire Eighteenmile Creek Sub-watershed was 7.7 (Fair). The lowest assessed score was 4.2 (Poor), measured at the NEU19 reach in Neuman Creek. The reach was assessed to be Poor, and was observed to be located near a farm, contain cattle tracks in the stream, and have a presence of manure. The reach with the highest assessed SVAP score in the sub-watershed was SSB1802, with an SVAP value of 9.3 (Excellent), in the South Branch of Eighteenmile Creek.

8% of assessed reaches scored excellent (SVAP score >9), while 60% scored in the Good range (7.5-8.9), 28% scored Fair (6.1-7.4), and just 5% scored in the Poor range (<6).

Within the sub-watershed, the stream segments with the highest average SVAP score were the South Branch of Eighteenmile Creek, and Hampton Brook, each scoring an average SVAP score of 8.4 (Good). The South Branch of Eighteenmile Creek had a low score of 5.5 (Poor), and a high score 9.3 (Excellent). Hampton Brook also had a high score of 9.3 (Excellent), but a low score of 7.2 (Fair), much higher than the South Branch of Eighteenmile Creek's lowest SVAP score.

Within the sub-watershed, the stream segment with the lowest average SVAP scored was assessed at Neuman Creek, 6.7 (Fair). The lowest assessed score within Neuman Creek was 4.2 (Poor), while the highest was 8.5 (Good). A standard deviation of 0.9 suggests that the stream's health does not greatly vary from reach to reach.

The SVAP score summary for each assessed element can be seen in Table 5 below.

Table 5 Eighteenmile Creek Sub-watershed SVAP Element Summary

	Channel Conditions	Riparian Zone left bank	Riparian Zone right bank	Bank Stability left bank	Bank Stability right bank	Water Appearance	Nutrient Enrichment
# of scores average	329 9.6	330 8.7	330 9.2	330 7.6	330 7.8	330 7.6	331 6.4
	Instream Fish Cover	Pools	Invertebrate Habitat	Canopy Cover	Manure Presence	Riffle Embeddedness	
# of scores average	331 5.8	326 5.9	331 8.9	237 5.2	1 1	301 9.4	

Channel conditions for the Eighteenmile Creek Sub-watershed were rated as excellent, having an average SVAP score of 9.6 for the 331 assessed reaches. Eighteenmile Creek's channel condition was, on average the highest rated SVAP element assessed within the sub-watershed, indicating that the stream for the most part, still exists in a healthy state, with little channelization, or stream channel structural issues.

Riparian zone scores for the sub-watershed scored slightly lower on the left bank of the stream (looking upstream), than the right bank. The left bank was rated as 8.7 (Good), while the right bank was rated 9.2 (Excellent).

Bank stability was rated nearly identically for both the left and right banks, with a sub-watershed average of 7.6 (Good), and 7.8 (Good), respectively.

Water appearance was assessed at a total of 330 reaches for an average score of 7.6 (Good), indicating that water was mostly clear, with objects visible to a depth of around three feet.

Nutrient enrichment, as assessed at 331 stream reaches was an average score of 6.4 (Fair). A fair score indicates that stream waters are slightly green-tinted from phosphorus runoff into the stream.

Instream fish cover was assessed at 331 reaches, and was found to have an average SVAP score of 5.8 (Poor) in the sub-watershed, indicating that fish habitat within the streams may be degraded.

Pools within the sub-watershed were assessed at 326 reaches, and had an average score of 5.9 (Poor). A poor score indicates that fish habitat within the sub-watershed's streams are degraded.

Invertebrate habitat was assessed to have an average score of 8.9 (Good) over 331 reaches. This element is important for stream health in that it provides an indicator as to whether invertebrate organism populations are affected by physical habitat, or greater water quality deficiencies.

Canopy cover, as assessed at 237 stream reaches within the sub-watershed, had an average score of 5.2 (Poor). A scarcity of vegetative shading over the stream can contribute to higher water temperature, and reduced levels of dissolved oxygen, which in turn, lead to decreased populations of native fish such as trout, which require lower water temperatures and levels of dissolved oxygen.

Manure was detected in one location in Neuman Creek, (reach NEU19). A farm was located near the stream reach, and the reach showed a cattle path through the stream bank, and into the stream.

Riffle embeddeness was rated highly, with a Sub-watershed average score of 9.4 (Excellent). A high score for riffle embeddedness indicates that gravel and cobble material in the stream bed is 25% embedded into the substrate. Loose material on the stream bed, not completely buried in sediment provides higher quality habitat for fish spawning and macroinvertebrates.

3.2.4 Water Quality

Water quality data for the Eighteenmile Creek Sub-watershed was collected from July 30, 2015 to September 1, 2015. In Table 6 below, the data collected is compiled, along with number of measurements, lowest recorded value, highest recorded value, and overall average for each recorded water quality criteria.

Table 6 Eighteenmile Creek Sub-watershed Water Quality Element Summary

	Temperature ºC	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	Phosphorus (µg/L)	Nitrate (µg/L)
# of scores	119	118	118	119	119	119	149	150	125
low value	15.90	6.2	66.2	318.0	228.5	7.7	0.6	6.6	3000
high value	29.0	15.2	184.1	781.9	403.0	9.5	32.8	303.6	21,400
average	21.0	9.6	107.6	495.8	347.2	8.18	5.4	79.2	10,300

Temperature was recorded as an average of 21ºC across 119 locations within the sub-watershed. The lowest recorded temperature within the sub-watershed was 15.9ºC, while the highest was recorded at 29ºC.

Average dissolved oxygen for the entire watershed was measured at 9.60 mg/L and 107.6%. The highest values recorded were 12.26 mg/L and 184.1%, while the lowest values recorded were 7.69 mg/L and 66.2%.

Conductivity was measured as an average of495.8 uS/cm across 119 sites. The lowest recorded value was 318 uS/cm, while the highest was 781.9 uS/cm.

Total dissolved solids (TDS) were measured at an average of 347.2 mg/L, with a maximum value 403 mg/L. The lowest value recorded in the sub-watershed was 228.5 mg/L.

Average measured pH for the entire sub-watershed was 8.18, with the lowest value being recorded as 7.7, and the highest value being recorded as 9.5.

Turbidity was recorded as a sub-watershed average of 5.4 NTU, with the lowest value being recorded as 0.6 NTU and the highest value being recorded as 32.8 NTU.

Phosphorus levels were recorded as a sub-watershed average of 79.2 μg/L, with a low of 6.6 μg/L, and a high of 303.6 μg/L.

Nitrate levels were recorded as a sub-watershed average of 10,300 μg/L, a low of 300 μg/L, and a high of 21,400 μg/L.

3.3 Smokes Creek Sub-watershed

Approximately 15 miles of stream within the Smokes Creek Sub-watershed were assessed from May 18, 2015 to July 20, 2015. 352 reaches were assessed in Smokes Creek (Main and South Branches), Rush Creek, and two unnamed tributaries. Each stream was broken up into segments, and assigned a unique identifier based on location (SMK, SSMK, LKS, EKS, SBS).

3.3.1 Physical Properties

As seen in Table 7, the Smokes Creek Sub-watershed had the shallowest average depth of the three sub-watersheds assessed, with an average depth of 7.5 inches throughout the five streams assessed. The sub-watershed also had the smallest average bankfull width measured in each of the sub-watersheds, with an average bankfull width of 27.2 feet. The average baseflow width for the sub-watershed was measured as 16.4 feet.

Table 7 Smokes Creek Sub-watershed Physical Properties

Stream	Average Depth (in.)	Average Bankfull Width (ft.)	Average Baseflow Width (ft.)
Smokes Creek	10.9	32.3	19.5
South Branch Smokes Creek	7.7	39.8	25.9
LKS (Unnamed Tributary)	5.6	17.7	9.9
Rush Creek	8.5	23.3	14.3
EKS (Unnamed Tributary)	4.8	22.9	12.1
Sub-watershed Average	7.5	27.2	16.4

3.3.2 General Parameters

Substrate within the Smokes Creek Sub-watershed was highly variable, with no overarching type of substrate dominating within the sub-watershed. Every stream was observed to have variable substrate particle size ranging from a silt/clay mix to boulder and cobble material.

The Smokes Creek Sub-watershed had the fewest number of invasive species out of the three assessed sub-watersheds, with 82% of all assessed reaches having no observed invasive species. 17% of assessed reaches were observed to have growth of Japanese Knotweed, while only one stream reach in Smokes Creek (SSMK01) was observed to have Phragmites.

3.3.3 SVAP Results

The average SVAP score for the entire watershed was 7.2 (Fair). The lowest assessed score was 1.5 (Poor), while the highest assessed score was 9.3 (Excellent). A standard deviation of 1.9 suggests that there is a fairly large variation in overall stream health throughout the sub-watershed system.

Within the sub-watershed, the stream reach with the lowest assessed score was EKS8, located within an unnamed tributary. The stream reach was scored as 1.5 (Poor), and suffered from degraded stream conditions due mainly to a large, long culvert located directly upstream of the sampled site. The stream reach with the highest assessed score was SSMK09 in Smokes Creek, with a score of 9.3 (Excellent).

The SVAP score summary for the Eighteenmile Creek Sub-watershed can be seen in Table 8 below.

Table 8 Smokes Creek SVAP Element Summary

	Channel Conditions	Riparian Zone left bank	Riparian Zone right bank	Bank Stability left bank	Bank Stability right bank	Water Appearance	Nutrient Enrichment
# of score *average*	349 8.7	347 8.4	349 8.8	349 7.0	348 7.3	350 6.5	347 5.2
	Instream Fish Cover	Pools	Invertebrate Habitat	Canopy Cover	Manure Presence	Riffle Embeddedness	
# of scores *average*	352 5.9	345 6.2	352 8.5	344 6.3	NA NA	267 7.6	

Average channel conditions for the sub-watershed were assessed as 8.7 (Good) over 349 stream reaches. Channel conditions were generally good, with 71% of all reaches scoring either a 9 or 10 (Excellent).

69% of reaches scored an average riparian zone score of nine or greater (Excellent), indicating that natural vegetation extends to two active channel widths on each side of the stream. 9% of assessed stream reaches had riparian zones rated Good (7.5-8.9), where natural vegetation extends to one active channel width on each side. 17% of assessed riparian zones were rated as Poor (<6).

Bank stability for the left side of the channel throughout the sub-watershed was assessed as an average of 7.0 (Fair), while the right side of the channel was assessed as an average of 7.3 (Fair). The average combined score for bank stability was 7.2 (Fair).

Water appearance was assessed as 6.5 (Fair) over 350 reaches. Fair water quality indicates a stream which is occasionally cloudy, especially after storm events, but contains sufficient water quality to observe objects at around 1.5 feet of depth.

Nutrient enrichment within the sub-watershed was observed to be poor, with an average score of 5.2. The stream reaches assessed were greenish in color, with noticeable algal and macrophyte growth. 67% of assessed stream reaches scored poor in nutrient enrichment, while only three reaches scored excellent (9 or greater).

Instream fish cover was also assessed to be Poor (under 6) on average, with 62% of stream reaches scoring Poor. 47% of reaches scored a 5 (Poor), indicating 4 to 5 cover types were present.

Pools were rated a sub-watershed-wide average score of 6.2 (Fair). 35% of reaches were assessed as Poor (under 6), although 21% of assessed reaches scored Excellent (9 or above).

Invertebrate habitat was rated an average score of 8.5 (Good) in the sub-watershed, indicating 4 to 5 types of habitat available for insect habitat.

Canopy Cover in the sub-watershed was assessed as an average of 6.3 (Fair), indicating that less than half of average reach is shaded.

Manure was not observed to be present at any reach within the sub-watershed.

Riffle embeddedness was assessed as an average of 7.6 (Good) over 267 stream reaches, indicating that gravel of cobble particles are around 30% embedded into the stream bed.

3.3.4 Water Quality

Water quality data for the Creek Sub-watershed was collected from May 18, 2015 to July 20, 2015. In Table 9 below, the data collected is compiled, along with number of measurements, lowest recorded value, highest recorded value, and overall average for each recorded water quality criteria.

Table 9 Smokes Creek Water Quality Element Summary

	Temperature ºC	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	Phosphorus (µg/L)	Nitrate (µg/L)
# of scores	95	95	95	95	95	95	165	155	156
low value	14.4	2.4	26.1	231.6	171.6	7.6	0.7	23.1	200
high value	28.1	16.4	182.7	1398.0	1001.0	8.6	112	1227.6	23,400
average	18.9	10.2	109.9	828.1	602.6	8.1	6.0	442.2	8700

Temperature was measured at 95 locations within the sub-watershed, and had an average value of 18.9ºC. The highest value recorded was 28.1ºC, while the lowest was 14.4ºC.

Average dissolved oxygen for the entire watershed was measured as 10.18 mg/L, and 109.9%. The high values recorded were 16.4 mg/L and 182.7%, while the lowest values recorded were 2.4 mg/L and 26.1%.

Conductivity was measured as an average 828 uS/cm throughout the sub-watershed, with low and high values of 231.6 and 1398.0 uS/cm, respectively.

Total dissolved solids (TDS) were measured at an average of 602.6mg/L, with a maximum value 1001.0mg/L, and a low value of 171.6mg/L.

Average measured pH for the entire sub-watershed was 8.1, with the low value being recorded as 7.57, and the high value being recorded as 8.6.

Turbidity was recorded as a sub-watershed average of 6 NTU, with a low value of 0.7 NTU and a high value of 112 NTU.

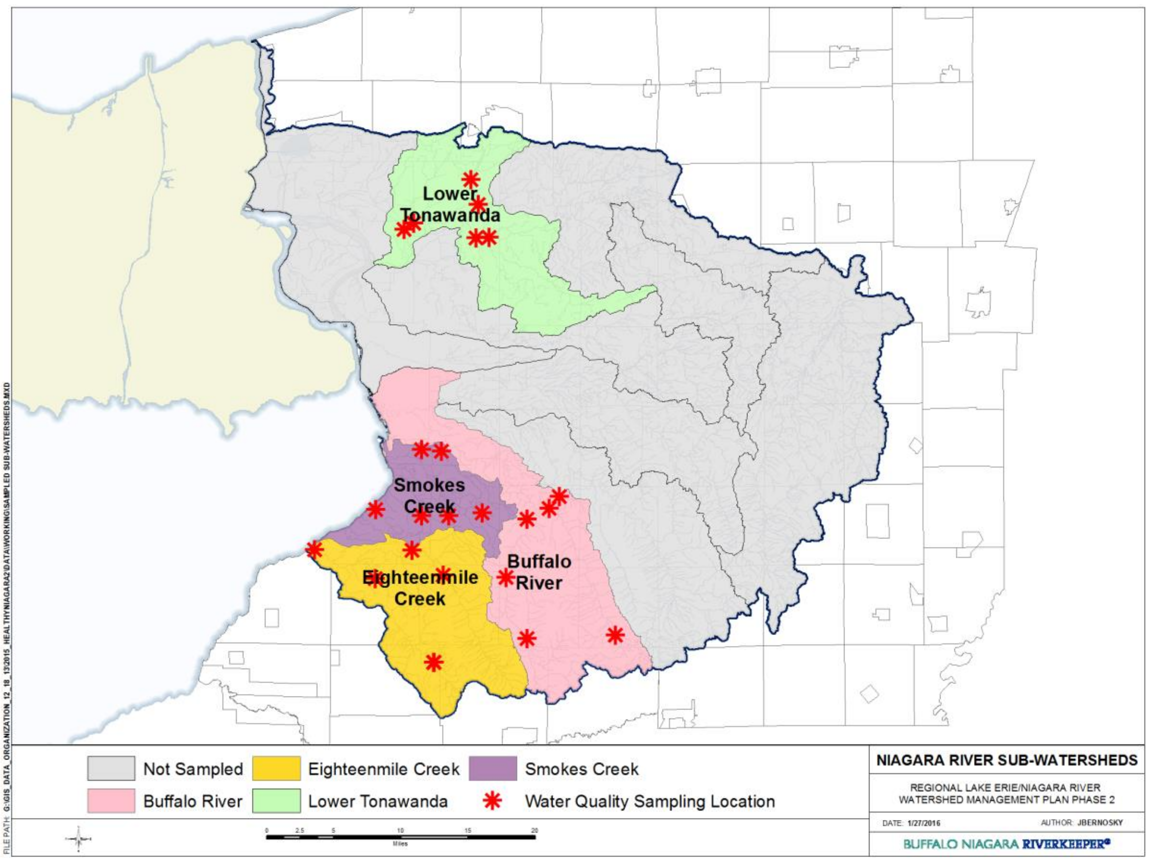
Phosphorus levels were recorded as a sub-watershed average of 442.2 μg/L, a low value of 23.1 μg/L, and a high value of 1227.6 μg/L.

Nitrate levels were recorded as a sub-watershed average of 8700 μg/L, a low value of 200 μg/L, and a high value of 23,400 μg/L.

4 Water Quality Monitoring

Water quality was repeatedly monitored at six sites in each sub-watershed in which assessments occurred, with the addition of the Lower Tonawanda Creek Sub-watershed. Figure 2 below shows the sub-watersheds in which sampling occurs during the 2015 data collection, and where water quality data was collected.

Figure 2 2015 Prioritized Sub-watersheds and Water Quality Sampling Locations



4.1 Lower Tonawanda Creek Sub-watershed

Six locations, Sawyer Creek, Bull Creek, Tonawanda Creek, Gott Creek, and Black Creek, within the Lower Tonawanda Creek Sub-watershed were monitored once a month from June 17, 2015 to October 29, 2015. Temperature, dissolved oxygen, conductivity, total dissolved solids, pH, turbidity, phosphorus, nitrate, and *E. coli* data were collected from each location, along with GPS location data.

Table 10 Lower Tonawanda Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100ml	Phosphorus (µg/L)	Nitrate (µg/L)
6/17/15	20.5	70.4	6.8	679.5	526.6	7.7	54.0	386.7	561	4066.7
7/8/15	21.7	62.0	5.4	670.6	466.6	7.8	24.6	938.3	217.25	2366.7
8/5/15	21.6	59.9	5.2	1019.9	716.2	7.9	19.2	366.7	144.65	9700
9/3/15	23.1	42.3	3.7	953.8	646.2	7.4	24.8			
10/1/15	14.8			909.3	601.2	8.0	21.0		30.8	
10/29/15	11.4	71.6	7.8	372.7	327.8	8.0	109.7		108.24	

Temperature within the six sites of the sub-watershed was an overall average of 18.8ºC, with the lowest temperature measurement of 10.6ºC recorded at Tonawanda Creek in October, and the highest measurement of 23.7ºC being recorded at Black Creek in September.

Dissolved oxygen was measured at the six sites with an overall average of 63.3% and 6.0 mg/L, respectively. High measurements of 86% and 10.2 mg/L were recorded at Sawyer Creek in June, while the lowest measurements of 12.8% and 1.2 mg/L were recorded at the same location in September. As can be seen in Table 10, dissolved oxygen was not able to be sampled on 10/01/2015 due to an equipment malfunction. The measured dissolved oxygen content of the assessed water bodies follows seasonal temperature fluctuations, as colder water has the ability to hold more dissolved oxygen.

Conductivity was recorded as an average of 767.6 uS/cm throughout the six sites from June to October, with a high value of 1838 uS/cm recorded at Gott Creek in September, and a low value of 237.2 uS/cm recorded at Black Creek in October.

Total Dissolved solids were recorded as an average of 547.4 mg/L throughout the six sites from June to October, with a high value of 1261.5 mg/L recorded at Gott Creek in September, and a low value of 209.3 mg/L recorded at Black Creek in October.

pH was recorded as an average of 7.8 throughout the six sites from June to October, with a high value of 8.2 recorded at Sawyer Creek in October, and a low value of 5.7 recorded at Sawyer Creek in September.

Turbidity was recorded as an average of 42.9 NTU throughout the six sites from June to October, with a high value of 222 NTU recorded at Bull Creek in October, and a low value of 1.8 NTU recorded at Sawyer Creek in August.

E. coli samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 563.9 cfu/100ml, with high and low values of 2300 cfu/100ml and 10 cfu/100ml, recorded in July at Gott Creek in July, and NYS Barge Canal, respectively.

Phosphorus samples were collected at the six sites from June to October, and the sub-watershed was assessed to have a five-month average of 212.4 μg/L. A low value of 42.9 μg/L was recorded at NYS Barge Canal in October, while a high value of 795.3 μg/L was recorded at Bull Creek in June. As can be seen in Table 10, phosphorus was not able to be sampled in September 2015 due to an equipment malfunction.

Nitrate samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month average of 5377.8 μg/L. A low value of 400 μg/L was recorded at Sawyer Creek in June, while a high value of 15,000 μg/L was recorded at Black Creek in June. As can be seen in Table 10, nitrate was not able to be sampled from September through October 2015 due to an equipment malfunction.

4.2 Eighteenmile Creek Sub-watershed

Six locations in the Eighteenmile Creek Sub-watershed, three in the main stem of Eighteenmile Creek, and three in the south branch of Eighteenmile Creek were monitored once a month from June 25, 2015 to November 30, 2015. Temperature, dissolved oxygen, conductivity, total dissolved solids, pH, turbidity, phosphorus, nitrate, and *E. coli* data were collected from each location, and a presented in Table 11 below.

Table 11 Eighteenmile Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100ml	Phosphorus (µg/L)	Nitrate (µg/L)
6/25/15	17.9	118.4	11.3	426.4	320.8	9.2	2.7	433.3	471.9	6000
7/22/15	18.7	126.7	11.8	479.9	352.4	8.0	0.4	180.0	206.8	
8/27/15	16.7	113.2	11.2	502.5	386.3	8.0	2.6	248.3	193.6	
9/28/15	17.0			480.2	372.8	7.6	1.3		42.9	
10/22/15	13.6	112.9	11.8	449.5	374.1	8.3	2.4		29.15	
11/30/15	3.4	129.6	16.6	275.0	304.8	8.2	4.1			

The water temperature of the six sites of the sub-watershed was an overall average of 14.9ºC, with the lowest temperature measurement of 2.8ºC recorded at site EMC06 in the South Branch of Eighteenmile Creek in November, and the highest temperature of 23.7ºC recorded at site EMC03 in Eighteenmile Creek in July.

Dissolved oxygen was measured at the six sites with an overall average value of 118.3% and 11.7 mg/L, respectively. As can be seen in Table 11, dissolved oxygen was not able to be sampled on 9/28/2015 due to an equipment malfunction. High measurements of 142.1% and 16.6 mg/L were recorded at site EMC04 in the South Branch of Eighteenmile Creek in July, while the lowest measurements of 60.1% and 5.7 mg/L were recorded at site EMC05 in the South Branch of Eighteenmile Creek in August.

Conductivity was recorded as an average of 440.1 uS/cm throughout the six sites from June to October, with a high value of 645 uS/cm recorded at site EMC02 in Eighteenmile Creek in October. A low value of 219.2 uS/cm was recorded at site EMC05 in the South Branch of Eighteenmile Creek in November.

Total dissolved solids were recorded as an average of 353 mg/L throughout the six sites from June to October. A high value of 533 mg/L was recorded at site EMC02 in Eighteenmile Creek in October, while a low value of 245.1 mg/L was recorded at site EMC05 in the South Branch of Eighteenmile Creek in November.

pH was recorded as an average of 8.2 throughout the six sites from June to October. A high value of 9.7 was recorded at site EMC04 in the South Branch of Eighteenmile Creek in June, and a low value of 5.3 was recorded at site EMC05 in the South Branch of Eighteenmile Creek in September.

Turbidity was recorded as an average of 2.1 NTU throughout the six sites from June to October, with a high value of 7.3 NTU recorded at site EMC06 in the South Branch of Eighteenmile Creek in November, and a low value of 0.3 NTU recorded at both EMC05 and EMC06 in the South Branch of Eighteenmile Creek in July.

E. coli samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 287.2 cfu/100ml. A high value of 870 cfu/100ml was measured at site EMC03 in Eighteenmile Creek in June, while a low value of 50 cfu/100ml was measured at site EMC06 in the South Branch of Eighteenmile Creek in August.

Phosphorus samples were collected at the six sites from June to October, and the sub-watershed was assessed to have a five-month average of 188.8 μg/L. A low value of 9.9 μg/L was recorded at site EMC04 in the South Branch of Eighteenmile Creek in September, while a high value of 765.6 μg/L was recorded at site EMC06 in the South Branch of Eighteenmile Creek in June. As can be seen in Table 11, phosphorus was not able to be sampled on November 30, 2015 due to an equipment malfunction.

Nitrate samples were collected at the six sites in June, and the sub-watershed was assessed to have a five-month average of 600 μg/L. A low value of 3600 μg/L was recorded at site EMC05 in the South Branch of Eighteenmile Creek, while a high value of 10,600 μg/L was recorded at site EMC01 in Eighteenmile Creek. As can be seen in Table 11, total nitrate was not able to be sampled from July through November 2015 due to an equipment malfunction.

