

Section 7:

Stream Assessments in the Niagara River Greenway

Stream Assessments in the Niagara River Greenway



Prepared by: Dr. Kelly M. Frothingham
Prepared for: Buffalo Niagara Riverkeeper



January 2014

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1. INTRODUCTION

The purpose of this study was to collect baseline data on a number of physical, chemical, and biological conditions in streams in the Niagara River Greenway. The Natural Resources Conservation Service's (NRCS) Stream Visual Assessment Protocol (SVAP) (NRCS, 1998 and 2009) was used to collect this data. The SVAP is a qualitative multidisciplinary assessment used to perform rapid visual assessment of several elements of overall stream corridor conditions. Opportunities for habitat conservation and restoration are identified in this report and study results will contribute to and help guide watershed management activities in the Greenway.

2. METHODS

2.1 Stream Visual Assessment Protocol

The SVAP (NRCS, 1998 and 2009) was used to collect baseline stream condition data on streams within the Niagara River Greenway during the summer 2013 field season. A trained two- to three-person field crew scored the following elements in each stream reach assessed: channel condition, riparian zone, bank condition, water appearance, nutrient enrichment, instream fish cover, pools, and canopy cover (see Appendix A for element descriptions and scores). Elements were scored using a 0 to 10 scale and overall scores for each reach were calculated by dividing the sum of the element scores by the number of elements assessed. Overall scores indicate if stream reaches are Severely Degraded (score 1.0-2.9), Poor (3.0-4.9), Fair (5.0-6.9), Good (7.0-8.9), or Excellent (9.0-10.0) (NRCS, 2009).

Stream reaches were selected to represent the combinations of vegetation, stream morphology, and hydrologic regime found throughout the Niagara River Greenway. A standard reach length of 200 feet was used during this study.

In addition to the element scores, the following characteristics were noted in each reach: stream channel width (lowflow and bankfull), reach length, and dominant bed substrate type. Additional notes were taken to document the presence of litter or trash, presence/absence of emergent or submerged aquatic vegetation (EAV and SAV), and presence of introduced species (i.e., Phragmites, Japanese knotweed, purple loosestrife, water chestnut, or hydrilla) in the reach. A Garmin e-trex GPS unit was used to obtain latitude and longitude coordinates in each reach. A digital photograph was taken in each reach and included in a photo index database. The field data sheet is in Appendix B.

Weather conditions were monitored throughout the field season. Temperature and precipitation data were obtained from the National Weather Service website (Buffalo, NY office: <http://www.nws.noaa.gov/climate/index.php?wfo=buf>) and a Weather Underground site (KNYLWEIS2) located in the Tall Oaks subdivision in Lewiston, NY (<http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KNYLEWIS2&graphspan=day&month=6&day=10&year=2013>). Field work was not conducted within 24 hours of a rain event resulting in more than 0.25 of rain. This was done in order to ensure that assessments were done under lowflow conditions and to minimize the potential impact of high flow conditions on the water appearance element, in particular.

2.2 QA/QC

A subset of the reaches were assessed early in the field season (May and June) and then re-assessed in late July and early August to determine if the SVAP was interpreted and applied consistently over the course of this study. Field sheets from the initial assessment were not made available to the field crew for the re-assessment. Reaches were re-located for the second assessment using the previously

recorded GPS coordinates. The SVAP elements were scored during both assessments and overall scores were calculated and compared. Overall scores from the two assessments were determined to be the same if both scores fell within the same SVAP (NRCS, 2009) rating range as follows:

- 1 to 2.9 Severely Degraded
- 3 to 4.9 Poor
- 5 to 6.9 Fair
- 7 to 8.9 Good
- 9 to 10 Excellent

2.3 Water Quality

Water quality data was collected one time in a subset of reaches assessed during this study. A YSI 6920 water quality sonde connected to a 650 MDS handheld data logger was used to measure temperature, conductivity, dissolved oxygen (DO), pH, and turbidity. Water quality data was collected at three points within each reach (upstream, midstream, and downstream) at approximately 0.6 of the total depth at each point. The data from the three points were averaged to yield reach-averaged values for each water quality parameter.

3. RESULTS and OPPORTUNITIES

A total of 348 reaches on 12 streams in the Niagara River Greenway were assessed between May and August 2013 (Table 1). A period of at least 24 rain-free hours preceded 84% of the field work days and sampling did not occur within 24 hours of a rain event with greater than 0.25 inches (Figure 1). Appendix C contains the individual SVAP scores for each reach and Appendix D is a photo index that contains a photo of each reach.

Table 1 Field Data Summary

Creek	Number of reaches assessed	Average SVAP score	SVAP rating (NRCS, 2009)
Niagara County			
Fish	72	6.0	Fair
Gill	26	6.9	Fair
Cayuga	56	6.7	Fair
Bergholtz (and tributary)	41	6.2	Fair
Bull	30	6.0	Fair
Erie County			
Ellicott	2	3.1	Poor
Tonawanda	2	3.3	Poor
Two Mile (and tributary)	19	6.9	Fair
Grand Island (Erie County)			
Woods (and tributaries)	32	6.7	Fair
Gun	32	6.6	Fair
Big Six Mile (and tributary)	13	6.0	Fair
Spicer	23	6.5	Fair

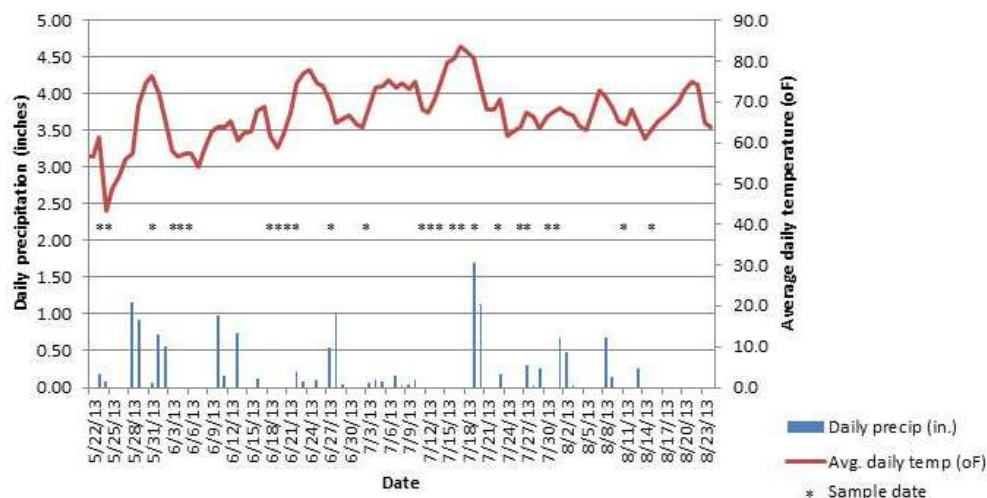


Figure 1 Field season weather conditions and sample day summary (data from the KNYLWEIS2 Weather Underground site).

The majority of assessed reaches (57%; 200 reaches) had overall SVAP scores in the Fair rating range (Figure 2). There were 109 reaches (31%) with Good overall scores, one reach was rated Severely Degraded (Ellicott Creek Reach 1), and there were not any reaches with an Excellent overall rating (Figure 2).