4.3 Buffalo River Sub-watershed

Six locations in the Buffalo River Sub-watershed, two in the East Branch of Cazenovia Creek, three in the West Branch of Buffalo Creek, and one in Tannery Brook, were monitored once a month from June 29, 2015 to November 19, 2015. Temperature, dissolved oxygen, conductivity, total dissolved solids, pH, turbidity, phosphorus, nitrate, and *E. coli* data were collected from each location, and a presented in Table 12 below.

Table 12 Buffalo River Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100ml	Phosphorus (µg/L)	Nitrate (µg/L)
6/29/15	15.8						21.5	2416.7	557.2	2666.7
7/15/15	15.5	124.5	12.2	324.0	240.5	8.0		2113.3	205.2	
8/19/15	20.5	97.5	8.8	488.3	346.9	8.1	6.3	1331.7	17.1	
9/17/15	16.3			482.0	376.0	8.2	2.1		30.3	
10/15/15	12.2	102.8	11.0	350.3	302.3	8.3	3.6		2.5	
11/19/15	12.0	125.3	13.6	341.1	294.7	8.2	3.9		30.3	

The water temperature of the six sites of the sub-watershed was an overall average of 15.4ºC, with the lowest temperature measurement of 10.3ºC recorded at site CC06 in the East Branch of Cazenovia Creek in November, and the highest temperature measurement of 21.4ºC being recorded at the same location in August.

Dissolved oxygen was measured at the six sites from July to October, with an overall average value of 110.7% and 11.2 mg/L, respectively. High measurements of 160.5% and 15.7 mg/L were recorded at site CC06 in the East Branch of Cazenovia Creek in July, while the lowest measurements of 57.9% and 5.1 mg/L were recorded at the same site in August. As can be seen in Table 12, Dissolved oxygen was not able to be sampled on 6/29/2015 or 9/17/2015 due to an equipment malfunction.

Conductivity was recorded as an average of 339.7 uS/cm throughout the six sites from July to October, with a high value of 844 uS/cm recorded at the Tannery Brook site in September, and a low value of 207.4 uS/cm measured at site CC05 in the East Branch of Cazenovia Creek in October. As seen in Table 12, Conductivity was not able to be sampled on 6/29/2015 due to an equipment malfunction.

Total dissolved solids were recorded as an average of 314.5 mg/L throughout the six sites from July to October, with a high value of 663 mg/L recorded at the Tannery Brook site in September, and a low value of 182 mg/L recorded at site CC05 in the East Branch of Cazenovia Creek in October. As seen in Table 12, TDS was not able to be sampled on 6/29/2015 due to an equipment malfunction.

pH was recorded as an average of 8.2 throughout the six sites from July to October, with a high value of 8.6 recorded at the Tannery Brook site in September, and a low value of 5.3 recorded at site CC06 in the East Branch of Cazenovia Creek in July. As seen in Table 12, pH was not able to be sampled on 6/29/2015 due to an equipment malfunction.

Turbidity was recorded as an average of 7.6 NTU throughout the six sites from June to October, with the exclusion of July. A high value of 40.6 NTU was recorded at site CC09 in the West Branch of Cazenovia Creek in June, while a low value of 0.1 NTU was recorded at the Tannery

Brook site in September. As seen in Table 12, Turbidity was not able to be sampled on 7/15/2015 due to an equipment malfunction.

E. coli samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 1953.9 cfu/100ml. A high value of 5900 cfu/100ml was measured at site CC06 in the East Branch of Cazenovia Creek in August, while a low value of 50 cfu/100ml was measured at site CC05 in the East Branch of Cazenovia Creek in August.

Phosphorus samples were collected at the six sites from June to October, and the sub-watershed was assessed to have a six-month average of 140.4 μg/L. A low value of 3.3 μg/L was recorded at site CC05 in the East Branch of Cazenovia Creek in October and August, as well as at the Tannery Brook site in August, while a high value of 877.8 μg/L was recorded at site CC09 in the West Branch of Cazenovia Creek in June.

Nitrate samples were collected at the six sites in June, and the sub-watershed was assessed to have an average of 2666.7 μg/L. A low value of 1000 μg/L was recorded at site CC06 in the East Branch of Cazenovia Creek, while a high value of 4400 μg/L site CC07 in the West Branch of Cazenovia Creek. As can be seen in Table 12, total nitrate was not able to be sampled from September through November 2015 due to an equipment malfunction.

4.4 Smokes Creek Sub-watershed

Six locations in the Smokes Creek River Sub-watershed, Berricks Creek, Rush Creek, the South Branch of Smokes Creek, and three locations in the North Branch of Smokes Creek were monitored once a month from June 29, 2015 to November 12, 2015. Temperature, dissolved oxygen, conductivity, total dissolved solids, pH, turbidity, phosphorus, nitrate, and *E. coli* data were collected from each location, and a presented in Table 13 below.

Table 13 Smokes Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100ml	Phosphorus (μg/L)	Nitrate (μg/L)
6/29/15	17.5	100.0	9.5	575.9	439.0	8.8	6.8	2455.0	1.64	5.4
7/9/15	17.1	100.4	9.7	635.1	483.7	8.0	3.6	870.0	0.79	7.0
8/12/15	19.0	97.0	8.8	585.4	432.3	7.9	15.4	4400.0	0.34	1.3
9/10/15	19.9	74.0	7.1	802.8	579.6	7.8	12.9		0.19	
10/8/15	15.0	106.1	10.6	826.8	663.2	8.1			0.25	
11/12/15	9.8	109.6	12.4	601.4	548.6	8.2	8.7		0.14	

The water temperature of the six sites of the sub-watershed was an overall average of 16.3ºC, with the lowest temperature measurement of 8.9ºC recorded at site SC06 in the North Branch of Smokes Creek in November, and the highest measurement of 21.5ºC being recorded at site SC05 in the North Branch of Smokes Creek in September.

Dissolved oxygen was measured at the six sites from July to October, with an overall average value of 97.9% and 9.8 mg/L, respectively. High measurements of 128.8% and 13.4 mg/L were recorded at site SC05 in the North Branch of Smokes Creek in June, while the lowest measurements of 52.8% and 4.8 mg/L were recorded at the Berricks Creek location in September.

Conductivity was recorded as an average of 672.3 uS/cm throughout the six sites from June to November, with a high value of 1189 uS/cm recorded at the Berricks Creek site in October, and a low value of 326.5 uS/cm measured at site SC04 in the North Branch of Smokes Creek in November.

Total dissolved solids were recorded as an average of 525.6 mg/L throughout the six sites from July to November, with a high value of 903.5 mg/L at the Berricks Creek site in October, and a low value of 247.7 mg/L at site SC04 in the North Branch of Smokes Creek in August.

pH was recorded as an average of 8.1 throughout the six sites from June to November, with a high value of 9.6 recorded at site SC05 in the North Branch of Smokes Creek in June, and a low value of 7.6 recorded at the Berricks Creek site in August and September, and additionally at the Rush Creek site in September.

Turbidity was recorded as an average of 9.5 NTU throughout the six sites from June to November, with the exclusion of October. A high value of 41.9 NTU was recorded at the Berricks Creek location in August, while a low value of 1.4 NTU was recorded at site SC03 in the South Branch of Smokes Creek in September. As seen in Table 13, turbidity was not able to be sampled on 10/8/2015 due to an equipment malfunction.

E. coli samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 2575 cfu/100ml. A high value of 9300 cfu/100ml was measured at the Rush Creek site in August, while a low value of 410 cfu/100ml was measured at site SC05 in the North Branch of Smokes Creek in June.

Phosphorus samples were collected at the six sites from June to October, and the sub-watershed was assessed to have a six-month average of 182.7 μg/L. A low value of 3.3 μg/L was recorded at site SC03 in the South Branch of Smokes Creek in September. A high value of 768.9 μg/L was recorded at Rush Creek in June.

Nitrate samples were collected at the six sites from June to August, and the sub-watershed was assessed to have an average of4534 μg/L. A low value of 100 μg/L was recorded at Rush Creek in August, while a high value of 9000 μg/L was recorded at site SC03 in the South Branch of Smokes Creek in July. As can be seen in Table 13, total nitrate was not able to be sampled from September through November 2015 due to an equipment malfunction.

References

NRCS, 1998. Stream Visual Assessment Protocol. Technical Note 99-1.

Appendix D – 2016 Technical Data Report

Regional Niagara River/Lake Erie Watershed Management Plan – Phase 2:

2016 Technical Data Report

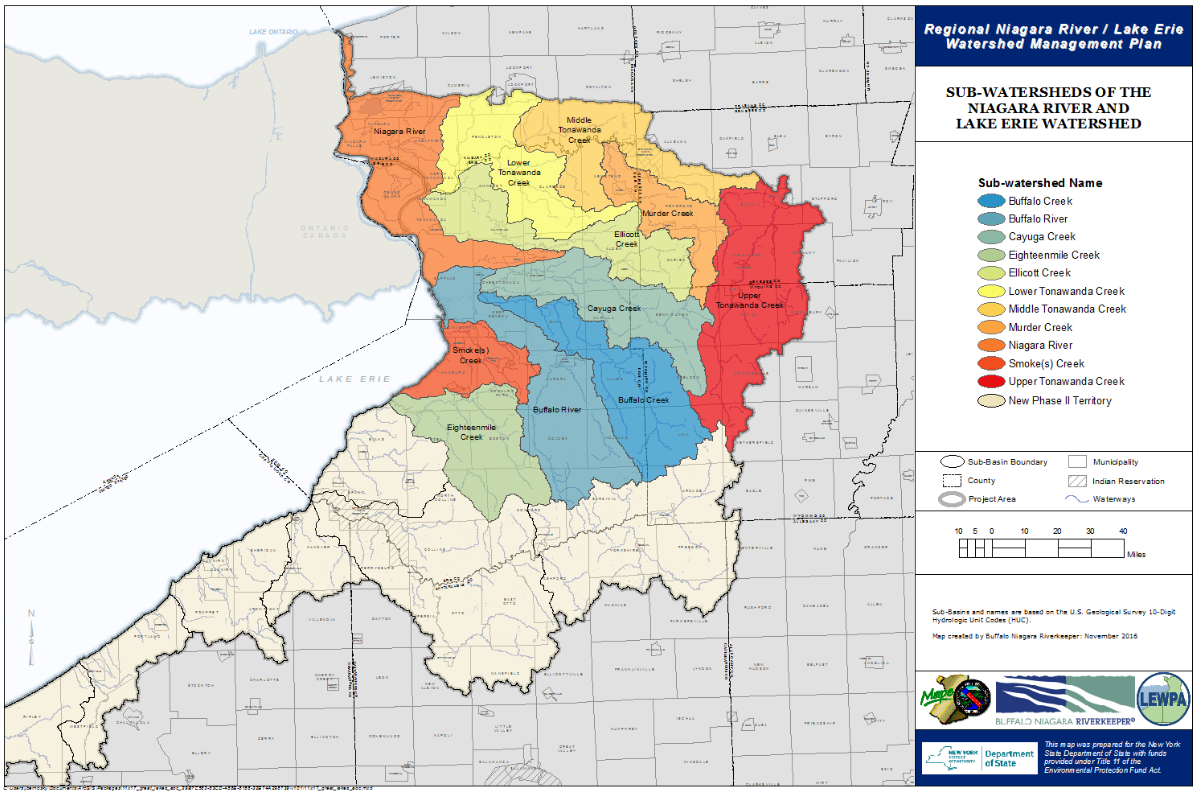


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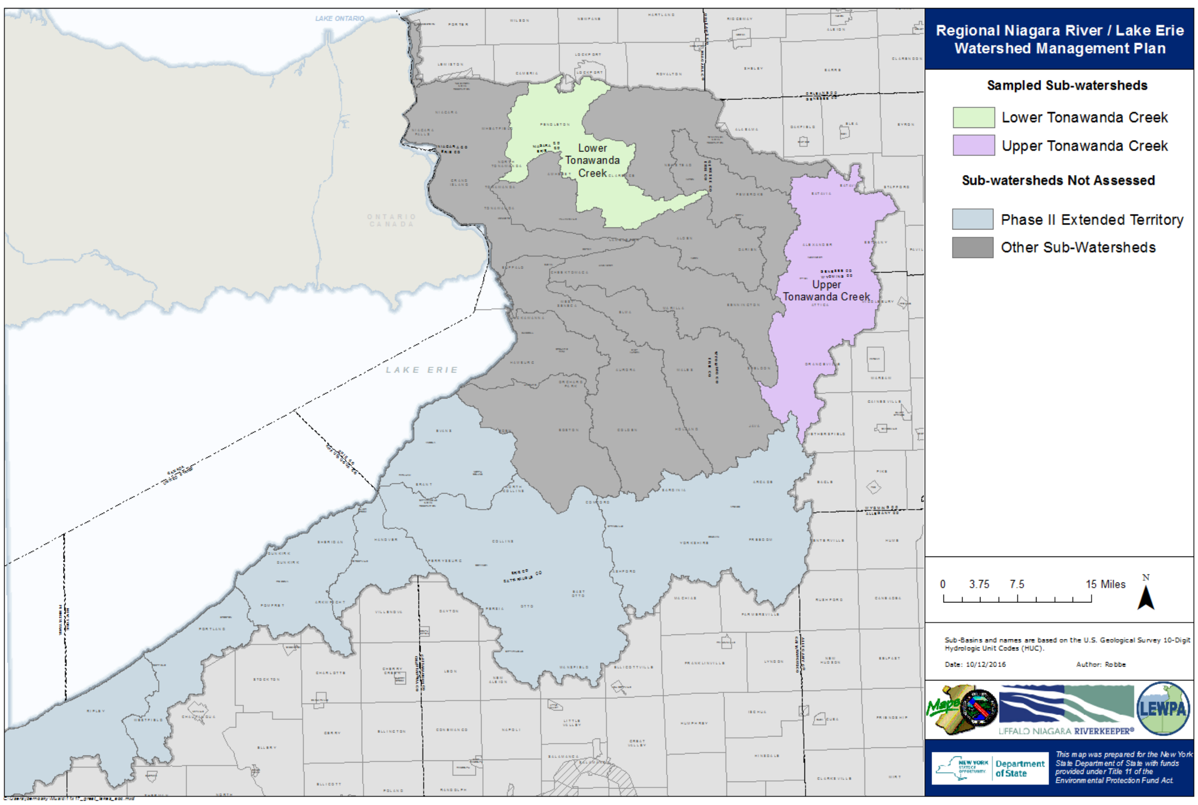
Table of Contents

1 Introduction

The purpose of this document is to report data collected during year two of the multi-year Regional Niagara River Lake Erie Watershed Management Plan - Phase 2 project (Healthy Niagara Phase 2).

To define baseline conditions of streams in two sub-watersheds of the Niagara River, Stream Visual Assessment Protocol (SVAP) and water quality data was collected. Data collection occurred from May 23, 2016 to August 8, 2016 and resulted in the assessment of approximately 61 miles of streams. The sub-watersheds assessed in 2016 were Upper Tonawanda Creek Sub-watershed (approximately 30 miles assessed), and Lower Tonawanda Creek Sub-watershed (approximately 31 miles assessed) as shown in Figure 1. Assessment in the three other prioritized sub-watersheds (Smoke Creek, Buffalo River, and Eighteenmile Creek) was completed in 2015.

Figure 1 2016 Prioritized Sub-watersheds



2 Methods

2.1 Stream Visual Assessment Protocol

The SVAP is a tool developed by the Natural Resources Conservation Service (NRCS, 1998) to quickly and easily qualify a stream's condition by assessing several elements indicative of overall stream health. SVAP provides a "snapshot in time" of qualitative stream conditions, which are helpful for gauging the apparent health of a stream. For this study, the SVAP was modified slightly and included (if applicable) the following elements:

- Channel Conditions
- Riparian Zone (Left and Right Bank)
- Bank Stability (Left and Right Bank)
- Water Appearance
- Nutrient Enrichment
- Instream Fish Cover
- Pools
- Invertebrate Habitat
- Riffle Embeddedness
- Canopy Cover
- Manure Presence

Individual elements were scored using a 1-10 scale. Overall scores for each reach were calculated by dividing the sum of the element scores by the number of elements assessed.

SVAP scores are defined by NRCS as:

- 1.0-6.0 poor;
- 6.1 – 7.4 fair;
- 7.5 – 8.9 good;
- 9.0-10.0 excellent.

Stream segments within each prioritized sub-watershed were selected based on their ability to best represent the sub-watershed's baseline conditions. Each segment was then divided into reaches with a standard length of 200 feet. Trained three-person field crews conducted sampling while moving upstream in the stream segment. Each reach received a SVAP score based on observed elements.

In addition to standard SVAP elements, the presence of invasive vegetation, aquatic vegetation, and barriers to fish movement were noted. Photo documentation occurred at the end of each reach, looking downstream. Additional photos and notes were taken to record any stream features that may influence stream condition or health such as pipes, culverts, tributaries, etc.

2.2 General Parameters and Water Quality Methods

General Parameters (GPS location, stream depth, bankfull width, baseflow width, and dominate substrate type) were recorded at each stream reach. Thalweg measurements were discounted while calculating average depth measurements when stream conditions were intermittent.

General water quality measurements were recorded at every fourth stream reach that SVAP was applied. YSI Pro Plus Multiparameter Instruments were used to measure temperature, conductivity, total dissolved solids, dissolved oxygen, and pH. YSI's were calibrated no longer than 24 hours in advance of sampling, as per manufacture specifications.

If water quality sampling was unable to be performed, due to equipment malfunction or dangerous conditions, it was noted on the field data sheets.

Grab samples were taken and stored on ice to later to analyze phosphorus, nitrate, and turbidity using a YSI 9500 Photometer and a HACH 2100 Q Turbidimeter.

Additional water quality sampling was performed at 16 sites within the five prioritized sub-watersheds (Upper Tonawanda, Lower Tonawanda, Buffalo River, Smoke Creek, and Eighteenmile Creek Sub-watersheds) from April 25, 2016 to November 15, 2016. During the months of June to August, grab samples for *Escherichia coli* were collected and analyzed at the Erie County Health Department Lab. The sites were sampled regardless of weather or stream flow conditions.

3 Sub-watershed Results

3.1 Upper Tonawanda Creek Sub-watershed

Approximately 30 miles of the Upper Tonawanda Creek Sub-watershed were assessed from May 23, 2016 to August 3, 2016. Within seven stream bodies, 784 reaches were assessed. The streams assessed were Tonawanda Creek, East Fork Tonawanda Creek, Little Tonawanda Creek, Stony Brook, Bowen Creek, Crow Creek, and one unnamed minor tributary. Each stream was broken up into segments, and assigned a unique identifier based on location (BOW, CRW, LTC, LTC3, STN, TONA, TONB, TONC, TONE, and TONF).

3.1.1 Physical Properties

As seen in Table 1, the Upper Tonawanda Creek Sub-watershed recorded an average depth 8.7 inches for the seven streams assessed. The sub-watershed recorded an average bankfull width of 34.0 feet and an average baseflow width of 19.3 feet. This sub-watershed recorded the widest bankfull and baseflow measurements of the two sub-watersheds assessed.

Table 1 Upper Tonawanda Creek Sub-watershed Physical Properties

Stream	Average Depth (in)	Average Bankfull Width (ft.)	Average Baseflow Width (ft.)
Tonawanda Creek	14.3	50.0	33.4
East Fork Tonawanda Creek	8.2	46.8	25.4
Little Tonawanda Creek	10.3	38.4	23.3
Stony Brook	6.8	39.4	18.2
Bowen Creek	9.7	28.8	12.3
Crow Creek	6.7	23.8	13.5
TONF (minor tributary)	4.6	11.1	8.8
Sub-watershed Average	8.7	34.0	19.3

3.1.2 General Parameters

Substrate in the sub-watershed is predominantly cobble, with 45% of assessed reaches having a cobble substrate. Silt/clay was observed to cover 22% of the sub-watershed's assessed substrate. Gravel comprised 20%, bedrock comprised 8%, boulder comprised 4%, and sand comprised 2% of the sub-watershed's assessed substrate.

Japanese Knotweed was observed in 9% of assessed stream reaches in the sub-watershed. Hydrilla was observed in 3%, Phragmites was observed in 2%, and Purple Loosestrife was observed in 1% of all assessed reaches.

3.1.3 SVAP Results

The average SVAP score for the entire Upper Tonawanda Sub-watershed was 7.0 (Fair). The lowest assessed SVAP score for an individual reach was 2.2 (Poor) at TONA74 in Tonawanda Creek. The highest SVAP score was 9.2 (Excellent) at STN106 in Stony Brook. A standard deviation of 1.19 for SVAP reach scores suggests that the sub-watershed does not have a large discrepancy or variety in terms of stream condition or health.

Within the sub-watershed, the STN stream segment in Stony Brook had the highest average SVAP score, 7.8 (Good). The lowest score recorded in the STN stream segment was 5.9 (Poor) and the highest score was 9.2 (Excellent). The stream segment with the lowest average SVAP score was the TONA segment in Tonawanda Creek, which recorded an average of 5.6 (Poor). The lowest score recorded in the segment was of 2.2 (Poor) and the highest score was 7.5 (Good).

Table 2 presents an SVAP score summary for the Upper Tonawanda Creek Sub-watershed.

Table 2 Upper Tonawanda Creek Sub-Watershed SVAP Element Summary

	Channel Conditions	Riparian Zone left bank	Riparian Zone right bank	Bank Stability left bank	Bank Stability right bank	Water Appearance	Nutrient Enrichment
# of scores *average*	784 9.4	784 8.5	784 8.4	784 7.3	784 7.5	784 7.5	784 6.7
	Instream Fish Cover	Pools	Invertebrate Habitat	Canopy Cover	Manure Presence	Riffle Embeddedness	
# of scores *average*	784 4.9	784 4.5	784 7.2	784 5.3	88 4.5	527 6.6	

Channel conditions for the Upper Tonawanda sub-watershed were rated as Excellent, having an average SVAP score of 9.4 over 784 assessed stream reaches. The channel condition was, on average the highest rated SVAP element assessed within the sub-watershed, indicating that the stream for the most part, still exists in a healthy state, with little channelization, or stream channel structural issues.

Riparian zone scores for both the left and right bank (looking downstream) were rated as Good, having average scores of 8.5 and 8.4 over 784 assessed reaches.

Bank stability for the sub-watershed scored slightly lower on the left bank of the stream than the right bank throughout the 784 reaches assessed. The left bank was rated 7.3 (Fair), while the right bank was rated 7.5 (Good).

Water appearance was assessed at 784 reaches and recorded an average SVAP score of 7.5 (Good). This indicates that the water was mostly clear, with objects visible to a depth of around three feet.

Nutrient enrichment was assessed at 784 reaches and recorded an average SVAP score of 6.7 (Fair). A standard deviation of 2.12 indicates that nutrient enrichment within the sub-watershed was variable from reach to reach.

Instream fish cover was assessed at 784 reaches and recorded an average SVAP score of 4.9 (Poor), indicating that fish habitat within the streams may be degraded.

Pools in the sub-watershed were assessed at 784 reaches, and were found to have an average SVAP score of 4.5 (Poor), indicating that pools are not highly prevalent within the streams assessed.

Invertebrate habitat was assessed as an average of 7.2 (Fair) at 784 reaches within the sub-watershed. Invertebrate habitat includes woody debris, leaf packs, and submerged logs, among other debris.

Canopy cover was assessed at 784 reaches and recorded an average score of 5.3 (Poor). A scarcity of vegetative shading over the stream can contribute to higher water temperature, and reduced levels of dissolved oxygen. This can lead to decreased populations of native fish such as trout, which require lower water temperatures and levels of dissolved oxygen.

Manure presence was observed at 88 reaches within the sub-watershed. Manure presence was observed in 49 stream reaches in Tonawanda Creek, 13 stream reaches in East Fork Tonawanda Creek, 11 stream reaches in Little Tonawanda Creek, 8 stream reaches in Stony Brook, and in 7 stream reaches in Crow Creek. An extensive amount of manure was present in segment TONB in Tonawanda Creek. A farm was located nearby, and several reaches showed cattle paths through the stream. Several cows were also witnessed in the stream during assessment.

Riffle embeddedness was assessed as an average of 6.6 (Fair) over 527 stream reaches indicating that gravel and cobble material in the stream bed are around 30% embedded into the substrate.

3.1.4 Water Quality

Water quality data for the Upper Tonawanda Creek Sub-watershed was collected from May 23, 2016 to August 3, 2016. In Table 3 below, the data collected is compiled, along with number of measurements, lowest recorded value, highest recorded value, and overall average for each measured water quality criteria.

Table 3 Upper Tonawanda Creek Sub-watershed Water Quality Element Summary

	Temperature ºC	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	Phosphorus (µg/L)	Nitrate (µg/L)
# of meas.	187	187	187	186	186	187	182	181	183
low value	8.6	6.57	66.9	193.8	166.4	7.48	0.7	0	400
high value	27.5	17.05	193.2	854	617.5	8.81	94.2	214.5	34,600
average	17.1	11.3	119.3	409.5	311.9	8.1	8.1	33	10,000

The average temperature for the sub-watershed was measured at 17.1ºC across 187 stream reaches. The lowest recorded temperature was 8.6ºC in Crow Creek on June 6, 2016. The highest recorded temperature was 27.5ºC in Little Tonawanda Creek on July 20, 2016.

Average dissolved oxygen for the sub-watershed was measured at 11.3 mg/L and 119.3%. Dissolved oxygen levels over 100% can be a function of photosynthesis, rapid aeration, water temperature, or a lack of aquatic respiration. Organisms producing oxygen through photosynthesis contribute to a stream's dissolved oxygen level. In addition, cold water has the ability to hold more dissolved oxygen than warm water, and as water temperatures rise throughout the day, a stream may not quickly equalize its dissolved oxygen content with the atmosphere, resulting in a saturation level over 100%. The highest values recorded were 17.05 mg/L and 193.2%, while the lowest values recorded were 6.57 mg/L and 66.9%.

Average conductivity was measured at 409.5 uS/cm, with low and high values of 193.8 and 854 uS/cm, respectively.

Average total dissolved solids (TDS) were measured at 311.9 mg/L, with a high value of 617.5 mg/L. The lowest value recorded in the sub-watershed was 166.4 mg/L.

Average pH was measured at 8.1. The lowest value recorded was 7.48 while the highest value recorded was 8.81.

Average turbidity was measured at 8.1 NTU, with a low value of 0.7 NTU and a high value of 182 NTU.

Average phosphorus was measured at 33 µg/L, with a low of 0 µg/L, and a high of 214.5µg/L.

Average nitrate was measured at 10,000 µg/L, with a low of 400 µg/L, and a high of 34,600 µg/L.

3.2 Lower Tonawanda Creek Sub-watershed

Approximately 31 miles of streams within the Lower Tonawanda Creek Sub-watershed were assessed from June 20, 2016 to August 8, 2016. 825 reaches were assessed in eight streams, Black Creek, Bull Creek, Ransom Creek, Ransom Creek Tributary, Sawyer Creek, Gott Creek, and two tributaries of Tonawanda Creek. Each stream was broken up into segments, and assigned a unique identifier based on location (BLK, BUL, RSM, RT, SAW, GOT, TOND and EC).

3.2.1 Physical Properties

As seen below in Table 4, the Lower Tonawanda Creek Sub-watershed recorded an average depth of 9.9 inches for the eight streams assessed, the deepest of the two sub-watersheds assessed. The sub-watershed recorded an average bankfull width of 23.7 feet and an average baseflow width of 13.4 feet.

Table 4 Lower Tonawanda Creek Sub-watershed Physical Properties

Stream	Average Depth (in.)	Average Bankfull Width (ft.)	Average Baseflow Width (ft.)
Sawyer Creek	13.2	29.4	21.9
Black Creek	6.5	25.5	11.0
Bull Creek	8.8	24.2	12.4
Ransom Creek	8.8	24.1	13.8
Gott Creek	9.5	22.9	14.4
Ransom Creek Tributary	12.9	17.4	8.2
TOND (Tonawanda Creek Tributary)	15	28.9	17.9
EC (Minor Tributary to Tonawanda Creek)	4.3	17.1	7.8
Sub-watershed Average	9.9	23.7	13.4

3.2.2 General Parameters

Substrate at assessed reaches within the sub-watershed was observed to be predominantly silt/clay (66% of assessed reaches), cobble (17%), and gravel (13%), with sand, boulders, and bedrock making up only 4% of the substrate of assessed reaches, cumulatively.

Hydrilla was observed in 15% of stream reaches assessed in the sub-watershed. Phragmites was observed in 11%, Purple Loosestrife in 8%, and Japanese Knotweed in 3% of all assessed reaches.

3.2.3 SVAP Results

The average SVAP score for the entire Lower Tonawanda Creek Sub-watershed was 5.7 (Poor). The lowest assessed score was 1.7 (Poor) at RSM 106 in Ransom Creek.

The highest assessed SVAP score 8.5 (Good) at RSM 140 in Ransom Creek. A standard deviation of 1.3 for SVAP reach scores suggests that the sub-watershed does not have a large discrepancy or variety in terms of stream condition or health.

Within the sub-watershed, the EC stream segment had the highest average SVAP score, 6.9 (Fair). The lowest score recorded in the EC stream segment was 5.6 (Poor) and the highest score was 7.9 (Good). The stream segment with the lowest average SVAP score was the SAW segment in Sawyer Creek, which recorded an average of at 3.1 (Poor). The lowest SVAP score in the segment was 2.1 (Poor) and the highest score was 5.0 (Poor).

Table 5 presents an SVAP score summary for the Lower Tonawanda Creek Sub-watershed.

Table 5 Lower Tonawanda Creek Sub-watershed SVAP Element Summary

	Channel Conditions	Riparian Zone left bank	Riparian Zone right bank	Bank Stability left bank	Bank Stability right bank	Water Appearance	Nutrient Enrichment
# of scores *average*	825 7.3	825 7.4	825 7.2	825 6.8	825 8.6	825 4.8	825 4.3
	Instream Fish Cover	Pools	Invertebrate Habitat	Canopy Cover	Manure Presence	Riffle Embeddedness	
# of scores *average*	825 3.5	825 2.7	825 5.5	823 6.5	83 5.0	104 4.3	

Channel conditions for the Lower Tonawanda Creek Sub-watershed were rated as Fair, having an average SVAP score of 7.3 for the 825 assessed reaches.

Riparian zone scores for the sub-watershed were rated nearly identically for both left and right banks, with a sub-watershed average of 7.4 (Fair), and 7.2 (Fair), respectively.

Bank stability scores for the sub-watershed scored lower on the left bank of the stream (looking downstream), than the right bank. The left bank was rated as 6.8 (Fair), while the right bank was rated 8.6 (Good).

Water appearance was assessed at 826 reaches and recorded an average score of 4.8 (Poor), indicating that water was relatively cloudy, tinted green, with limited visibility.

Nutrient enrichment was assessed at 826 reaches and recorded an average SVAP score of 4.3 (Poor), indicating that the water had abundant macrophyte and algal growth.

Instream fish cover was assessed at 826 reaches and recorded an average SVAP score of 3.5 (Poor) in the sub-watershed, indicating that fish habitat within the streams may be degraded.

Pools within the sub-watershed were assessed at 826 reaches and recorded an average score of 2.7 (Poor), indicating that pools are not highly prevalent within the streams assessed.

Invertebrate habitat was assessed as an average score of 5.5 (Poor) over 826 reaches within the sub-watershed, indicating a lack of habitat types for insects.

Canopy cover was assessed at 823 reaches and recorded an average score of 6.5 (Fair).

Manure presence was observed at 83 stream reaches within the sub-watershed. Manure presence was observed in 54 stream reaches in Ransom Creek, 18 reaches in Bull Creek, 7 stream reaches in a Ransom Creek Tributary, and in 4 stream reaches in Gott Creek. These reaches in question received manure presence SVAP scores of five, indicating there was evidence of livestock/wildlife in the stream’s riparian zone.

Riffle Embeddedness was assessed at 105 reaches and recorded an average score of 4.3 (Poor), indicating that gravel and cobble material in the stream bed are around 40% embedded into the substrate.

3.2.4 Water Quality

Water quality data for the Lower Tonawanda Creek Sub-watershed was collected from June 20, 2016 to August 8, 2016. Collected data is compiled in Table 6, along with number of measurements, lowest recorded value, highest recorded value, and overall average for each recorded water quality criteria.

Table 6 Lower Tonawanda Creek Sub-watershed Water Quality Element Summary

	Temperature ºC	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	Phosphorus (µg/L)	Nitrate (µg/L)
# of scores	194	172	172	194	194	194	193	193	181
low value	12.6	2.8	30	336.5	225.6	7.19	1.09	3.3	0
high value	29.2	15.1	178	1982	1670.5	8.27	820	848.1	30,400
average	20.77	7.37	83.32	1160.41	828.09	7.72	52.35	128.7	6310

The average temperature for the sub-watershed was measured at 20.77 ºC across 194 stream reaches. The lowest recorded temperature was 12.6ºC in Gott Creek on July 6, 2016. The highest recorded temperature was 29.2ºC in Black Creek on July 13, 2016.

Average dissolved oxygen for the sub-watershed was measured at 7.37 mg/L and 83.32%. The highest values recorded were 15.1 mg/L and 178 %, while the lowest values recorded were 2.8 mg/L and 30%.

Average conductivity was measured at 1160.41 uS/cm, with low and high values of 336.5 uS/cm and 1928 uS/cm, respectively.

Average total dissolved solids (TDS) were measured at 828.09 mg/L, with a high value of 1670.5 mg/L. The lowest value recorded in the sub-watershed was 225.6 mg/L.

Average pH was measured at 7.72. The lowest value being recorded was 7.19. The highest value recorded was 8.27.

Average turbidity was measured at 52.35 NTU, with a low value of 1.09 NTU and a high value of 820 NTU.

Average phosphorus was measured at 128.7 µg/L, with a low of 3.3 µg/L, and a high of 848.1 µg/L.

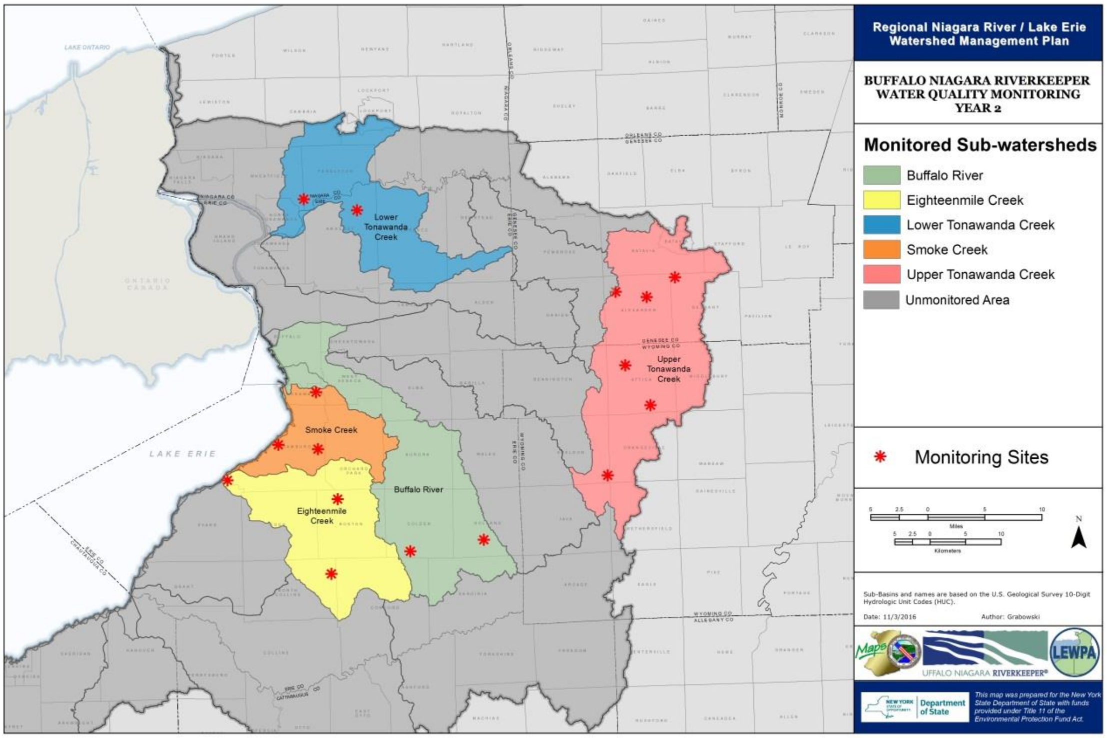
Average nitrate was measured at 6310 µg/L, with a low of 0 µg/L, and a high of 30,400 µg/L.

4 Water Quality Monitoring

Water quality was repeatedly monitored at sixteen sites within the five prioritized sub-watersheds during the months of April to November 2016. Below, Figure 2 shows the locations of this sampling within the prioritized sub-watersheds.

Testing parameters included temperature, dissolved oxygen, conductivity, total dissolved solids, pH, turbidity, phosphorus, and nitrate. Samples tested for *E. coli* were collected during the months of June, July, and August.

Figure 2 2016 Prioritized Sub-watersheds and Water Quality Sampling Locations



4.1 Upper Tonawanda Creek Sub-watershed

Six locations in the Upper Tonawanda Creek Sub-watershed, two in Crow Creek, one in Bowen Creek, one in Little Tonawanda Creek, one in the East Fork Tonawanda Creek, and one in the main stem of Tonawanda Creek were monitored once a month from April 25, 2016 to November 15, 2016. Results are compiled in Table 7.

Table 7 Upper Tonawanda Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100mL	Phosphorus (µg/L)	Nitrate (µg/L)
4/25/16	11.8	134.3	14.6	353.7	298.3	7.9	2.2		21.5	14,466.7
5/16/16	10.1	120.3	13.3	334.7	309.3	8.3	2.3		11.6	1710.7
6/16/16	18.0	118.3	10.7	449.5	337.0	7.9	7.7	400.0	18.2	8266.7
7/19/16	18.7	81.2	7.3	453.5	338.3	7.9	4.1	346.7	23.1	1136.7
8/16/16	21.0	74.2	6.4	462.3	323.4	7.7	14.1	1483.3	77.9	5433.3
9/20/16	17.0	82.8	7.8	427.1	327.9	7.9	9.8		29.7	5066.7
10/19/16	15.2	95.7	9.3	483.2	386.4	8.1	7.7		53.9	4766.7
11/15/16	5.6	120.6	15.2	422.3	434.7	8.3	5.7		40.7	9033.3
Averages	**14.7**	**103.4**	**10.6**	**423.3**	**344.4**	**8.0**	**6.7**	**743.3**	**34.6**	**6235.1**

The temperature of the six sites in the sub-watershed recorded an overall average of 14.7ºC. The lowest recorded temperature was 4.6ºC recorded at East Fork Tonawanda Creek in November. The highest temperature of 23.4ºC was recorded at Tonawanda Creek in August.

Dissolved oxygen recorded an average of 103.4% and 10.6 mg/L, respectively. The highest value recorded was 172.8% and 19.1 mg/L at Bowen Creek in August. The lowest value recorded was 25% and 2.1mg/L at Crow Creek in August.

Conductivity recorded an average of 423.3 uS/cm with a high value of 729 uS/cm recorded at Bowen Creek in October. A low value of 187.1 uS/cm was recorded at Crow Creek in October.

Total Dissolved Solids recorded an average of 344.4 mg/L. A high value of 624 mg/L was recorded at Bowen Creek in November. A low value of 146.9 mg/L was recorded at Crow Creek in July.

pH recorded an average of 8.0 with a high value of 8.9 was recorded at East Fork Tonawanda Creek in April. A low value of 7.37 was recorded at Little Tonawanda Creek in July.

Turbidity recorded an average of 6.7 NTU throughout the six sites from April to November, with a high value of 42.1 NTU was recorded at Tonawanda Creek in August. A low value of 0.69 NTU was recorded at East Fork Tonawanda Creek in May.

E. coli samples were collected at the six sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 743.3 cfu/100mL. A high value of 4900 cfu/100mL was measured at Bowen Creek in August, while a low value of 60 cfu/100mL was measured at Crow Creek in June and August and East Fork Tonawanda Creek in June.

Phosphorus recorded an average of 34.6 μg/L. A low value of 0 μg/L was recorded at Bowen Creek in July and Crow Creek in September. A high value of 148.5 μg/L was recorded at Little Tonawanda Creek in August.

Nitrate recorded an average of 6235.1 μg/L. A low value of 100 μg/L was recorded at Bowen Creek, while a high value of 19,600 μg/L was recorded at Little Tonawanda Creek.

4.2 Lower Tonawanda Creek Sub-watershed

Two locations, Bull Creek and a minor tributary of Ransom Creek were monitored once a month from April 25, 2016 to November 14, 2016 in the Lower Tonawanda Creek Sub-watershed. Results are compiled in Table 8.

Table 8 Lower Tonawanda Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100mL	Phosphorus (µg/L)	Nitrate (µg/L)
4/28/16	10.4	125.7	13.7	910.2	817.4	8.0	53.8		42.9	1920.0
5/16/16	13.8	125.5	12.7	1109.0	913.3	8.2	44.5		51.2	1595.0
6/14/16	14.8	63.0	6.3	1381.5	1121.3	7.8	66.8	1295	293.7	1400.0
7/19/16	20.5	70.0	6.3	1401.5	997.8	7.8	37.6	630	67.7	1600.0
8/16/16	23.5	68.5	5.7	1141.0	763.8	7.7	200.6	5095	66.0	2600.0
9/20/16	20.1	92.0	8.3	903.5	646.8	7.9	42.3		36.3	2600.0
10/18/16	17.7	59.0	5.4	1052.5	793.0	8.0	25.7		191.4	0
11/14/16	8.1	94.5	10.4	929.5	887.3	7.4	62.2		54.5	4400.0
Averages	**16.1**	**87.3**	**8.6**	**1103.6**	**867.6**	**7.8**	**62.2**	**2340**	**100.4**	**2302.1**

The temperature of the two sites in the sub-watershed recorded an overall average of 16.1ºC. The lowest recorded temperature was 7.5ºC was recorded at Bull Creek in November. The highest temperature of 23.6ºC was recorded at Bull Creek in August.

Dissolved oxygen recorded an overall average of 87.3% and 8.6 mg/L, respectively. The highest value recorded was 15.52 mg/L at a tributary of Ransom Creek in April. The lowest value recorded was 4.0 mg/L at Bull Creek in both August and October. The dissolved oxygen content of the assessed water bodies follows seasonal temperature fluctuations, as colder water has the ability to hold more dissolved oxygen.

Conductivity recorded an average of 1103.6 uS/cm, with a high value of 1789 uS/cm recorded at a tributary of Ransom Creek in June. A low value of 491.4 uS/cm was recorded at Bull Creek in April.

Total Dissolved solids recorded an average of 867.6 mg/L, with a high value of 1469 mg/L recorded at a tributary of Ransom Creek in September. A low value of 451.8 mg/L was recorded at Bull Creek in April.

pH recorded an average of 7.8, with a high value of 8.33 recorded at a tributary of Ransom Creek in May. A low value of 7.32 was recorded at the same location in November.

Turbidity recorded an average of 62.2 NTU, with a low value of 13.2 NTU in May. A low value of 374 NTU was recorded in August at a tributary of Ransom Creek.

E. coli samples were collected at the two sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 2340 cfu/100mL. A high value of greater than 10,000 cfu/100mL was measured at a tributary of Ransom Creek in August. A low value of 160 cfu/100mL was measured at Bull Creek in July.

Phosphorus recorded an average of 100.4 µg/L. A low value of 6.6 µg/L was recorded at a tributary of Ransom Creek in August. A high value of 339.9 µg/L was recorded at Bull Creek in June.

Nitrate recorded an average of 2302.1 µg/L. A low value of 0.0 µg/L in June and a high value of 5600 µg/L in November were recorded at a tributary of Ransom Creek.

4.3 Buffalo River Sub-watershed

Two locations in the Buffalo River Sub-watershed, one in the East Branch and one in the West Branch, were monitored once a month from April 28, 2016 to November 15, 2016. Results are compiled below in Table 9.

Table 9 Buffalo River Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100mL	Phosphorus (µg/L)	Nitrate (µg/L)
4/28/16	9.5	141.6	15.5	332.8	307.2	8.5	1.8		79.2	17300.0
5/16/16	12.9	135.0	14.0	322.7	271.7	8.7	1.5		47.9	1234.0
6/14/16	15.2	138.0	13.4	418.3	334.8	8.4	3.8	135	34.7	8900.0
7/21/16	16.3	113.5	10.8	426.7	332.5	8.1	2.5	125	140.3	9100.0
8/17/16	19.4	113.0	10.1	401.7	292.9	7.9	16.2	315	26.4	7300.0
9/19/16	21.5	123.5	10.7	442.0	305.5	8.0	3.3		69.3	4300.0
10/18/16	18.1	147.5	13.3	466.7	349.4	7.9	1.6		99.0	2300.0
11/15/16	6.8	151.7	18.4	246.9	244.1	8.7	502.2		16.5	4300
Averages	**14.9**	**133.0**	**13.3**	**382.2**	**304.7**	**8.3**	**66.6**	**191.7**	**64.1**	**6841.8**

The temperature of the two sites in the sub-watershed recorded an overall average of 14.9ºC. The lowest recorded temperature was 5.9ºC at East Branch Cazenovia Creek in November. The highest temperature of 23ºC was recorded at West Branch Cazenovia Creek in September.

Dissolved oxygen recorded an average of 133% and 13.3 mg/L, respectively. The highest value recorded was 173.1% and 20.65 mg/L at West Branch Cazenovia Creek in November. The lowest value recorded was 106% and 9.7 mg/L at East Branch Cazenovia Creek in September.

Conductivity recorded an average of 382.2 uS/cm with a high value of 477 uS/cm at West Branch Cazenovia Creek in October. A low value of 159.3 uS/cm was recorded at East Branch Cazenovia Creek in November.

Total Dissolved solids recorded an average of 304.7 mg/L. A high value of 358.1 mg/L was recorded at West Branch Cazenovia Creek in October, while a low value of 163.1 mg/L was recorded at East Branch Cazenovia Creek in November.

The average recorded pH was 8. A high value of 9.03 was recorded in November while a low value of 7.73 was recorded in October at East Branch Cazenovia Creek.

Turbidity recorded an average of 66.6 NTU throughout the six sites from April to November. A high value of 1000+ NTU was recorded at East Branch Cazenovia Creek in November while a low value of 0.64 NTU was recorded at West Branch Cazenovia Creek in April.

E. coli samples were collected at the two sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 191.7 cfu/100mL. A high value of 420 cfu/100mL was measured in the East Branch of Cazenovia Creek in August, while a low value of 60 cfu/100mL was measured at the same site in July.

Phosphorus recorded an average of 64.1 µg/L. A high value of 161.7 µg/L was recorded at West Branch Cazenovia Creek in October, while a low value of 0.0 µg/L was recorded at East Branch Cazenovia Creek in May.

Nitrate recorded an average of 6841.8 µg/L. A high value of 27,400 µg/L was recorded in April and a low value of 900 µg/L was recorded in May at the West Branch of Cazenovia Creek.

4.4 Smoke Creek Sub-watershed

Three locations in the Smoke Creek River Sub-watershed, Barricks Creek, Rush Creek, and the North Branch of Smoke Creek were monitored once a month from April 28, 2016 to November 15, 2016. Results are compiled in Table 10 below.

Table 10 Smoke Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100mL	Phosphorus (µg/L)	Nitrate (µg/L)
4/28/16	11.4	159.8	17.0	1009.3	879.7	8.3	2.9		25.3	5333.3
5/16/16	15.5	142.0	14.9	1097.0	860.2	8.6	2.0		62.7	1881.3
6/17/16	17.1	79.0	7.5	954.0	732.3	7.9	8.5	1166.7	48.4	8436.7
7/21/16	19.9	73.7	7.3	981.3	719.3	7.8	9.9	1063.3	70.4	3800.0
8/17/16	21.7	85.7	7.4	799.3	552.5	7.9	17.8	1393.3	30.8	2133.3
9/19/16	21.8	114.0	9.8	855.7	589.3	8.0	6.0		56.1	5133.3
10/18/16	18.6	113.0	10.1	876.3	650.0	8.1	14.2		155.1	3300.0
11/15/16	7.9	142.7	16.9	759.3	730.2	8.1	8.2		59.4	8266.7
Averages	**16.8**	**113.7**	**11.4**	**916.5**	**714.2**	**8.1**	**8.7**	**1207.8**	**63.5**	**4785.6**

The temperature of the six sites in the sub-watershed recorded an overall average of 16.8ºC. The lowest recorded temperature was 7.2ºC recorded at Smoke Creek in November, and the highest temperature of 23.5ºC was recorded at Barricks Creek in September.

Dissolved oxygen recorded an average of 113.7% and 11.4 mg/L, respectively. The highest value recorded was 19.3mg/L at Barricks Creek in November. The lowest value recorded was 50% and 4.5 mg/L at Smoke Creek in June.

Conductivity recorded an average of 916.5 uS/cm with a high value of 1554 uS/cm recorded at Barricks Creek in May. A low value of 573 uS/cm was recorded at Smoke Creek in September.

Total Dissolved solids recorded an average of 714.2 mg/L. A high value of 1202.5 mg/L was recorded at Barricks Creek in April, while a low value of 396.5 mg/L was recorded at Smoke Creek in September.

pH recorded an average of 8.1. A high value of 8.77 was recorded in May, while a low value of 7.74 was recorded in July at Barricks Creek.

Turbidity recorded an average of 8.7 NTU throughout the six sites from April to November. A high value of 28.6 NTU recorded at Barricks Creek in October, and a low value of 1.42 NTU recorded at Smoke Creek in May.

E. coli samples were collected at the three sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 1207.8 cfu/100mL. A high value of 2500 cfu/100mL was measured at the North Branch of Smoke Creek in July, while a low value of 80 cfu/100mL was measured at Barricks Creek in July.

Phosphorus recorded an average of 63.5 μg/L. A high value of 188.1 μg/L was recorded at Smoke Creek in October, while a low value of 9.9 μg/L was recorded at Barricks Creek in April.

Nitrate recorded an average of 47885.6 μg/L. A high value of 570 μg/L was recorded at Smoke Creek in November, while a low value of 30 μg/L site was recorded at Barricks Creek in April.

4.5 Eighteenmile Creek Sub-watershed

Three locations in the Eighteenmile Creek River Sub-watershed, South Branch Eighteenmile creek and two locations on the main stem of Eighteenmile creek were monitored once a month from April to November. Results are compiled in Table 11.

Table 11 Eighteenmile Creek Sub-watershed Average Monthly Water Quality Results

Date	Temperature ºC	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	Total Dissolved Solids (mg/L)	pH	Turbidity (NTU)	*E. coli* cfu/100mL	Phosphorus (μg/L)	Nitrate (μg/L)
4/28/16	11.1	131.4	14.1	423.5	374.8	8.3	1.9		25.3	9600.0
5/16/16	15.8	128.7	12.5	459.0	363.4	8.5	1.0		110.0	614.3
6/14/16	15.4	133.0	13.0	462.5	365.7	8.2	1.6	43.3	17.6	5733.3
7/21/16	19.1	109.0	9.9	505.6	368.6	8.0	1.7	126.7	47.3	4400.0
8/17/16	21.2	109.7	9.5	495.4	345.6	8.1	12.0	843.3	14.3	2400.0
9/19/16	21.9	121.0	10.3	557.9	383.5	8.0	5.1		39.6	4333.3
10/18/16	18.8	128.3	11.5	551.7	408.4	8.0	3.4		85.8	2133.3
11/15/16	6.6	168.6	69.7	370.5	369.4	8.3	3.9		60.5	6866.7
Averages	**16.2**	**128.7**	**18.8**	**478.3**	**372.4**	**8.2**	**4.5**	**337.8**	**50.1**	**4510.1**

The temperature of the six sites in the sub-watershed recorded an overall average of 16.2ºC. The lowest recorded temperature was 5.6ºC was recorded at the South Branch of Eighteenmile Creek in November and the highest temperature of 23.7ºC was recorded at Eighteenmile Creek in September.

Dissolved oxygen recorded an average of 128.7% and 18.8 mg/L, respectively. The highest value recorded was 213.6% and 26.77mg/L at the South Branch of Eighteenmile Creek in November. The lowest value recorded was 100% and 8.7mg/L at Eighteenmile Creek in July.

Conductivity recorded an average of 478.3 uS/cm. A high value of 662 uS/cm was recorded in September, while a low value of 265.4 uS/cm was recorded in November at Eighteenmile Creek.

Total Dissolved Solids recorded an average of 372.4 mg/L. A high value of 461.5 mg/L was recorded at Eighteenmile Creek in April, while a low value of 259.3 mg/L was recorded at the South Branch of Eighteenmile Creek in April.

pH recorded an average of 8.2 with a high value of 8.91 was recorded at the South Branch of Eighteenmile Creek in May and a low value of 7.87 was recorded at Eighteenmile Creek in September.

Turbidity recorded as an average of 4.5 NTU throughout the six sites from April to November, with a high value of 23.4 NTU recorded at Eighteenmile Creek in August, and a low value of 0.8 NTU recorded at the South Branch of Eighteenmile Creek in July.

E. coli samples were collected at the three sites from June to August, and the sub-watershed was assessed to have a three-month sub-watershed average of 337.8 cfu/100mL. A high value of 1200 cfu/100mL was measured in the main stem of Eighteenmile Creek. A low value of 30 cfu/100mL was measured in the South Branch of Eighteenmile Creek in June.

Phosphorus recorded an average of 50.1 µg/L. A high value of 280.5 µg/L was recorded at the South Branch of Eighteenmile Creek, while a low value of 6.6 µg/L was recorded at Eighteenmile Creek in June.

Nitrate recorded an average of 4510.1 µg/L. A high value of 10,600 µg/L was recorded Eighteenmile Creek in April, while a low value of 300 µg/L was recorded at the South Branch of Eighteenmile Creek in May.

References

NRCS, 1998. Stream Visual Assessment Protocol. Technical Note 99-1.

Appendix E

Eighteenmile Creek Sub-watershed Priority Projects

ERIE COUNTY FOREST LOT 13 (18MC01- HEAD)
Cattaraugus Hills Ecoregion

PRIOITY: HIGH

Strategy: Conserve headwater forests for water quality, stream habitat and climate change resilience

Conservation Opportunities: Enhancement of ecological management plans; invasive species management; enhanced land protection; mitigation of landscape fragmentation

Site Description: Lot 13 is the uppermost county forest located in the Eighteenmile Creek Sub-basin and the largest in the Niagara River Watershed. It contains an uneven-age stand of native hardwoods, a Class A stream, trout and other Natural Heritage Program (NHP) protected species, as well as adjacent wetland and abandoned land potential to increase connectivity. According to the County Master Plan, this lot has the greatest ecological value of all 13 county forests and should be preserved for wildlife diversity, passive recreation and environmental education. Silviculture recommendations include harvesting mature trees of poor form and crop thinning in select areas.

Acreage: 295 acres

Location (road crossing): Sibley and Sharp Rd, Concord NY

Ownership: Erie County

Biodiversity Features: Woodlands: Uneven-aged native hardwoods (maple-beech-hemlock), wetlands, headwater stream

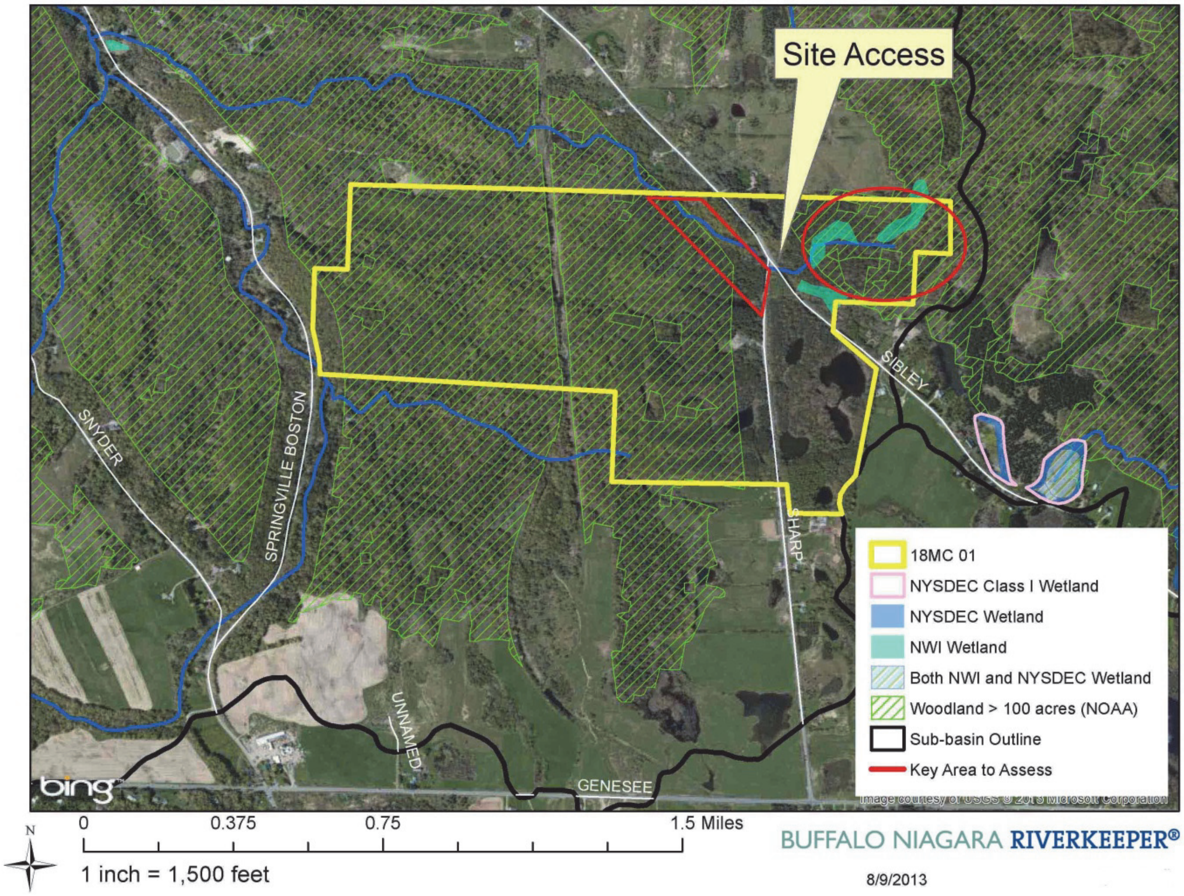
Crayfish Holes along 18-Mile Creek; Photo credit: AES

Proposed Action/Restoration Potential: Clarify ecological management goals and needs in County Forest Master Plan. Consider not removing trees of poor form as they may have significant ecological value—providing cavities for roosting, stream protection, nutrients and habitats to the forest floor, and control of invasive species. Maintain a minimum 100-ft buffer along streams, and manage invasives, including a large Japanese knotweed patch bordering the stream near Sharp and Sibley intersection.

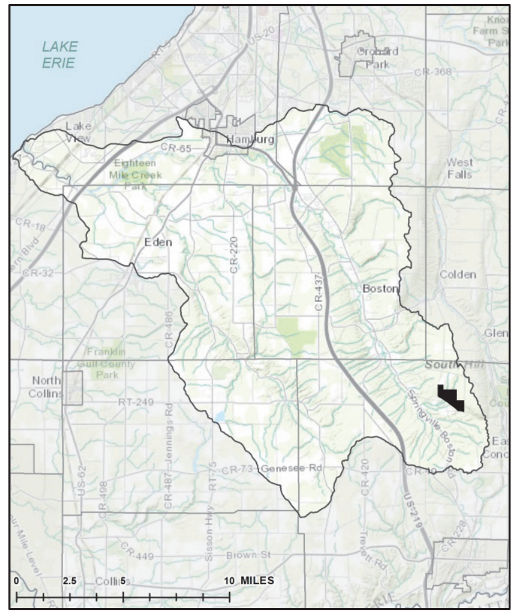
Potential Implementers/Partners: Erie County Department of Parks, Recreation, and Forestry; Erie County Department of Environment and Planning; Erie County SWCD/NRCS

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Great Lake Basin Program Soil Erosion and Sediment Control Grant, US Forest Service Northeastern Area State and Private Forestry Grant, Freshwater Future Project Grant Program

18MC 01- HEAD


Site Access
SNYDER
SPRINGVILLE BOSTON
SIBLEY
SHARP
UNNAMED
GENESEE
18MC 01
NYSDEC Class I Wetland
NYSDEC Wetland
NWI Wetland
Both NWI and NYSDEC Wetland
Woodland > 100 acres (NOAA)
Sub-basin Outline
Key Area to Assess
N
0
0.375
0.75
1.5 Miles
1 inch = 1,500 feet
BUFFALO NIAGARA RIVERKEEPER®
8/9/2013

ERIE COUNTY FOREST LOT 9 (18MC02)
Cattaraugus Hills Ecoregion



PRIORITY: HIGH

Strategy: Conserve headwater forests for water quality, stream habitat and climate change resilience

Conservation Opportunities: Enhanced ecological management plans; invasive species management; potential woodland reference site

Site Description: This County Forest lot includes steep terrain and, according to the County forester, is reserved for headwater protection. The site includes a healthy functioning secondary growth forest with stream channels of good riffle and pool structure and very high water quality, which could serve as a reference area for healthy functioning woodlands.

Acreage: 278 acres
Location (road crossing): Morse and Sharp Rd, Concord NY
Ownership: Erie County
Biodiversity Features: Woodlands: Contains an uneven-aged stand of northern hardwoods (mainly maple-beech-hemlock) on steep ravines with spring seeps, NYS-protected streams and long forested slopes. Sub-canopy, shrub and herbaceous layers include a good diversity of native plants. Aquatic: Stream channels have good riffle and pool structure and very high quality water. Salamander species were observed onsite.

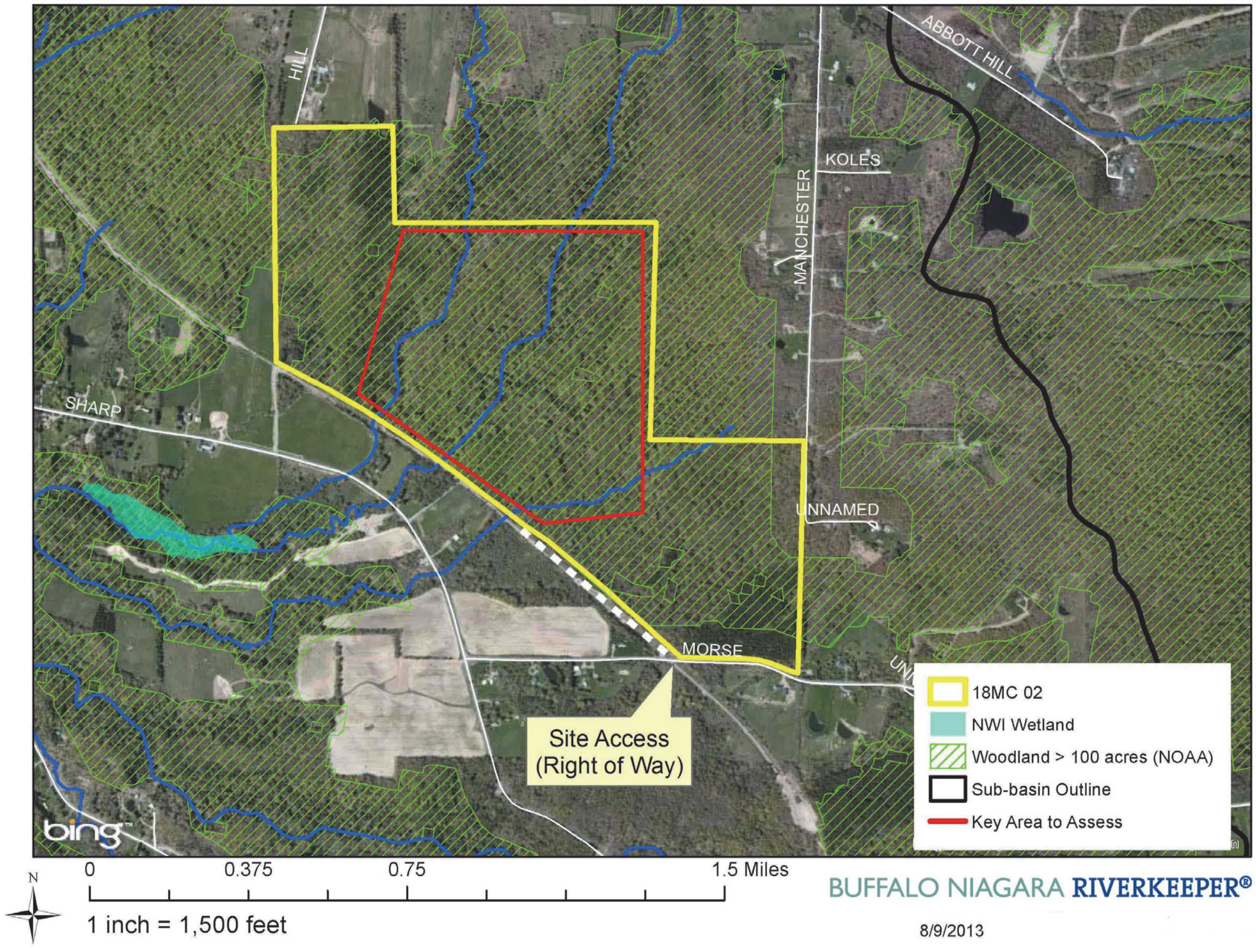
Northern Dusky Salamanders, native to this area; Photo credit: AES

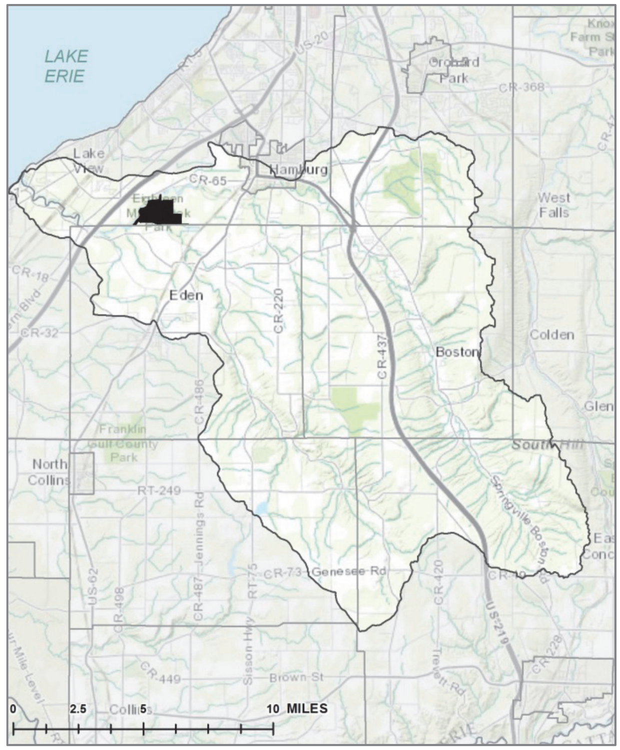
Proposed Action/Restoration Potential: Clarify ecological management goals and needs in County Forest Master Plan. This site would benefit from management of invasives along Right of Ways (ROWs) and streams. A no-cut buffer should be maintained along the ROW, ephemeral seeps, and a minimum of 500 feet on either side of streams. Select harvesting is not recommended. The lot is a priority for conservation due to its high quality forest and steep slopes. A plant and animal inventory should be completed to determine if the site is suitable for Rare, Threatened, and Endangered species including Cerulean warbler.

Potential Implementers/Partners: Erie County Department of Parks, Recreation, and Forestry; Erie County Department of Environment and Planning; Erie County SWCD/NRCS

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Great Lake Basin Program Soil Erosion and Sediment Control Grant, US Forest Service Northeastern Area State and Private Forestry Grant, Freshwater Future Project Grant Program

18MC 02- LOT 09





EIGHTEENMILE CREEK COUNTY PARK (18MC05)

Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Identify high quality aquatic and riparian wetlands for conservation

Conservation Opportunities: Invasive species management; erosion/sediment control; enhanced land protection

Site Description: This undeveloped Erie County Park is centered on the confluence of the main and south branches (and gorges) of Eighteenmile Creek. Of the 3 Lake Erie gorges within the Niagara River watershed, The Nature Conservancy ranked Eighteenmile highest as a functional landscape based on land cover within 400 meters of the stream, lack of dams/diversions, roadless blocks and water quality (LEGBI, 2010). The park is a NYS "significant fish and wildlife area," and also the upstream end of a DEC-designated fishing access area known for its spring Steelhead run.

Acreage: 464 acres
Location (road crossing): North Creek and Lakeview Rd, Hamburg NY
Ownership: Erie County

Biodiversity Features: Woodlands: Maturing hemlock-maple-oak forest (90% native woodland) found at the convergence of two major streams suitable to flycatcher, vireo and wood warbler species; shale cliff and talus communities present; cold spring micro-habitats present, botanically diverse functional floodplain.

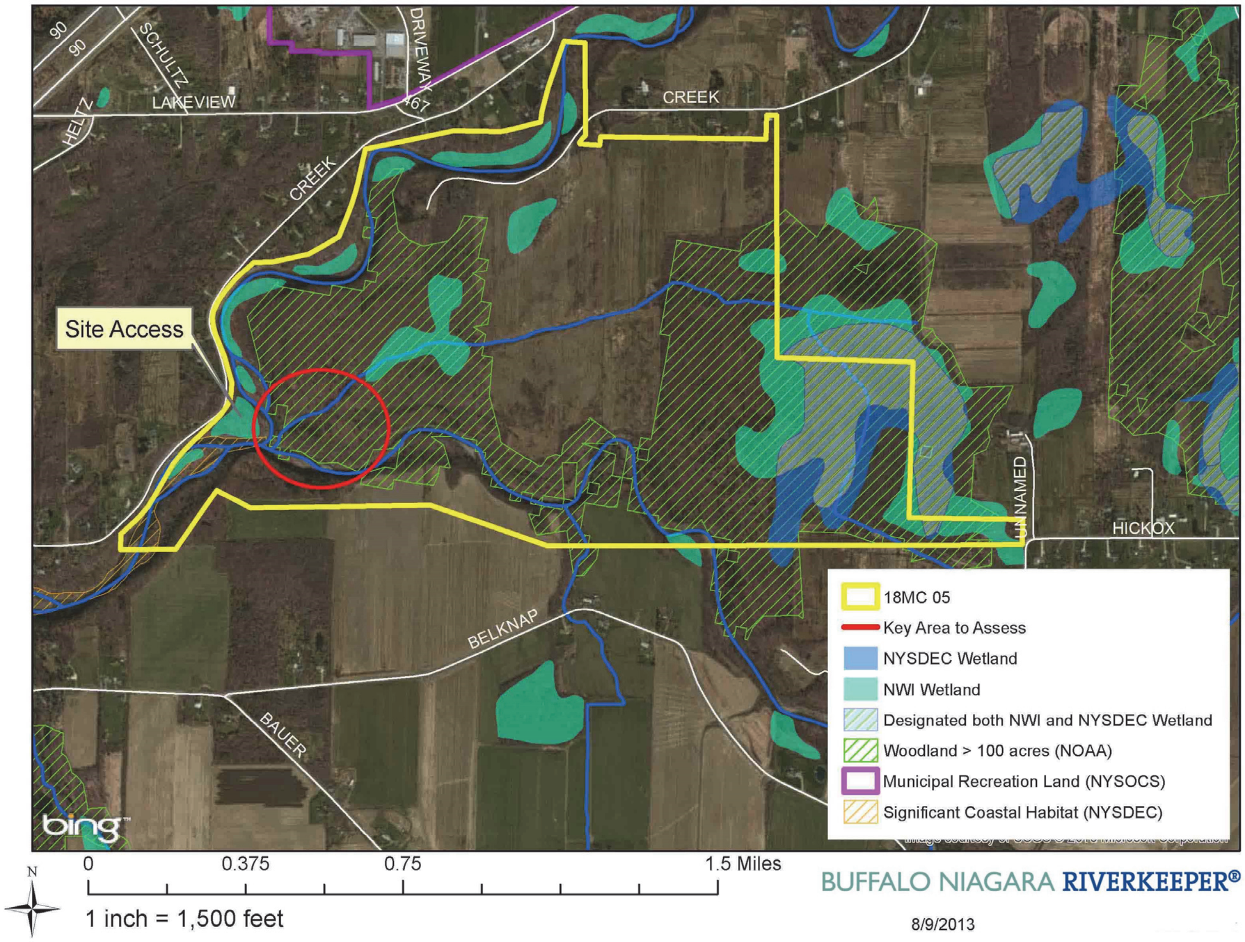
Fishing access in Eighteenmile Creek Park; Photo credit: AES

Proposed Action/Restoration Potential: This site would benefit most from invasive species control, especially in the floodplain, which is 40-50% invasives, mainly Japanese knotweed, purple loosestrife, mugwort, and reed canary grass. Continued protection of this site as an undeveloped, conservation county park is recommended to maintain a high level of biodiversity. Monitoring is needed for impacts from trail and other human encroachments. Completing a comprehensive wildlife assessment is recommended to document important species and would assist in defining further management goals.

Potential Implementers/Partners: Erie County Department of Parks, Recreation, and Forestry; Erie County Department of Environment and Planning; Erie County SWCD/NRCS; Town of Hamburg

Potential Funding Sources: EPA Great Lakes Restoration Initiative, US Forest Service Northeastern Area State and Private Forestry Grant, Great Lakes Basin Program Soil Erosion and Sediment Control

18MC 05- FORK

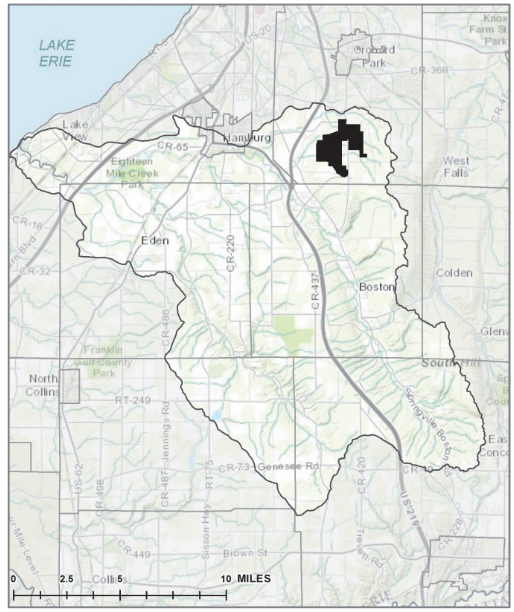

90
90
SCHULTZ
HELTZ
LAKEVIEW
DRIVEWAY
167
CREEK
CREEK
Site Access
UNNAMED
HICKOX
BELKNAP
BAUER
bing
18MC 05
Key Area to Assess
NYSDEC Wetland
NWI Wetland
Designated both NWI and NYSDEC Wetland
Woodland > 100 acres (NOAA)
Municipal Recreation Land (NYSOCS)
Significant Coastal Habitat (NYSDEC)
N
0
0.375
0.75
1.5 Miles
1 inch = 1,500 feet
BUFFALO NIAGARA RIVERKEEPER®
8/9/2013

SHALE CREEK - CHESTNUT RIDGE COUNTY PARK (18MC06)

Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Identify critical needs and opportunities for stream buffering.



Conservation Opportunities: erosion/sediment control; enhanced best management practices; enhanced ecological management plans

Site Description: This 90-acre undeveloped southwestern portion of the Chestnut Ridge multi-use park includes "Eternal Flame Falls." It was previously managed separately from the park by the Buffalo Museum of Science as a reference and field trip site for local woodland ecology. The forest includes a significant community of intact maturing second growth hemlock, maple, and beech. Areas of invasives are present, associated with canopy openings. Trails in this park are heavily used and excessively widened causing disturbance to the ecological community by erosion, compaction, and trampling of vegetation.

Acreage: 90 acres (Chestnut Ridge Park total: 1,231 acres)
Location (road crossing): Boston Ridge and Seufert Rd, Orchard Park NY
Ownership: Erie County
Biodiversity Features: Woodland: Second growth maple-beech-hemlock forest with a potentially diverse herbaceous understory, narrow shale ravine and waterfall.

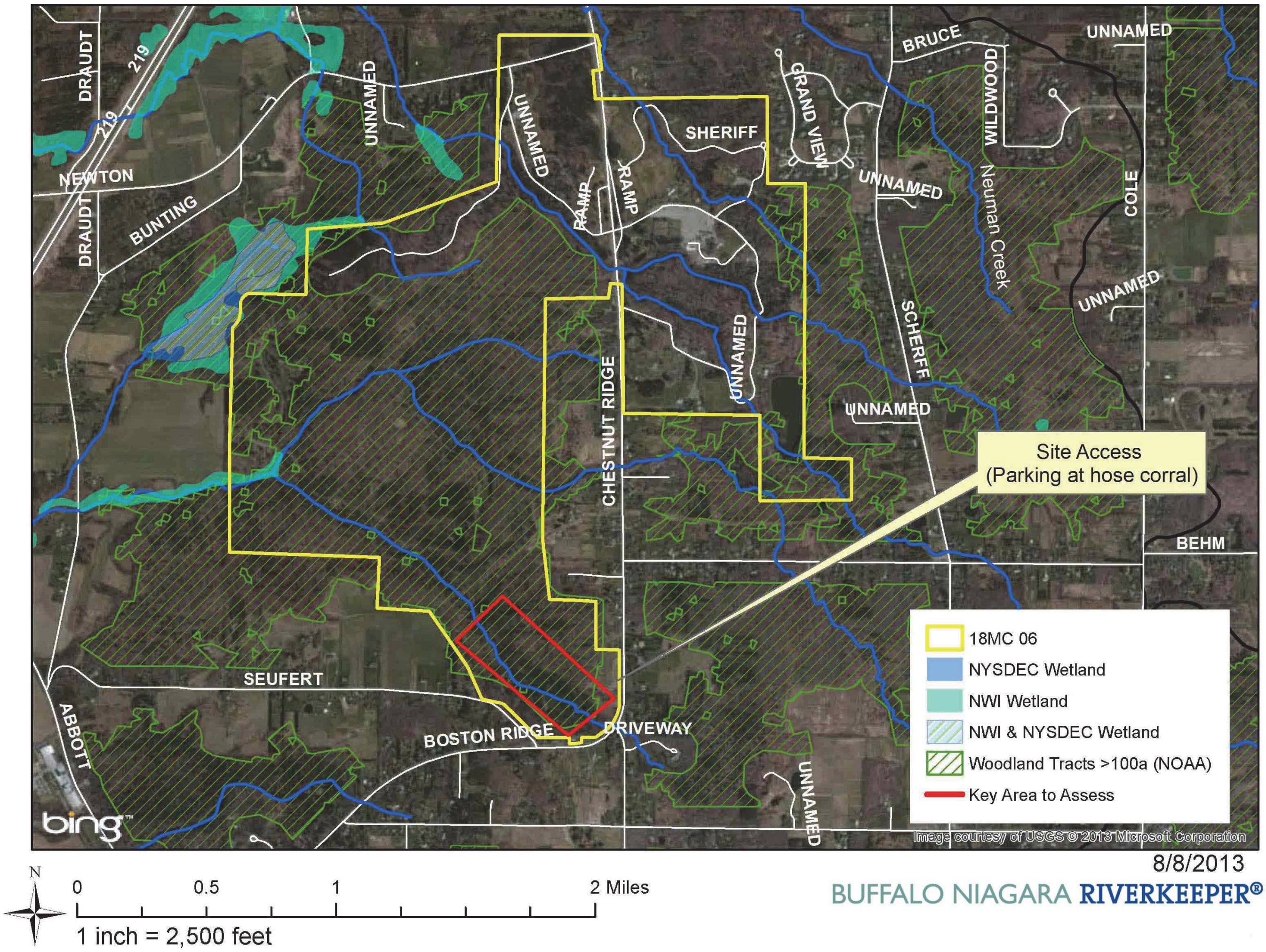
Trail erosion along Eternal Flame trail; Photo credit: Kerrie Gallo

Proposed Action/Restoration Potential: The trail system should be reworked to address the risks posed to water quality and riparian and upland habitat (especially near the gorge rim and falls) due to human disturbance. Interpretive signage and trail maintenance should be paired with off-limits areas for natural and assisted regeneration. "Herd trails" down the steep gorge faces to the "Eternal Flame" need to be addressed as a safety and erosion issue. Conduct a natural resource inventory to determine the presence/absence of RTE species and priority areas for limited access. Monitoring and management of invasive species is needed.

Potential Implementers/Partners: Chestnut Ridge Conservancy; Erie County Department of Parks; Recreation, and Forestry; Erie County SWCD/NRCS; Town of Orchard Park

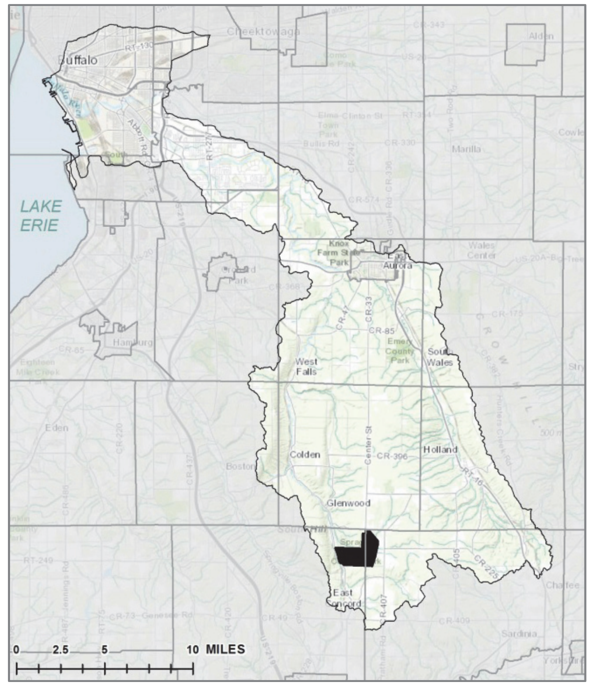
Potential Funding Sources: EPA Great Lakes Restoration Initiative, Freshwater Future Project Grant Program, Fields Pond Foundation Grant

18MC06- SHALE



Appendix F

Buffalo River Sub-watershed Priority Projects



SPRAGUE BROOK COUNTY PARK (BUFR03)

Cattaraugus Hills Ecoregion

PRIORITY: MEDIUM

Strategies: Identify critical needs and opportunities for stream buffering. Increase grassland habitat values for breeding birds.

Conservation Opportunities: Riparian buffer installation and management; erosion control; best management practice establishment (mowing); fragmentation/loss of connectivity

Site Description: Sprague Brook Park is one of the largest of the developed multi-purpose County Parks. Main uses include overnight camping, cross-country skiing and other recreation. The park is located in the headwaters of the West Branch of Cazenovia Creek and includes large patches of catchments without culverts. The terrain is gently sloping throughout, with some severe topography in the park's northeast section. A number of problems were found at the site including large areas of mowed lawn, unstable and eroding stream banks, and invasive species in the eroding riparian and grassland areas.

Acreage: 974 acres
Location (road crossing): Crane and Glenwood East Concord Roads, Sardinia NY
Ownership: Erie County
Biodiversity Features: Woodlands: Mature stands of maple-beech-hemlock forest buffer upstream reaches of creek. Breeding Bird Survey notes potential for forest interior-dwelling birds as well as grassland birds.

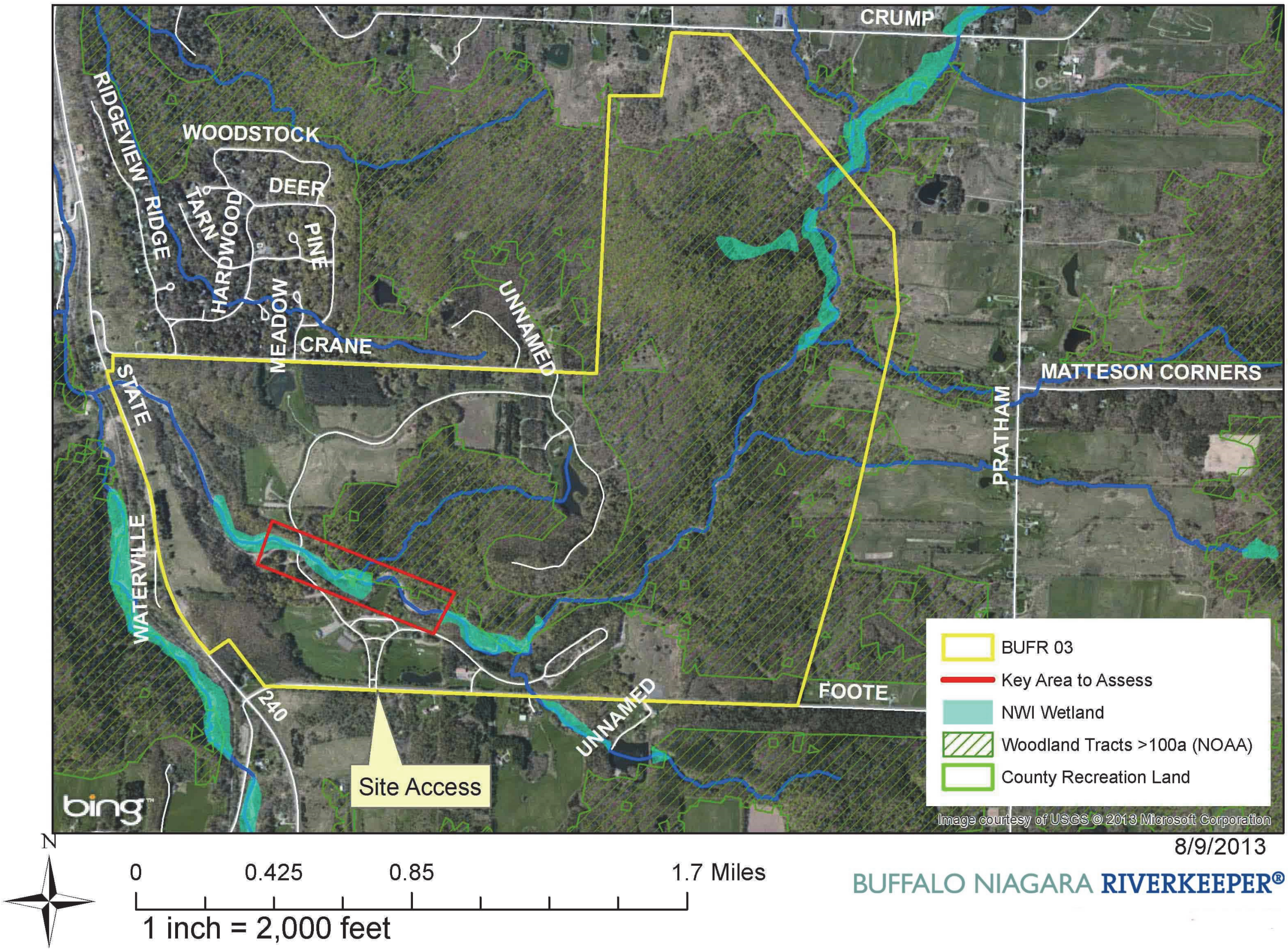
Unmown grassy areas provide good habitat for grassland birds and other wildlife; Photo credit: Kerrie Gallo

Proposed Action/Restoration Potential: Restore and connect grassland/meadow habitat in the Northwestern area of the park to support valuable host plants and nectar sources for pollinators and declining species of grassland birds. Revisit the mowing plan to maximize the amount of natural area, reduce cost of maintenance, and benefit breeding birds. Restore native plants and remove knapweed and tree rows within the grassland. Restore woodland or meadow in buffer zones on the south side of the stream and remove invasives in riparian areas, targeting the small population of *Phragmites*. Monitor the spread of invasives and the effects on stream bank erosion as buffers are restored.

Potential Implementers/Partners: Erie County Department of Parks; Recreation, and Forestry; Erie County SWCD/NRCS

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Freshwater Future Project Grant Program, Great Lake Basin Program Soil Erosion and Sediment Control Grant, Fish and Wildlife Service Joint Venture Habitat Restoration and Protection Grant

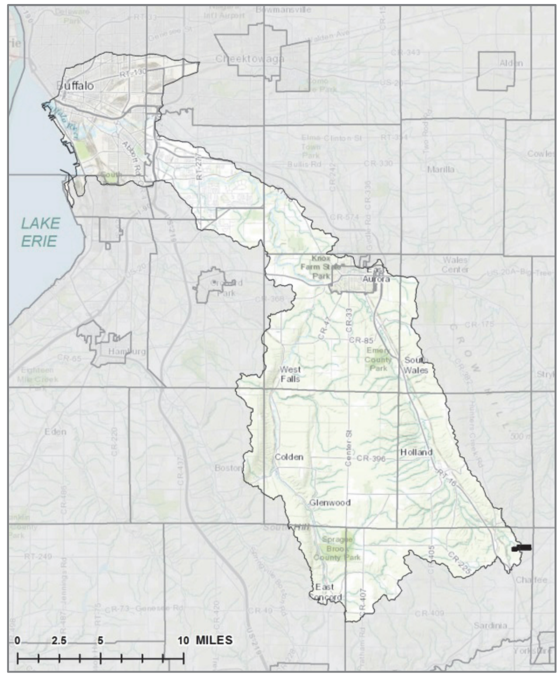
BUFR 03- SPRAGUE



BEAVER MEADOW AND GHOST POND (BUFC01 & 02)

CATTARAUGUS HILLS ECOREGION

PRIORITY: HIGH



Strategy: Identify and protect sites with high ecological value and use as reference sites for habitat restoration; Identify high quality aquatic and riparian wetlands for conservation

Conservation Opportunities: development of ecological headwater management plans; invasive species management; potential headwater wetland reference site.

Site Description: Ghost Pond is an artificial pond created by a railway embankment that feeds the wetlands and ponds of Beaver Meadow Nature Preserve, owned by the Buffalo Audubon Society, Inc. The pond is fed by cold groundwater seeps along the east side. A strong cold mineral spring flow at the east end of pond has created a unique peat-based wetland community including sphagnum moss, sundews, and orchids. Beaver Meadow Preserve features a large beaver pond, glacial kettle ponds, wetlands and wooded uplands. The preserve is open to visitors for hiking and educational tours.

Total acreage: 384 acres
Location (road crossing): Welch and Cattaraugus Rd, Java NY
Biodiversity Features: Wetlands/Aquatic and Woodland habitat - Mineral springs, peatlands, kettle ponds, shallow marshes, and wet meadows interspersed with forested knoll recharge areas. Significant floral and faunal diversity including 165 recorded bird species (21 avian Species in Greatest Conservation Need) and more than 278 plant species.

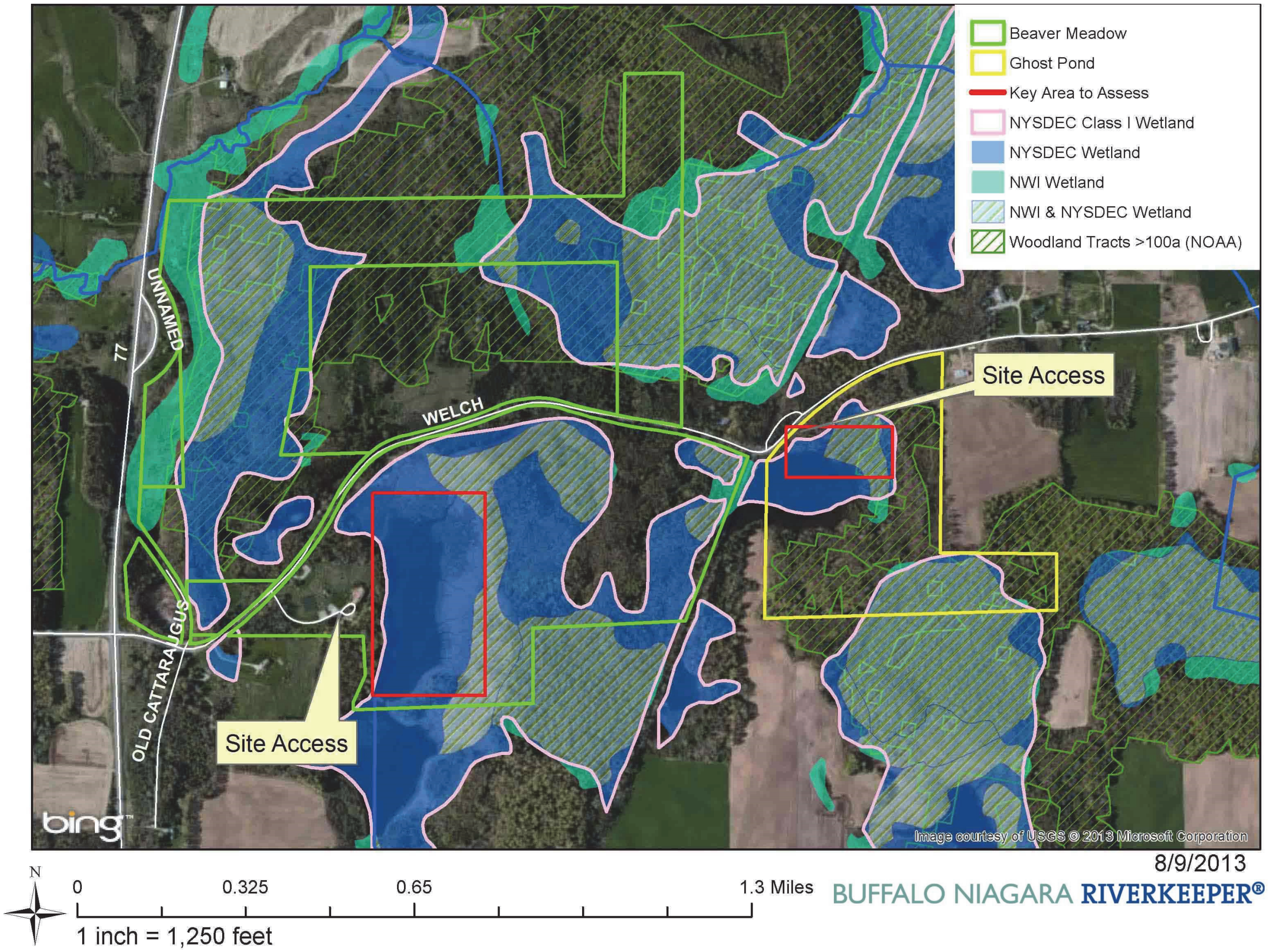
Ghost Pond at Beaver Meadow; Photo credit: AES

Proposed Action/Restoration Potential: Overall the Beaver Meadow complex is a good to excellent **reference area for headwater wetlands** due in part to limited agricultural and other human disturbances. Expand and extend stewardship education to other upland spring/source areas in the upper Tonawanda, Buffalo and Eighteenmile sub-basins. Ensure long-term protection of these properties and investigate acquisition of surrounding parcels on an ongoing basis. Manage invasives such as purple loosestrife.

Potential Implementers/Partners: Buffalo Audubon Society, Town of Java, Wyoming County SWCD, DEC

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Freshwater Future Project Grant Program, National Environmental Education Foundation Capacity Building Grant

BUFC 01 & 02- E. HEAD



Action: Identify opportunities to work with landowners in implementing agricultural best management practices

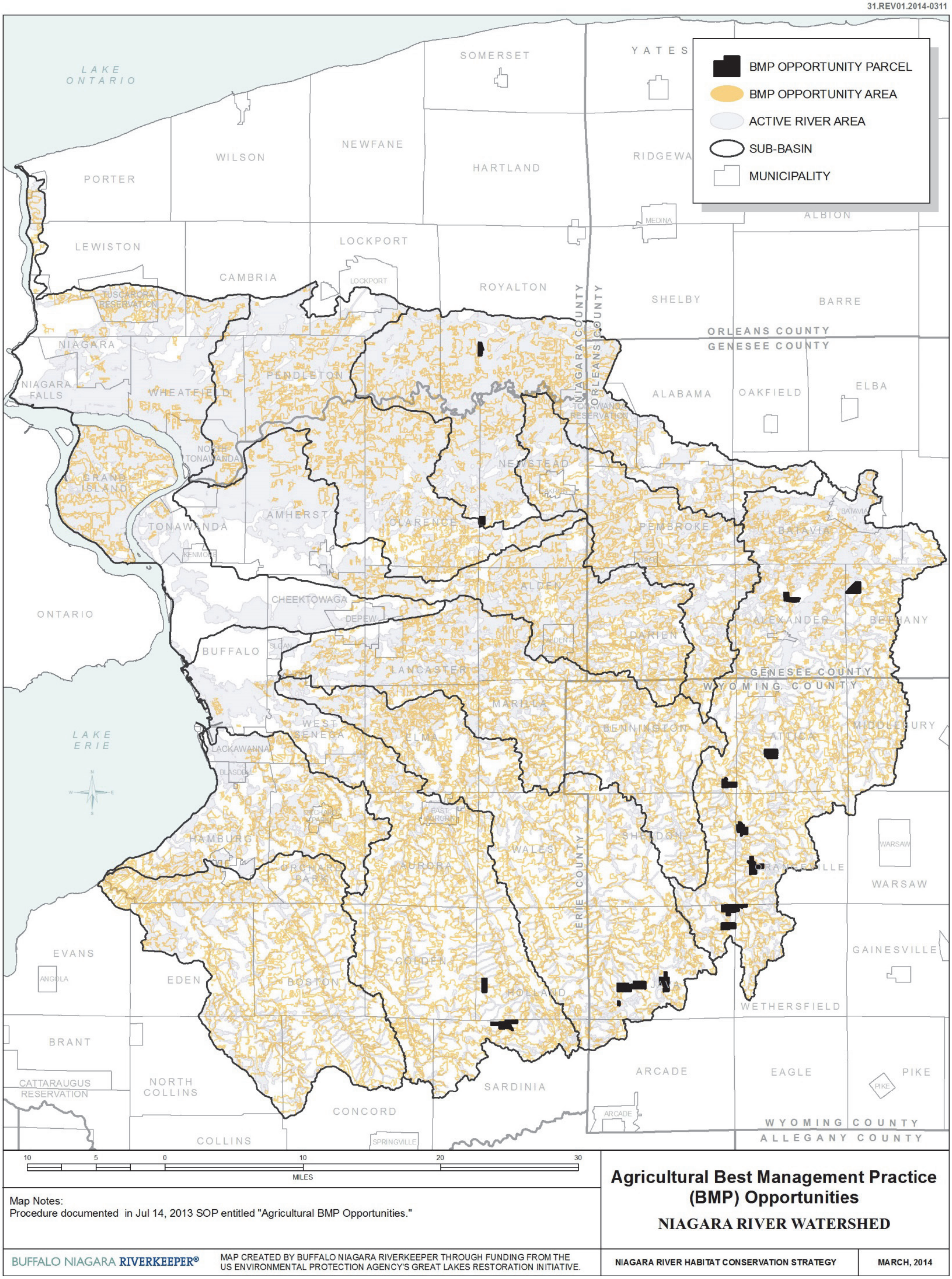
Threats Addressed: Lack of Riparian Buffers, Fragmentation, Mowing Regimes on Farmland, Invasive Species

Identified as a critical threat within several sub-basins, medium and large-scale farming operations sometimes fragment wetland and forest systems, as well as the continuity between wetland and woodland ecosystems. This fragmentation in turn threatens the life cycle of species that depend on the presence of forested wetland tracts and/or wetland and forest community connectivity to breed. By identifying the areas in the watershed where these “edge” fragmentation conditions are occurring, practitioners can identify opportunities to work with landowners in implementing agricultural best management practices and conservation incentive programs to achieve a benefit to species and water quality.

Opportunities:
The results of the analysis show nine specific opportunities to abate the threat of forest and wetland fragmentation on agricultural lands. For wetland protection and enhancement, area #s 1, 2, 7, and 9 have either protected wetlands within or adjacent to the agricultural parcel, and appear to be well suited for wetland expansion. Area #s 3, 4, and 6 represent good opportunities for protection of existing woodland habitats. Specific best management practices at these locations include expanded buffers around wetlands and streams and planting of areas not in active agricultural use to increase the acreage and connectivity of woodland areas. Opportunities for establishment of grassland areas are also a consideration for converting former agricultural lands into valuable habitat areas. Particularly where adjacent to wetlands, grassland habitat establishment is a desired outcome within the entire Niagara River Watershed. In addition to restoration efforts, landowner education is a critical best management practice that can be used more widely to promote conservation and stewardship as well as further degradation of woodland and wetland habitats.

Existing programs such as the USDA/NRCS Conservation Reserve Enhancement Program (CREP) and the Grassland Reserve Program offer immediate opportunities to assist landowners in implementing BMPs to enhance conservation values. The implementation of these programs should be supported by State and municipal entities to encourage growth of landowner participation (See Maps 4.22 – 4.29).

Map 4.22 Agricultural Best Management Practice (BMP) Opportunities Niagara River Watershed



Appendix G

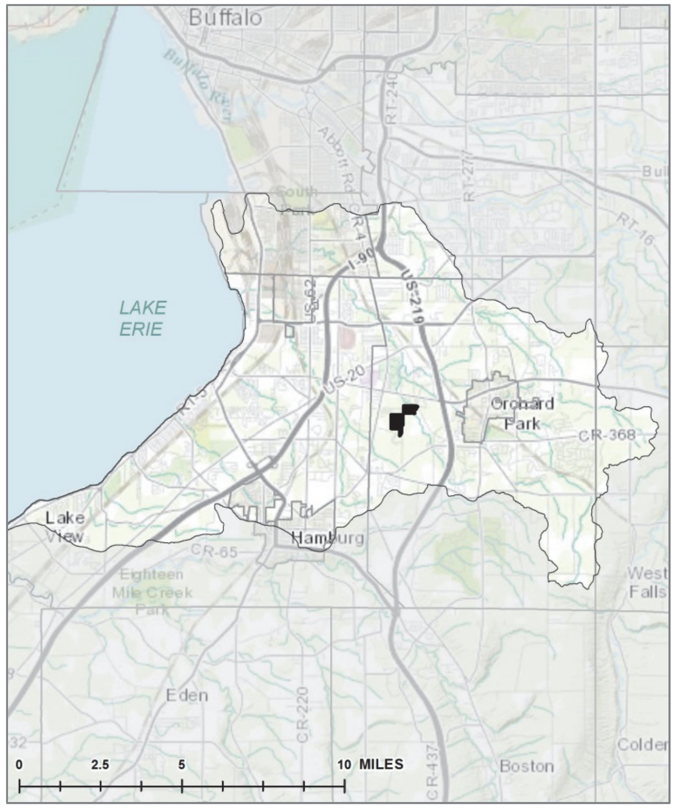
Smokes Creek Sub-watershed Priority Projects

BRUSH MOUNTAIN (SMOK01)

Erie/Ontario Lake Plain Ecoregion

PRIORITY: MEDIUM

Strategy: Identify and protect areas with high ecological value; identify reference sites for restoration



Conservation Opportunities: Enhanced protection of woodlands and wetlands

Site Description: This site includes three town owned parcels around Brush Mountain Municipal Park. The parcels contain NWI and DEC wetlands, along with tributaries to Smokes Creek. The areas investigated contain high quality hardwood swamp species and conditions that consist of hummock and hollow type features. The stream contains riffles and cobbles with some erosion and undercutting observed.

Acreage: 80.6 acres
Location (road crossing): Big Tree and California Rd, Orchard Park NY
Ownership: Town of Orchard Park
Biodiversity Features: Wetlands; red maple-sugar maple-green ash wooded wetland; State-listed plant and bird species

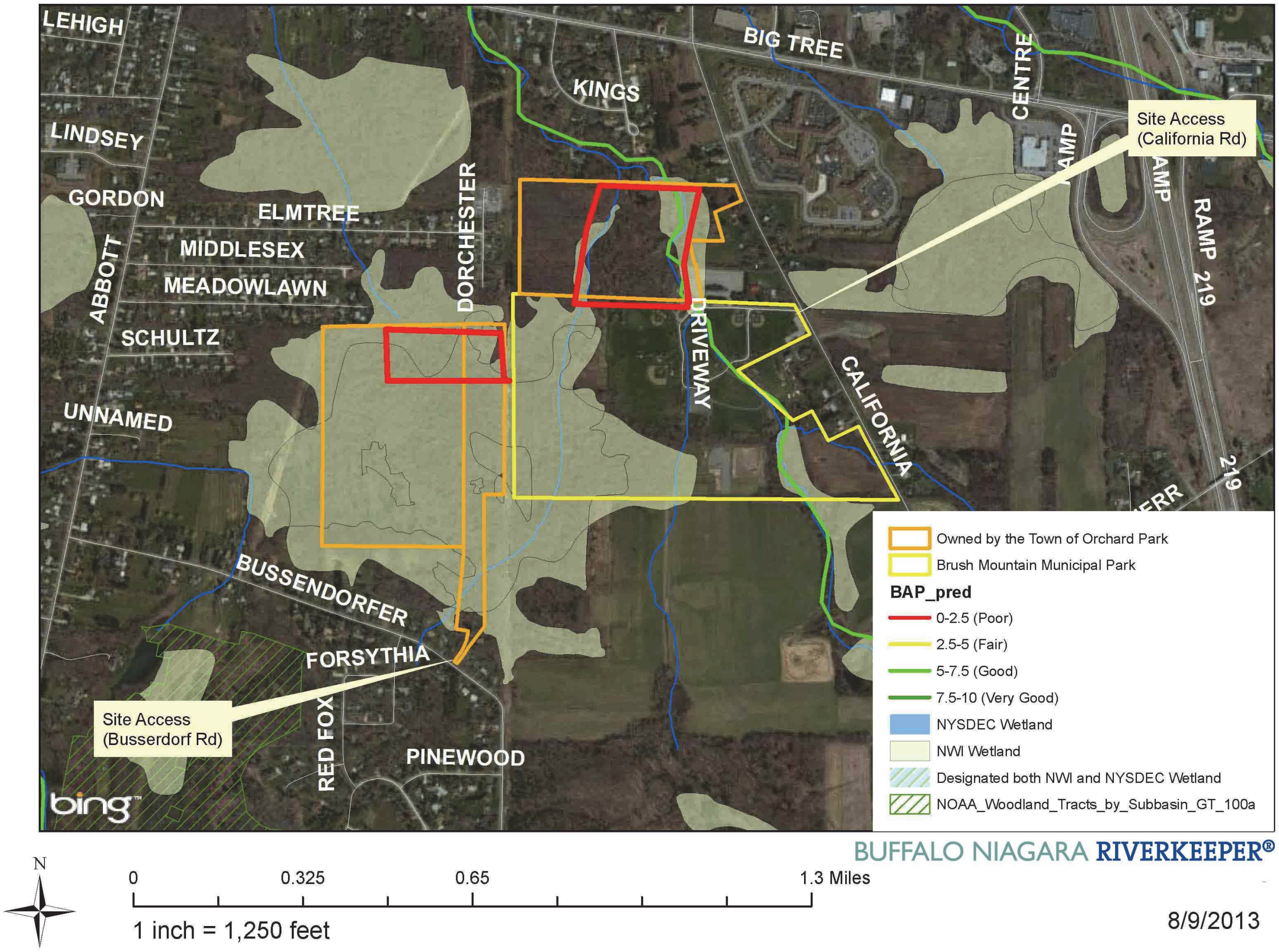
Some areas of the woods would benefit from invasive species removal; Photo credit: AES

Proposed Action/Restoration Potential: This site could serve as a **reference for native wooded wetland communities in the Lake Erie Plain Ecoregion**; however some of the woodland areas would benefit from invasive species removal. The two parcels west of Brush Mountain contain high quality hardwood swamp with hummock and hollow (vernal pool) features providing good surface and ground headwater conditions to Smoke’s Creek. Invasive species should be managed and monitored.

Potential Implementers/Partners: Town of Orchard Park, Erie County NRCS/SWCD

Potential Funding Sources: EPA Great Lakes Restoration Initiative, National Fish and Wildlife Foundation Pulling Together Initiative, NYS DEC Urban Forestry Grants

SMOK01

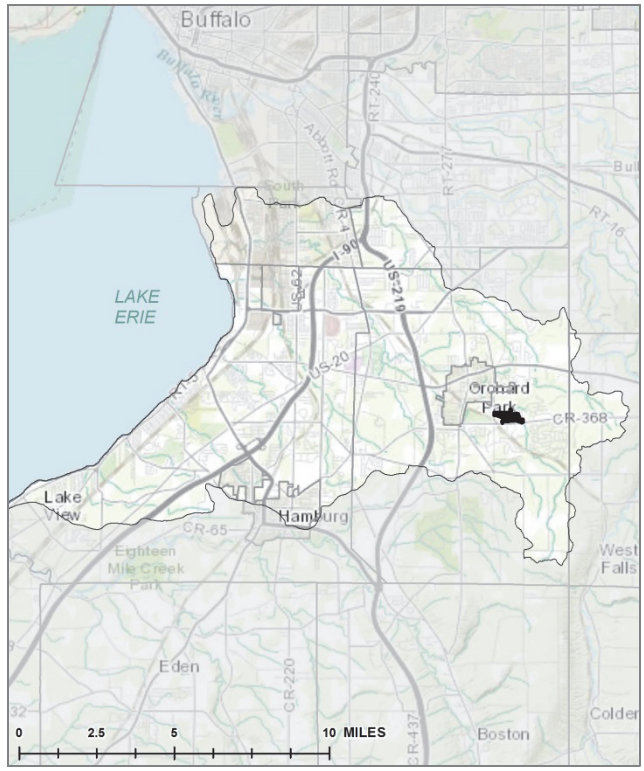


LEHIGH
LINDSEY
GORDON
ELMTREE
MIDDLESEX
MEADOWLAWN
ABBOTT
SCHULTZ
UNNAMED
DORCHESTER
KINGS
BIG TREE
CENTRE
RAMP
RAMP 219
DRIVEWAY
CALIFORNIA
219
BUSSENDORFER
FORSYTHIA
RED FOX
PINEWOOD
Site Access
(California Rd)
Site Access
(Busserdorf Rd)
bing
Owned by the Town of Orchard Park
Brush Mountain Municipal Park
BAP_pred
0-2.5 (Poor)
2.5-5 (Fair)
5-7.5 (Good)
7.5-10 (Very Good)
NYSDEC Wetland
NWI Wetland
Designated both NWI and NYSDEC Wetland
NOAA_Woodland_Tracts_by_Subbasin_GT_100a
BUFFALO NIAGARA RIVERKEEPER®
N
0
0.325
0.65
1.3 Miles
1 inch = 1,250 feet
8/9/2013

BIRDSONG PARKLANDS (SMOK02)

Erie/Ontario Lake Plain Ecoregion

PRIORITY: HIGH



Strategy: Identify opportunities to connect and protect significant natural areas

Conservation Opportunities: Enhanced public land management; mitigate barriers to fish movement; invasive species management

Site Description: This municipal park, referred to as Birdsong Parklands, is part of a 500+ acre woodland in the headwaters of Smoke's Creek. The stream bisects the parcel and both NWI and DEC wetlands can be found along the riparian area. A large portion of the front of the park is mowed lawn used for recreation and has little ecological value. The southern section is forested wetland. The heterogeneity of the site allows for high wildlife potential, especially for marsh and wetland associated birds. Outside of the park, large expanses of wetlands and woodlands connect to the riparian corridor within the park, providing connectivity to larger ecological communities.

Acreage: 68 acres
Location (road crossing): Bridsong Pkwy and Jewett Holmwood Rd, Orchard Park NY
Ownership: Town of Orchard Park
Biodiversity Features: Grassland, wetlands; artificial but native-vegetated ponds

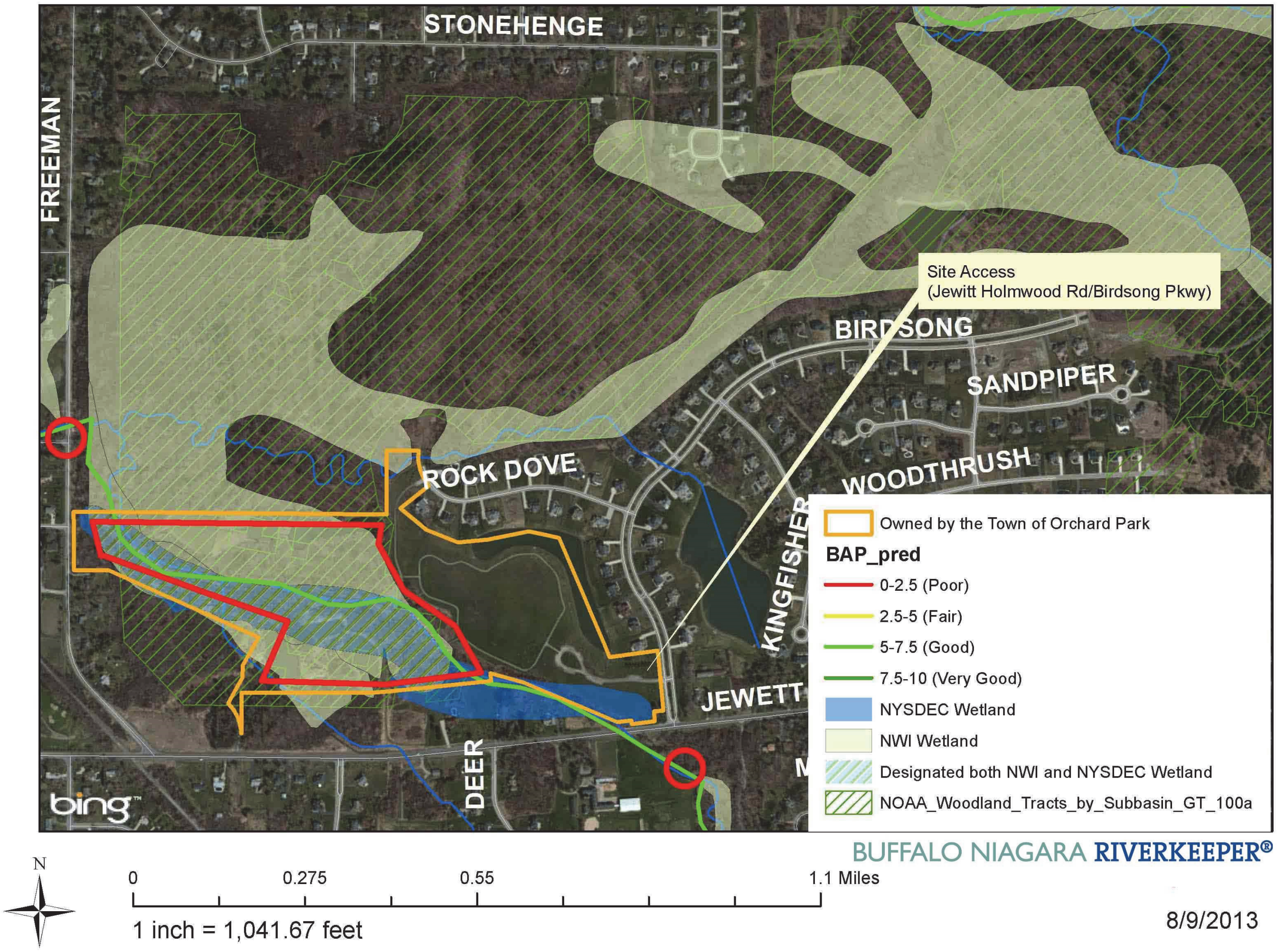
Artificial native-vegetated ponds increase the area's biodiversity; Photo credit: AES

Proposed Action/Restoration Potential: Limiting the mowed grass expanse and strips to allow restoration of a native grassland or meadow could provide significant grassland bird habitat. No mowing should occur in those areas from April to September to encourage bird nesting. Sediment build up in the culvert under Jewett Road should be removed and monitored over time to ensure fish passage. Invasive species also need to be managed and monitored over time—including glossy buckthorn, multiflora rose, garlic mustard, purple loosestrife, and honeysuckle species.

Potential Implementers/Partners: Town of Orchard Park, Erie County NRCS/SWCD

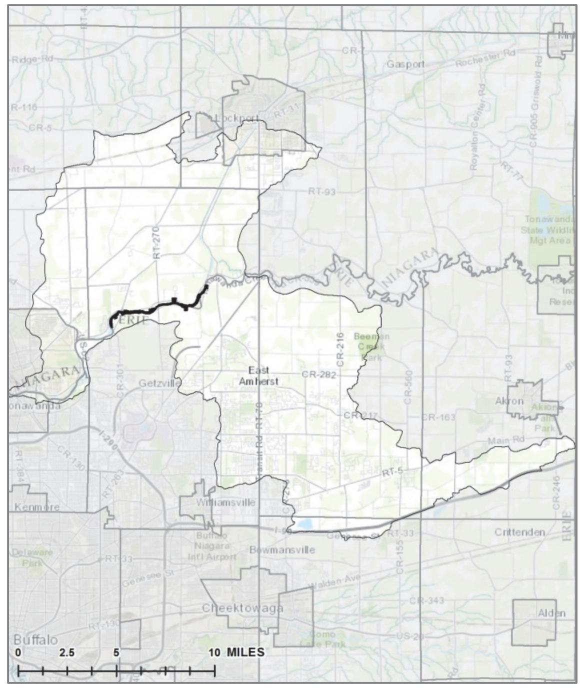
Potential Funding Sources: EPA Great Lakes Restoration Initiative, National Fish and Wildlife Foundation Pulling Together Initiative, NYS DEC Urban Forestry Grant

SMOK02


STONEHENGE
FREEMAN
Site Access
(Jewitt Holmwood Rd/Birdsong Pkwy)
BIRDSONG
SANDPIPER
ROCK DOVE
WOODTHRUSH
KINGFISHER
JEWETT
DEER
bing
Owned by the Town of Orchard Park
BAP_pred
0-2.5 (Poor)
2.5-5 (Fair)
5-7.5 (Good)
7.5-10 (Very Good)
NYSDEC Wetland
NWI Wetland
Designated both NWI and NYSDEC Wetland
NOAA_Woodland_Tracts_by_Subbasin_GT_100a
BUFFALO NIAGARA RIVERKEEPER®
N
0
0.275
0.55
1.1 Miles
1 inch = 1,041.67 feet
8/9/2013

Appendix H

Lower Tonawanda Creek Sub-watershed Priority Projects



ERIE CANAL CORRIDOR (LTON01)

Ontario Lowlands Ecoregion

PRIORITY: HIGH

Strategy: Identify opportunities to mitigate the effects of channelization and altered flows.

Conservation Opportunities: Riparian buffer installation/management; invasive species management

Site Description: This site includes NYS Canal Corps, Town of Amherst, and Town of Pendleton parcels located along an approximately 1-mile stretch of Tonawanda Creek. Veterans Park is also included in the area assessed. Channelization, poor riparian management, and presence of hydrilla are all factors occurring along this stretch that may be adding to Tonawanda Creek degradation.

Acreage: Roughly 1 mile of shoreline along each bank
Location (road crossing): Tonawanda Creek and Brenon Rd, Buffalo NY (Veterans Park)
Ownership: NYS Canal Corps, Town of Amherst, Town of Pendelton
Biodiversity Features: Aquatic-channelized riparian edge

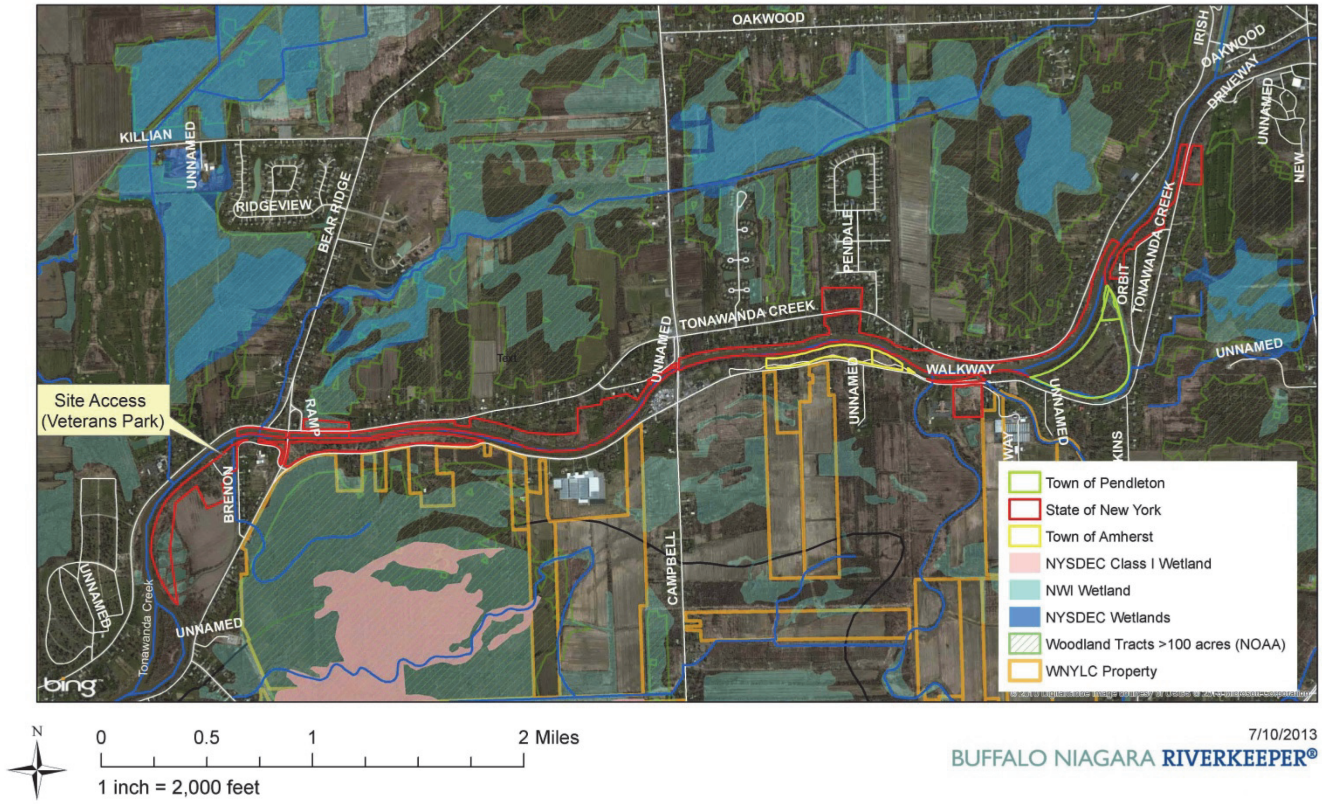
Riparian management is poor in this area; Photo credit: AES

Proposed Action/Restoration Potential: This site presents a good opportunity to work with multiple partners to address the degrading quality of the stream. Suggested actions include removal of invasive species, a riparian/canalside overlay zone encouraging public and private landowners to install native grasses and herbaceous species to help improve habitat and scenic quality and stabilize banks. A small amount of hydrilla was observed and should be controlled while minimizing the negative impacts to native aquatic flora and fauna. Boater inspections, public education, and invasive plant disposal stations along the Canal are recommended.

Potential Implementers/Partners: NYS Canal Corps, Town of Pendleton, Town of Amherst, private landowners

Potential Funding Sources: EPA Great Lakes Restoration Initiative, NYS DEC Water Quality Improvement Project Program, National Fish and Wildlife Foundation Five Star Urban Waters Restoration Program, Fish and Wildlife Service State and Interstate Aquatic Nuisance Species Management Plan Program

LTON 01 & 02- CANAL



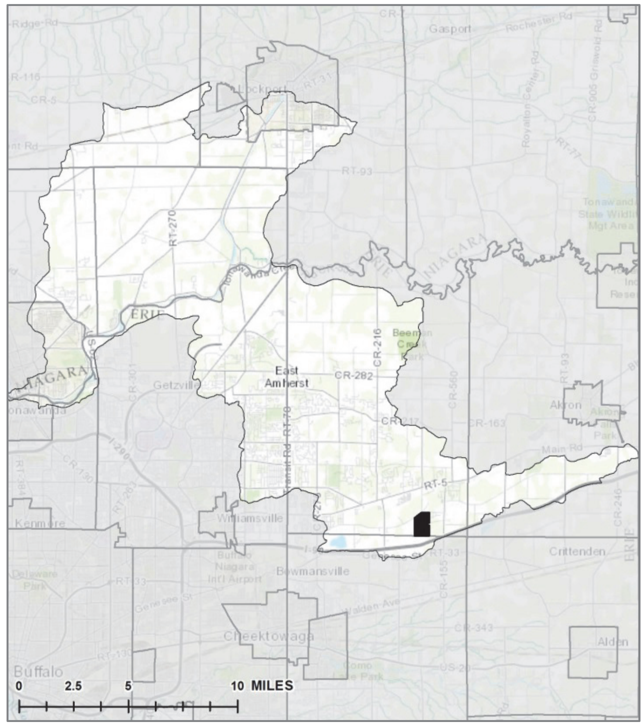
TILLMAN SWAMP (LTON03)

Ontario Lowlands Ecoregion

PRIORITY: MEDIUM

Strategy: Identify and protect areas with high ecological value; use as reference sites for restoration.

Conservation Opportunities: Invasive species management; potential reference site for wetlands



Site Description: Tillman Swamp, a DEC Wildlife Management Area, is also a Class 1 wetland due in part to its connection to the Onondaga Aquifer. Along with two nearby Class 1 wetlands, it is a source area to Ransom Creek. Two distinctive communities exist on either side of Tillman Rd. The north side consists of a button bush swamp with a small area of grassland habitat. The south side is mainly a cattail marsh and of overall lower habitat quality. The combination of both wetland habitats and the surrounding wet woods on the south side of the WMA provides a wide range of habitats and a diverse assemblage of native plants and habitats.

Acreage: 219 acres
Location (road crossing): Tillman and Shisler Rd, Clarence NY
Ownership: NYS DEC
Biodiversity Features: Wetlands; Button bush and cattail species

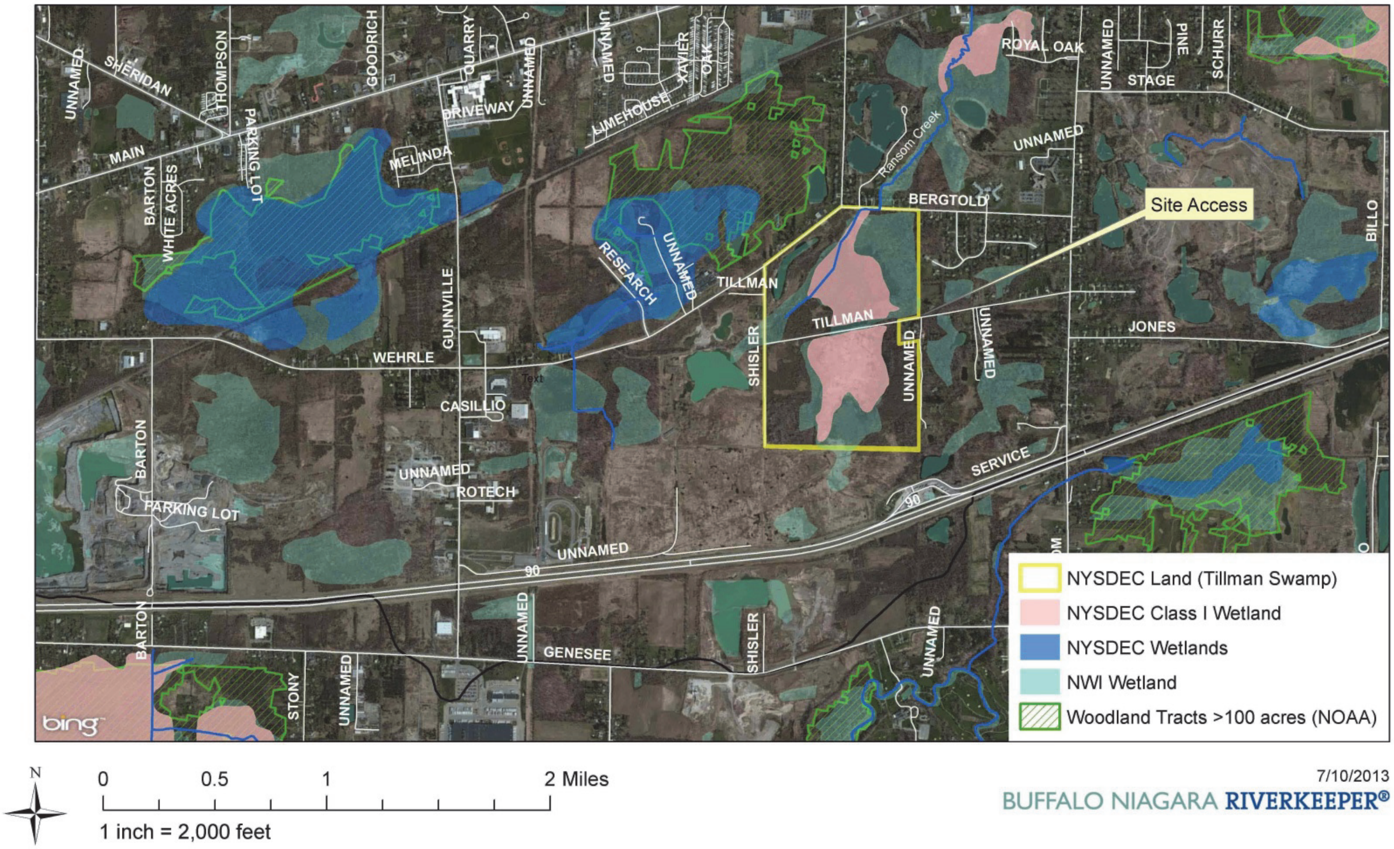
Tillman Swamp is a source area to Ransom Creek and a Class I wetland; Photo credit: AES

Proposed Action/Restoration Potential: Tillman Swamp was selected as a potential **reference site for wetland habitat and shallow quarry (sand-gravel pit) restoration**. Although quarries surround it, it is not clear that Tillman was ever mined. Because of its size, aquifer connection, and diverse assemblage of native habitats it should be further studied as a potential reference area for shallow water wetland restoration in the escarpment area, including plant, marsh bird and amphibian surveys. Invasives like purple loosestrife and reed canary grass should be managed to retain the diverse plant community.

Potential Implementers/Partners: NYS DEC, NFBS, Town of Clarence

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Natural Resource Conservation Service Conservation Innovation Grants, Fish and Wildlife Service Candidate Conservation Action Funds

LTON 03-TILLMAN



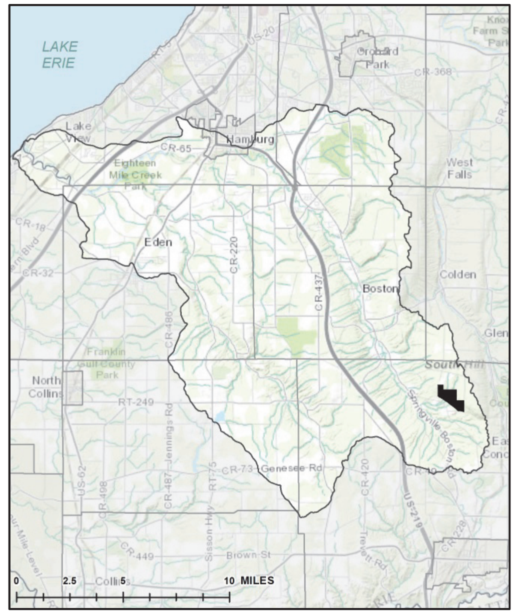
Appendix I

Upper Tonawanda Creek Sub-watershed Priority Projects

ERIE COUNTY FOREST LOT 9 (18MC02)
Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Conserve headwater forests for water quality, stream habitat and climate change resilience



Conservation Opportunities: Enhanced ecological management plans; invasive species management; potential woodland reference site

Site Description: This County Forest lot includes steep terrain and, according to the County forester, is reserved for headwater protection. The site includes a healthy functioning secondary growth forest with stream channels of good riffle and pool structure and very high water quality, which could serve as a reference area for healthy functioning woodlands.

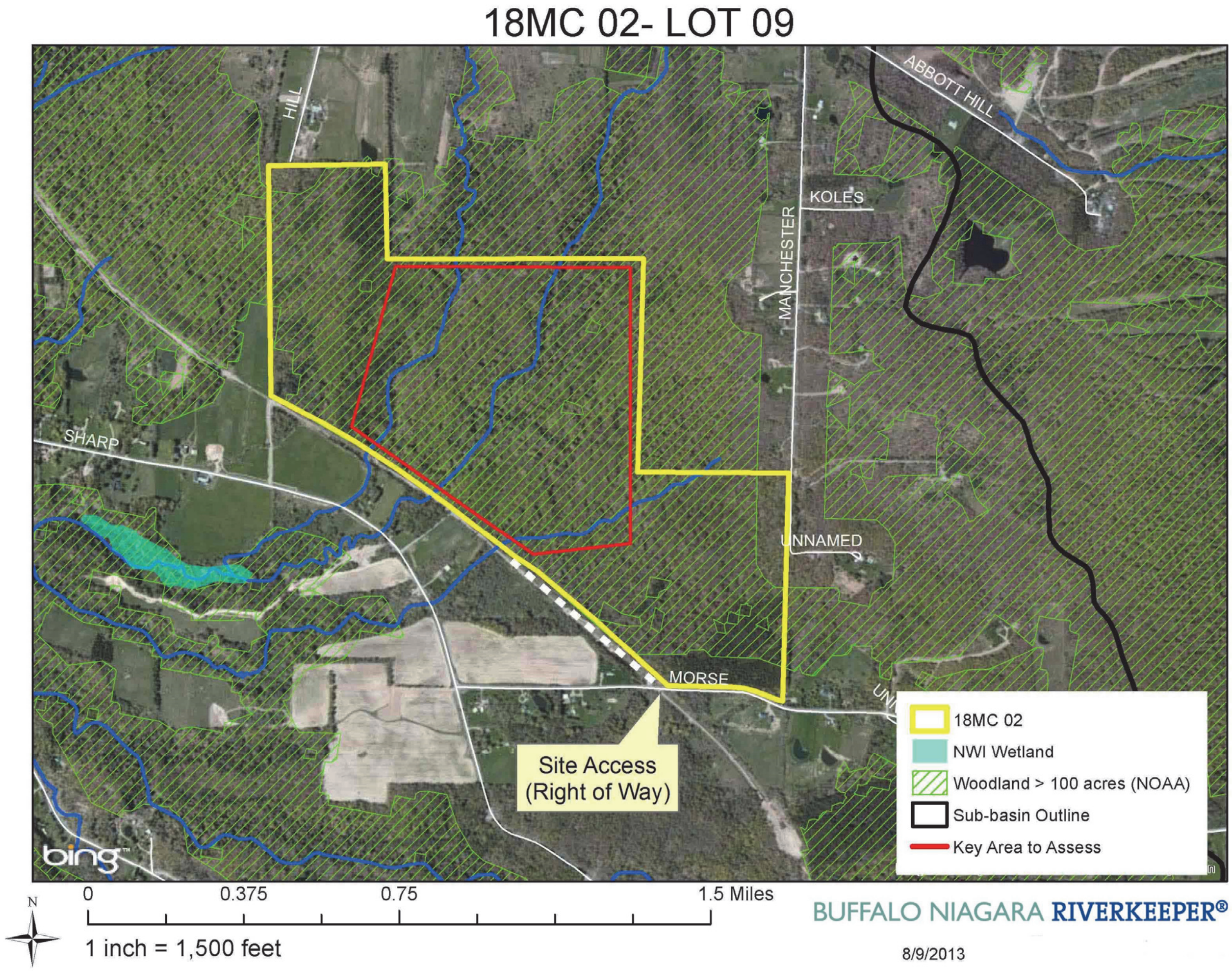
Acreage: 278 acres
Location (road crossing): Morse and Sharp Rd, Concord NY
Ownership: Erie County
Biodiversity Features: Woodlands: Contains an uneven-aged stand of northern hardwoods (mainly maple-beech-hemlock) on steep ravines with spring seeps, NYS-protected streams and long forested slopes. Sub-canopy, shrub and herbaceous layers include a good diversity of native plants. Aquatic: Stream channels have good riffle and pool structure and very high quality water. Salamander species were observed onsite.

Northern Dusky Salamanders, native to this area; Photo credit: AES

Proposed Action/Restoration Potential: Clarify ecological management goals and needs in County Forest Master Plan. This site would benefit from management of invasives along Right of Ways (ROWs) and streams. A no-cut buffer should be maintained along the ROW, ephemeral seeps, and a minimum of 500 feet on either side of streams. Select harvesting is not recommended. The lot is a priority for conservation due to its high quality forest and steep slopes. A plant and animal inventory should be completed to determine if the site is suitable for Rare, Threatened, and Endangered species including Cerulean warbler.

Potential Implementers/Partners: Erie County Department of Parks, Recreation, and Forestry; Erie County Department of Environment and Planning; Erie County SWCD/NRCS

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Great Lake Basin Program Soil Erosion and Sediment Control Grant, US Forest Service Northeastern Area State and Private Forestry Grant, Freshwater Future Project Grant Program


18MC 02- LOT 09
HILL
ABBOTT HILL
KOLES
MANCHESTER
SHARP
UNNAMED
MORSE
Site Access
(Right of Way)
18MC 02
NWI Wetland
Woodland > 100 acres (NOAA)
Sub-basin Outline
Key Area to Assess
0
0.375
0.75
1.5 Miles
N
1 inch = 1,500 feet
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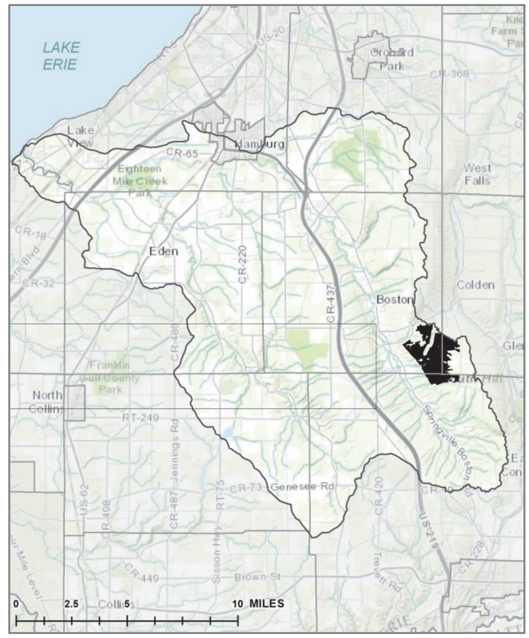
8/9/2013

FOWLERVILLE FOREST (18MC03)
Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Conserve headwater forests for water quality, stream habitat and climate change resilience



Conservation Opportunities: Land protection; Mitigation of fragmentation; culvert maintenance/removal; streambank erosion control

Site Description: Ranked high by the The Nature Conservancy as a functional forest due to contiguity and relatively low road density (LEGBI, 2010), this forest is entirely privately owned in over a dozen parcels many of them tax-labeled “rural vacant” land. The 1,300+ acre roadless block is a priority for conservation. The northernmost tributary, Landon Brook, is a NYS Natural Heritage Program-noted rocky headwater stream. Rainbow trout are documented. A shrub carr wetland at Dunn Road hosts a diverse plant community. Potential wetland reference site.

Acreage: 1,386 acres
Location (road crossing): Generally, Dunn and Fowlerville Rds, Boston NY
Ownership: Private, multiple owners and parcels
Biodiversity Features: Woodlands/Wetlands: Second growth maple-beech-hemlock forest present. High quality headwater brook and native shrub carr wetland that may support flycatcher species of concern and other shrub wetland-dependent birds is present. A wide diversity of amphibian species were observed, with potential for listed reptiles.

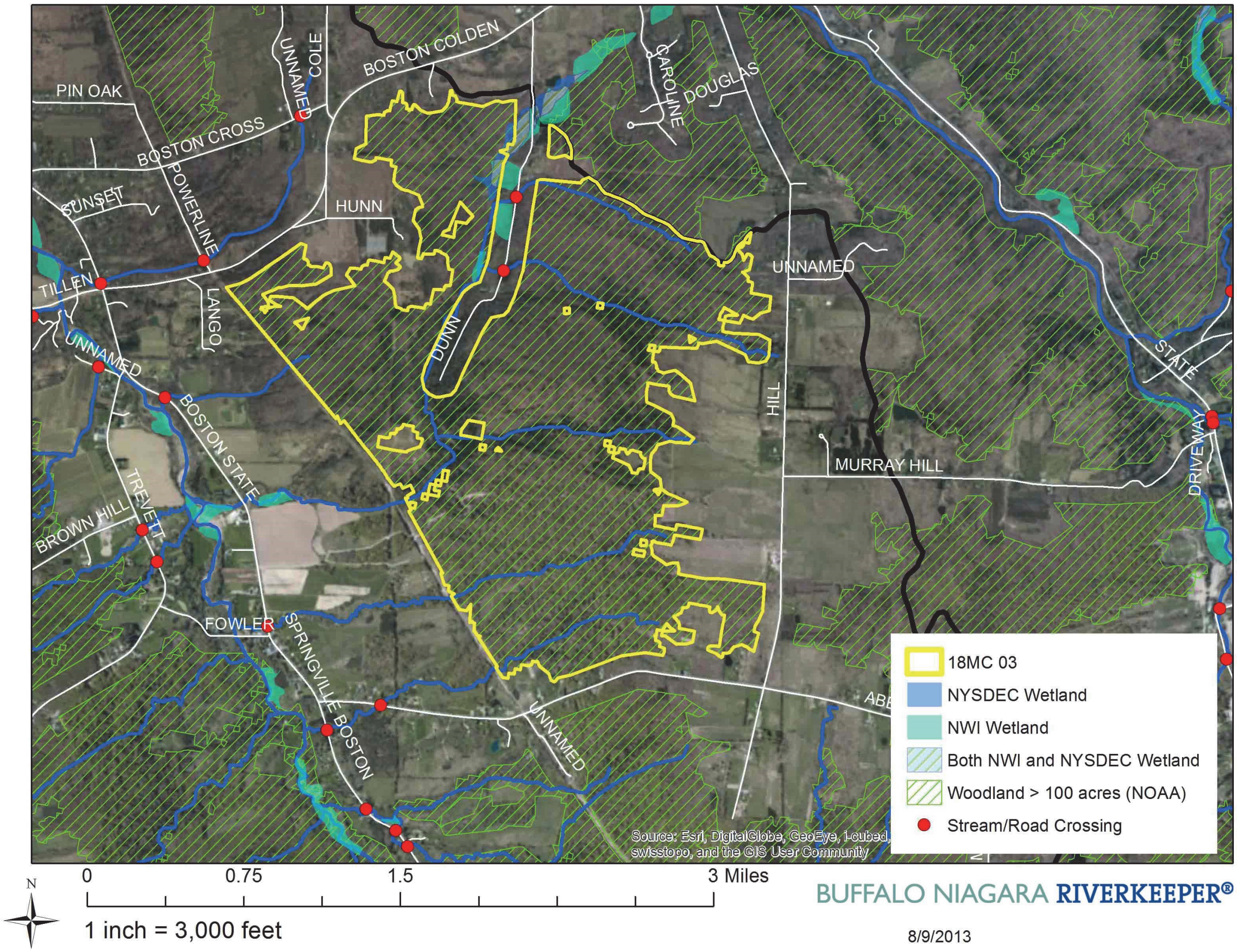
Landon Brook, northernmost tributary at Fowlerville; Photo credit: AES

Proposed Action/Restoration Potential: Prevent forest fragmentation through public acquisition of forested land or easements and promotion of collective stewardship among private landowners should target the 1,300-acre forested roadless block. Improve the flow of Landon Brook from impoundments at road crossings and protect banks from more clearing, allowing regeneration along the entire course of the stream. **Consider the shrub-car wetland as a reference area and a high priority for protection.** AES field assessments of 22 road culverts provide a preliminary analysis of where there are blockage and erosion problems that need to be addressed.

Potential Implementers/Partners: The Nature Conservancy; Western New York Land Conservancy; NYS DEC; Erie County SWCD/NRCS; Towns of Boston and Concord.

Potential Funding Sources: US Forest Service Northeastern Area State and Private Forestry Grant, US Forest Service Community Forest and Open Space Program, NRCS Wetland Reserve Program, National Fish and Wildlife Foundation Acres for America

18MC 03- FOWLERVILLE



EIGHTEENMILE CREEK COUNTY PARK (18MC05)

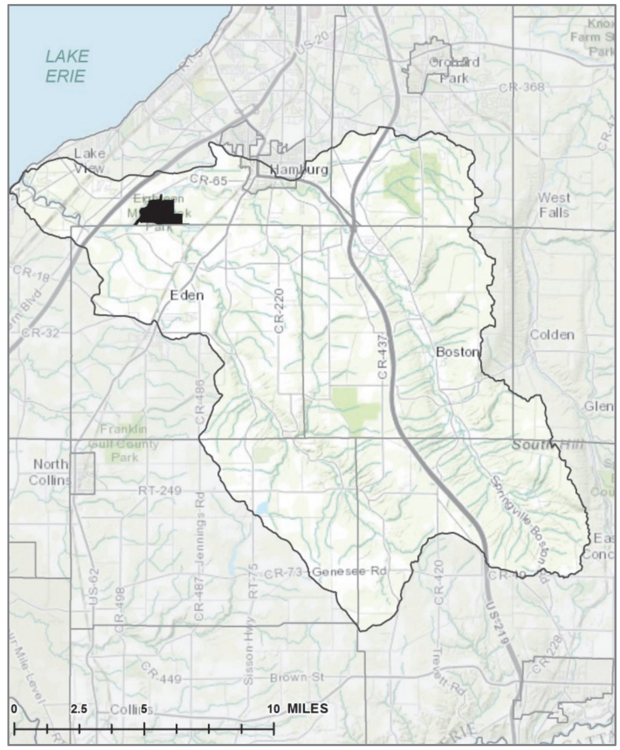
Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Identify high quality aquatic and riparian wetlands for conservation

Conservation Opportunities: Invasive species management; erosion/sediment control; enhanced land protection

Site Description: This undeveloped Erie County Park is centered on the confluence of the main and south branches (and gorges) of Eighteenmile Creek. Of the 3 Lake Erie gorges within the Niagara River watershed, The Nature Conservancy ranked Eighteenmile highest as a functional landscape based on land cover within 400 meters of the stream, lack of dams/diversions, roadless blocks and water quality (LEGBI, 2010). The park is a NYS "significant fish and wildlife area," and also the upstream end of a DEC-designated fishing access area known for its spring Steelhead run.



Acreage: 464 acres
Location (road crossing): North Creek and Lakeview Rd, Hamburg NY
Ownership: Erie County

Biodiversity Features: Woodlands: Maturing hemlock-maple-oak forest (90% native woodland) found at the convergence of two major streams suitable to flycatcher, vireo and wood warbler species; shale cliff and talus communities present; cold spring micro-habitats present, botanically diverse functional floodplain.

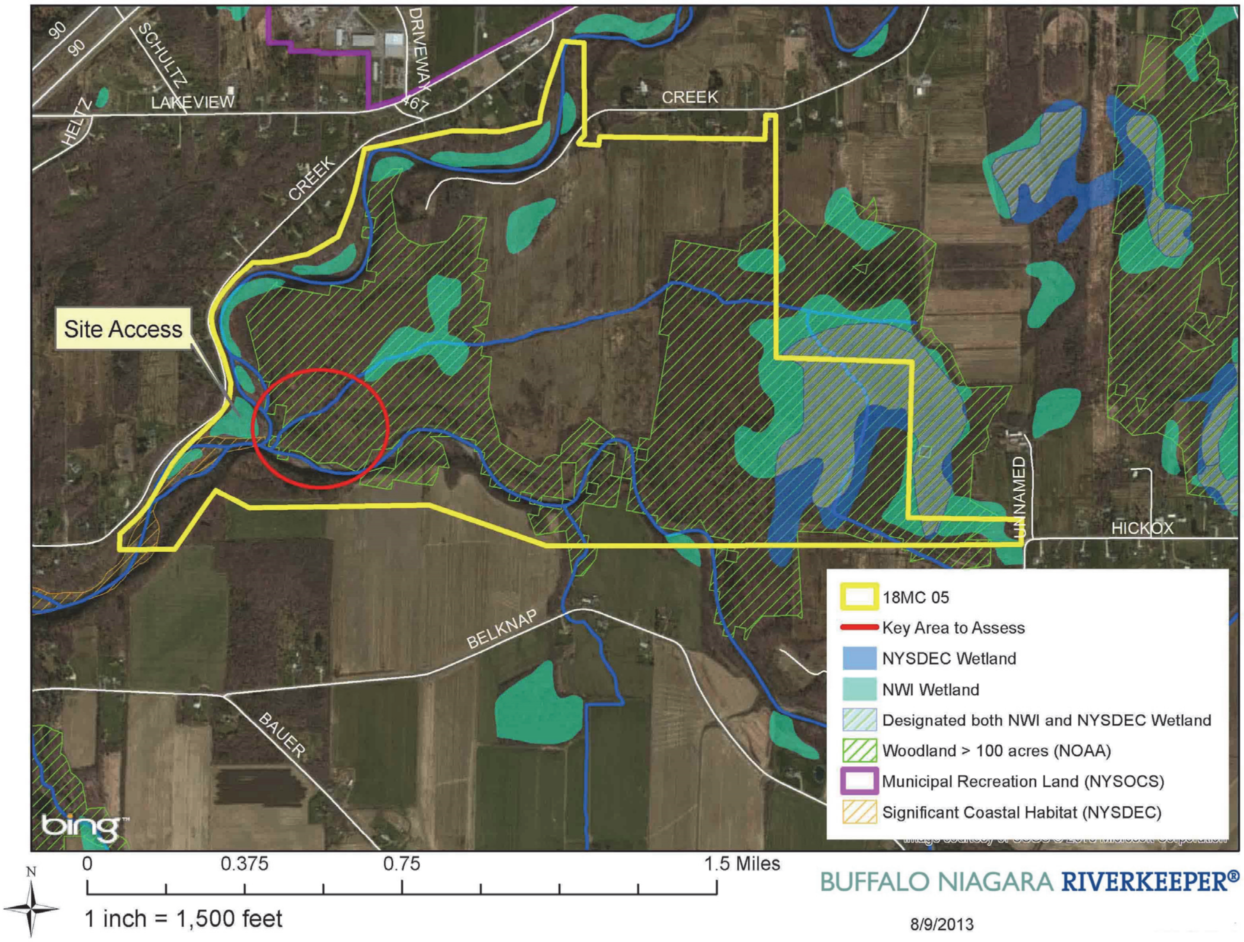
Fishing access in Eighteenmile Creek Park; Photo credit: AES

Proposed Action/Restoration Potential: This site would benefit most from invasive species control, especially in the floodplain, which is 40-50% invasives, mainly Japanese knotweed, purple loosestrife, mugwort, and reed canary grass. Continued protection of this site as an undeveloped, conservation county park is recommended to maintain a high level of biodiversity. Monitoring is needed for impacts from trail and other human encroachments. Completing a comprehensive wildlife assessment is recommended to document important species and would assist in defining further management goals.

Potential Implementers/Partners: Erie County Department of Parks, Recreation, and Forestry; Erie County Department of Environment and Planning; Erie County SWCD/NRCS; Town of Hamburg

Potential Funding Sources: EPA Great Lakes Restoration Initiative, US Forest Service Northeastern Area State and Private Forestry Grant, Great Lakes Basin Program Soil Erosion and Sediment Control

18MC 05- FORK


90
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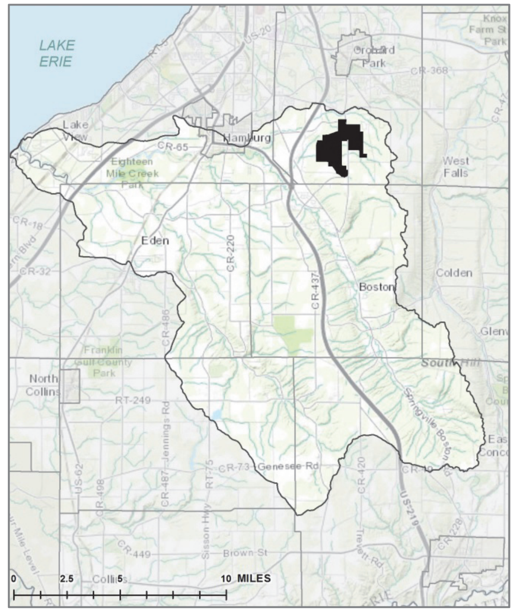
SCHULTZ
HELTZ
LAKEVIEW
DRIVEWAY
CREEK
CREEK
Site Access
UNNAMED
HICKOX
BELKNAP
BAUER
bing
18MC 05
Key Area to Assess
NYSDEC Wetland
NWI Wetland
Designated both NWI and NYSDEC Wetland
Woodland > 100 acres (NOAA)
Municipal Recreation Land (NYSOCS)
Significant Coastal Habitat (NYSDEC)
N
0
0.375
0.75
1.5 Miles
1 inch = 1,500 feet
BUFFALO NIAGARA RIVERKEEPER®
8/9/2013

SHALE CREEK - CHESTNUT RIDGE COUNTY PARK (18MC06)

Cattaraugus Hills Ecoregion

PRIORITY: HIGH

Strategy: Identify critical needs and opportunities for stream buffering.



Conservation Opportunities: erosion/sediment control; enhanced best management practices; enhanced ecological management plans

Site Description: This 90-acre undeveloped southwestern portion of the Chestnut Ridge multi-use park includes "Eternal Flame Falls." It was previously managed separately from the park by the Buffalo Museum of Science as a reference and field trip site for local woodland ecology. The forest includes a significant community of intact maturing second growth hemlock, maple, and beech. Areas of invasives are present, associated with canopy openings. Trails in this park are heavily used and excessively widened causing disturbance to the ecological community by erosion, compaction, and trampling of vegetation.

Acreage: 90 acres (Chestnut Ridge Park total: 1,231 acres)
Location (road crossing): Boston Ridge and Seufert Rd, Orchard Park NY
Ownership: Erie County
Biodiversity Features: Woodland: Second growth maple-beech-hemlock forest with a potentially diverse herbaceous understory, narrow shale ravine and waterfall.

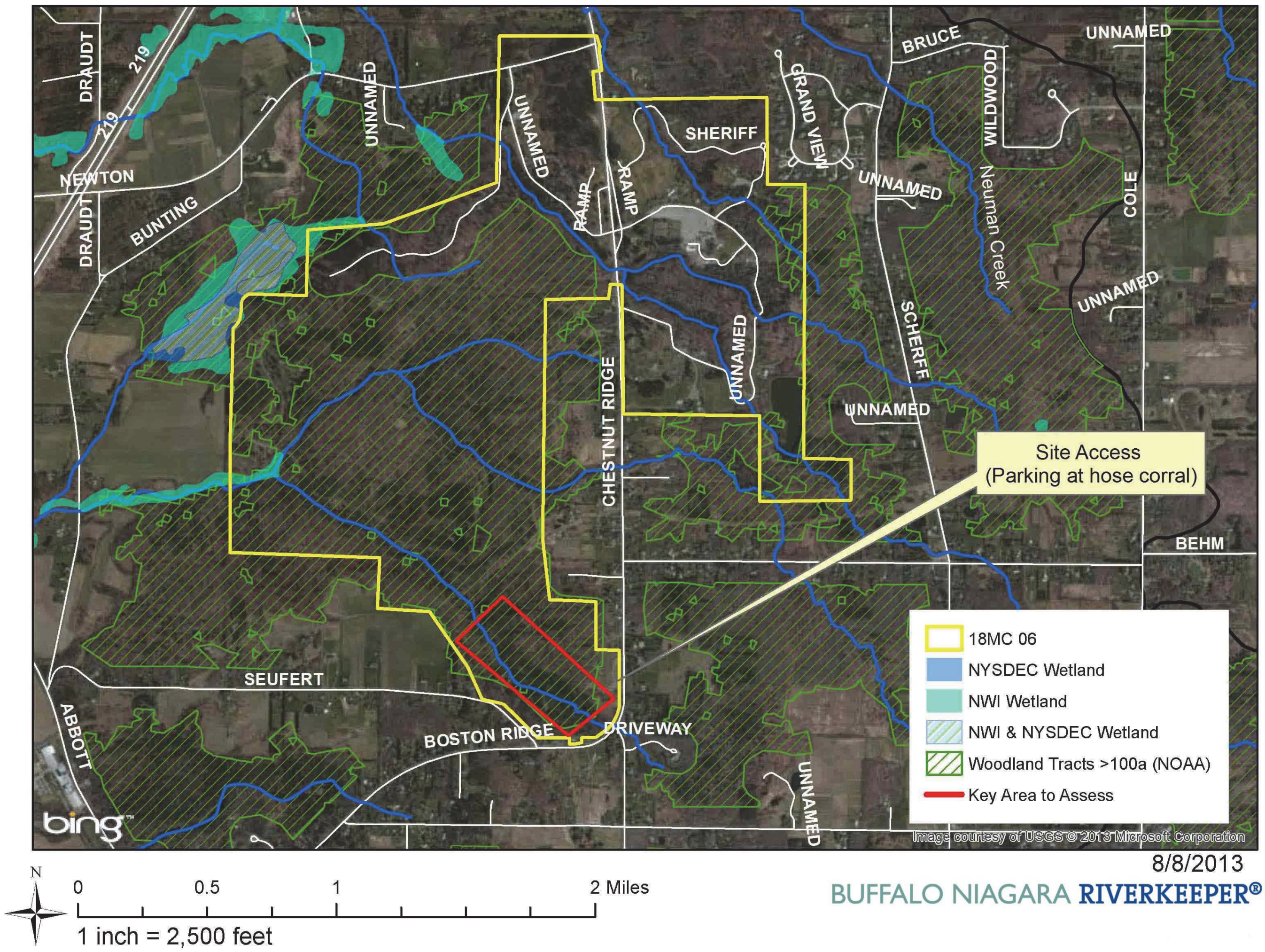
Trail erosion along Eternal Flame trail; Photo credit: Kerrie Gallo

Proposed Action/Restoration Potential: The trail system should be reworked to address the risks posed to water quality and riparian and upland habitat (especially near the gorge rim and falls) due to human disturbance. Interpretive signage and trail maintenance should be paired with off-limits areas for natural and assisted regeneration. "Herd trails" down the steep gorge faces to the "Eternal Flame" need to be addressed as a safety and erosion issue. Conduct a natural resource inventory to determine the presence/absence of RTE species and priority areas for limited access. Monitoring and management of invasive species is needed.

Potential Implementers/Partners: Chestnut Ridge Conservancy; Erie County Department of Parks; Recreation, and Forestry; Erie County SWCD/NRCS; Town of Orchard Park

Potential Funding Sources: EPA Great Lakes Restoration Initiative, Freshwater Future Project Grant Program, Fields Pond Foundation Grant

18MC06- SHALE



Appendix J

Inventory of Municipal Tools

The following list provides a breakdown of suggested management opportunities by municipality in the sub-watershed. These management actions are tailored towards current local laws, ecological impairments, and conservation opportunities, and provide a starting point for municipalities to develop and seek appropriate funding for implementation.

Municipalities in the Eighteenmile Creek Sub-Watershed

<u>Town of Hamburg</u>

- Zoning Code includes a Lakeview Overlay District.
- Has an LWRP targeted at protecting Eighteenmile Creek, Smokes Creek Shoals and Seneca Shoals.

<u>Town of Eden</u>

- Has codified conservation easement program
- Has Creekside overlay district to promote connected open space and protect stream corridors and habitat
- Codify vegetated buffer standards for areas not within the Creekside Open Space Corridors to protect from non-point source pollution

<u>Town of Evans</u>

- Could implement vegetated buffer or setback standards to mitigate non-point source pollution into creeks
- Coordinate with Eden on protection of abutting stream corridors

<u>Town of North Collins</u>

- Update Comprehensive Plan (1996)
- Village of North Collins is currently updating Comprehensive Plan (outside of sub-watershed)
- Include conservation overlay districts; vegetated buffer or setback requirements for the Eighteenmile Creek corridor to mitigate nonpoint source pollution

<u>Town of Orchard Park</u>

- Town has a listed policy objectives to "protect lands that contribute to biodiversity and natural groundwater recharge" and a conservation overlay district encouraging cluster development
- Town could explore overlay/floating zones to address drainage and stormwater concerns

<u>Town of Boston</u>

- Vision for 2020 Comprehensive plan[23] sets protecting Eighteenmile Creek, planting riparian vegetation for erosion control, and protecting open space as immediate goals for the town.
- Codify a Conservation Easement Program enabling the town to expend funds to purchase easements.
- Codify an environmental overlay district for Eighteenmile Creek.

- Include "waterfront" in the yard requirements to encourage "waterfront yard" setback keeping a certain distance from streams for new development.

<u>Town of Colden</u>

- Update Comprehensive Plan.
- Adopt Erie County model Stormwater Ordinance.
- Incorporate steep slope ordinances to protect highly erodible soils.

<u>Town of Concord</u>

- The Town of Concord and Village of Springville have a joint Comprehensive Plan although the Village of Springville is not located in the Eighteenmile Creek sub-watershed.
- The Town of Concord should adopt the wellhead protection overlay district that exists in the Village of Springville code

<u>Village of Hamburg</u>

- Village has use of native plants as a policy objective.
- Village has a policy to utilize soft engineering over hard engineering such as rip-rap installation to control erosion.
- Could include buffer requirements for riparian landowners to mitigate runoff into the Creek congruent with the goals outline in the Comprehensive Plan (2012) regarding access to Eighteenmile Creek.

Municipalities in the Buffalo River Sub-Watershed

<u>City of Buffalo</u>

- The City of Buffalo's Unified Development Ordinance and associated documents, known as the "Green Code" includes waterfront setbacks, and buffers for waterfront yards, as well as limited development in spaces zoned as open space or recreational uses.
- LWRP: The city has adopted a Local Waterfront Revitalization Plan for the waterfront area of the city along Lake Erie requiring new development to undergo consistency review with the plan.
- Setback requirement: requires 100-foot minimum development setback for non-water dependent new uses along the Buffalo River from Ohio Street Bridge east to the city line.

<u>Town of Aurora</u>

- Comprehensive plan sets a goal of conserving 1,500 acres in perpetuity.
- Codify conservation easement policy to protect land.
- Should designate important stream corridors as Critical Environmental Area (CEA).

Town of Boston

- Vision for 2020 Comprehensive plan sets protecting Eighteenmile Creek, planting riparian vegetation for erosion control and protecting open space as immediate goals for the town. [23]
- Codify a Conservation Easement Program enabling the town to expend funds to purchase easements.[4]
- Codify an environmental overlay district for Eighteenmile Creek.
- Include "waterfront" in the yard requirements to encourage "waterfront yard" setback to maintain a certain distance from streams for new development.

Town of Concord

- The Town of Concord and village of Springville have a joint Comprehensive Plan although the Village of Springville is not located in the Buffalo River sub-watershed.
- The Town of Concord should adopt the wellhead protection overlay district that exists in the Village of Springville code.

Town of Colden

- Update Comprehensive Plan.
- Adopt Erie County Model Stormwater Ordinance.
- Incorporate steep slope ordinances to protect highly erodible soils.

Town of Elma

- Towns of Aurora, Holland, Elma, Wales and Village of East Aurora should continue coordination of their existing regional comprehensive plan which includes a goal of including stream corridor preservation and the creation of linkages between important open space and recreational features.
- Codify vegetated riparian buffer ordinances to protect waterbodies from potential sprawl and maintain the rural character of the town.
- Develop conservation overlay district to protect the creeks that run through the town.

Town of Holland

- Comprehensive Plan sets a goal to include public wellhead and groundwater recharge areas in the zoning code.
- Zoning Cod does require the preservation of topsoil and other natural features.

Town of Sardinia

- Update Comprehensive Plan (2003).
- Ensure the Conservation overlay districts overlay Sprague Brook and East Branch Cazenovia Creek in the northern section of town.
- Consider removing golf course and ski resorts from conservation overlay district; while they are open space, they may be a significant source of run-off and contaminants.

Town of Wales

- Town of Wales and Village of East Aurora are part of a joint Comprehensive Plan with Aurora, Elma and Holland (2004).
- Sets a goal to preserve and protect significant environmental resources which includes stream corridors, wellhead areas, habitat and groundwater from failing septic systems.[31]
- Town should codify conservation overlay districts to protect wellhead areas.
- Town should codify vegetated buffer and setback requirements from waterways.

Town of West Seneca

- Establish Conservation overlay district to protect Buffalo, Smokes, Cazenovia Creeks and associated floodplains.
- Consider applying the vegetated buffer standard in the "Industrial park overlay district" to residential riparian landowners, where appropriate, through another overlay.

Village of East Aurora

- Has codified the NYS Stormwater Manual into zoning chapter.
- Continue the goals and cooperative actions outlined in the Joint Comprehensive Plan
- With little greenspace and open water, the towns should consider encouraging the inclusion of green spaces above and beyond what is required by the NYS Stormwater Manual.

Village of Sloan

- Write Comprehensive Plan.
- Village Department of Public Works encourages residents to properly dispose of yard waste by not disposing of it by blowing it in the street.

Municipalities in the Smokes Creek Sub-Watershed

City of Lackawanna

- Had adopted the Model Stormwater Ordinance.
- The City has a requirement that residential properties must be at least 50% green.
- Increase current 50ft buffer requirement to 100 feet.
- Create zoning requirements that limit the creation of impervious surface and encourage green infrastructure such as porous material.
- Connect with privately wetland owners (Catholic diocese of Buffalo) of management regarding mowing practices, fertilizer use and protecting riparian vegetation.

<u>Town of West Seneca</u>

- Consider applying the vegetated buffer standard in the "Industrial park overlay district" to residential riparian landowners, where appropriate, through another overlay
- Abutting parcels in the Industrial park overlay district should include abutting watercourses as outlined in the Town's environmental features map as there are industrial parcels abutting Smokes Creek.

<u>Town of Orchard Park:</u>

- Town has a listed policy objective to "protect lands that contribute to biodiversity and natural groundwater recharge" and a conservation overlay district encouraging cluster development
- Town could explore overlay/floating zones to address drainage and stormwater concerns.

<u>Town of Hamburg:</u>

- Zoning Code includes a Lakeview Overlay District.
- Has an LWRP targeting at protecting Eighteenmile Creek; Smokes Creek Shoals and Seneca Shoals.

<u>Village of Blasdell</u>

- Rush Creek runs through the southwest corner of the village of Blasdell yet the zoning code has no special requirements for riparian areas.
- The Village could add a conservation overlay district, required setbacks from the creek for new development or vegetated buffers for riparian landowners.
- Draft Comprehensive Plan.

<u>Village of Hamburg:</u>

- Village has use of native plants as a policy objective.
- Village has a policy to utilize soft engineering over hard engineering such as rip-rap installation to control erosion.
- Could include buffer requirements for riparian landowners to mitigate runoff into the creek congruent with the goals outlined in the Comprehensive Plan (2012) regarding access to Eighteenmile Creek.

Village of Orchard Park

- Despite two watercourses running through the village, there is little to no reference to waterways in the zoning code.
- Include streams or waterways in the definition of "setback"

Municipalities in the Lower Tonawanda Creek Sub-Watershed

Town of Cambria

- If 2014 comprehensive Plan update has not been complete, complete.
- The Town zoning code includes expansive stormwater requirements and, notably, a requirement that there be no increase in turbidity due to development activities.

Town/ City of Lockport

- Include hazardous waste sites with development limitations.

Town of Wheatfield

- Protect natural resources by focusing on Sawyer Creek as an important drainage and greenway (Municipality is in the Niagara River Greenway).

Town of Pendleton

- Naturalize shoreline/add riparian buffers between Veterans Park and Pendleton
- Protect important natural resources by making poor drainage areas and floodplains a conservation priority.
- Coordinate inter-municipal regulations and BMPs by extending trails to interconnect open spaces with adjacent communities.

Town of Clarence

- The town has already has some environmentally beneficial regulations including an environmental protection overlay district and an Open Space Design Overlay district which encourages cluster development to protect resources such as woodlands and prime farmland identified in the town's Open Space Plan. In addition, there is a codified conservation easement program.
- The above could be strengthened by amending local laws to require the preservation of mature woodlands and other natural features and establish an agricultural zoning and natural feature overlay.

Town of Amherst

- Naturalize shoreline/add riparian buffers between Veterans Park and Pendleton
- The town has a codified conservation easement program
- Amend local laws to require stream buffers and setbacks for all new development
- Develop an overlay district to establish greenway corridors along streams including trails along Tonawanda creek.
- Establish an agricultural zoning district and an overlay district to establish a conservation overlay creating greenway corridors along streams, including trails along Tonawanda Creek.

Town of Lancaster

- Many of the watercourses run through the "agricultural residential" zone so encouraging best management practices such as riparian buffers or conservations overlay districts would greatly benefit water health.

Town of Newstead

- Comprehensive Plan could include a goal of counteracting loss of viable soils
- Install Riparian buffers to combat erosion.
- Use abandoned sand and gravel pits for wetland mitigation banking.[28]
- The Town of Newstead was analyzed in depth in the Niagara River Watershed Management Plan (Phase I).[1]

City of North Tonawanda

- Codify and apply the best management practices outlined in Niagara River Watershed Management Plan to the city's six marinas.
- The City of North Tonawanda was analyzed in depth in the Niagara River Watershed Management Plan (Phase I).

Municipalities in the Upper Tonawanda Creek Sub-Watershed

Town Alexander

- Revise town zoning regulations to prohibit the establishment of new commercial gravel mines and the expansion of existing mines.
- Provide training to Town Highway Dept. personnel in practices that minimize erosion and sedimentation from roadside ditches.
- Revise town zoning regulations to prohibit the establishment of new commercial gravel mines or the expansion of existing mines.

Village of Attica

- Village could adopt aquifer protection law.
- Village could establish a Conservation Easement Program which "would improve safety in the village's floodplain including purchase land or facilitate the creation of land trading programs to prevent flood damage to homes and increase the flood storage capacity of the areas/encourage land uses in the floodplain to benefit the area's ecology."

Town of Batavia

- Currently undergoing revision of Comprehensive Plan and possibly developing Conservation Overlay District.
- Town would benefit from a local law or cooperative approach to limit dam or road interference with stream flow.
- Include in overlay district long-range protection for water resources, wildlife habitat and erosion stability.
- Utilize highway maintenance BMPs.
- Consider adopting the NYS Model ordinance for stormwater management and erosion and sediment control.

Town of Bennington

- Draft Comprehensive Plan for Town – state grants may be available for funding this type of municipal work.

Town of Bethany

- 2016: Comprehensive Plan Updated.
- Add an overlay district to local zoning code: preservation districts for land with unique character.
- With the bodies of water predominately in the "agricultural-residential" zone, coupled with the importance of maintaining agricultural land uses and the potential increase in development as noted in the comprehensive plan update, the town would benefit from implementing riparian buffers to mitigate runoff and erosion, especially during flood events.

Town of Darien

- Update Comprehensive Plan; most recent update found was from 2005.
- Could amend zoning code to include stream buffers zones and setbacks.
- Promote overlay district to protect natural streams and woodlands.

Town of Java

- Draft Comprehensive Plan- State grants may be available for this type of municipal work.
- Coordinate with Wyoming Agricultural District 4 (Arcade; Sheldon; Bennington) to implement agricultural best practices and participate in District-wide agricultural trainings.

Town of Orangeville

- Coordinate inter-municipal regulations and Best Management Practices (BMPs) for shared resources which in Orangeville would coordinate drainage planning efforts with neighboring towns.
- Could create an overlay district that would require developers to dedicate easements along creeks (Tonawanda) to allow for maintenance and to reduce the risk of flood damages.
- Consider developing environmental overlay zones for steep slope areas for significant tributaries.
- Prohibit erection of structures within at least 50 feet of environmentally sensitive areas.

Town of Sheldon

- Already limits development and thereby impervious surface for open space and agricultural land.
- 2008 Local Law 1; Right to farm law. Work within this law to encourage agricultural landowners to adopt best management practices included utilizing riparian buffers.
- Updated Comprehensive Plan in 2016; Plan encourages continued coordination with Wyoming County Agricultural District 4 (Java, Bennington and Arcade).
- Encourage Town Board during annual public input session to incorporate sustainable practices into services provided for agricultural purposes.
- Enact regulations to protect forested tracts which can alleviate run-off.
- Vegetative buffers suggested in comprehensive plan should be enacted into the town's zoning code.
- Develop zoning conservation district overlays to protect the headwater forests of Buffalo and Cayuga creek and their tributaries.

Town of Stafford

- Update Comprehensive Plan (2009).

Town of Warsaw

- Draft Comprehensive Plan.
- Continue coordination through Wyoming County Revitalization Strategy.

Town of Wethersfield

- Draft Comprehensive Plan.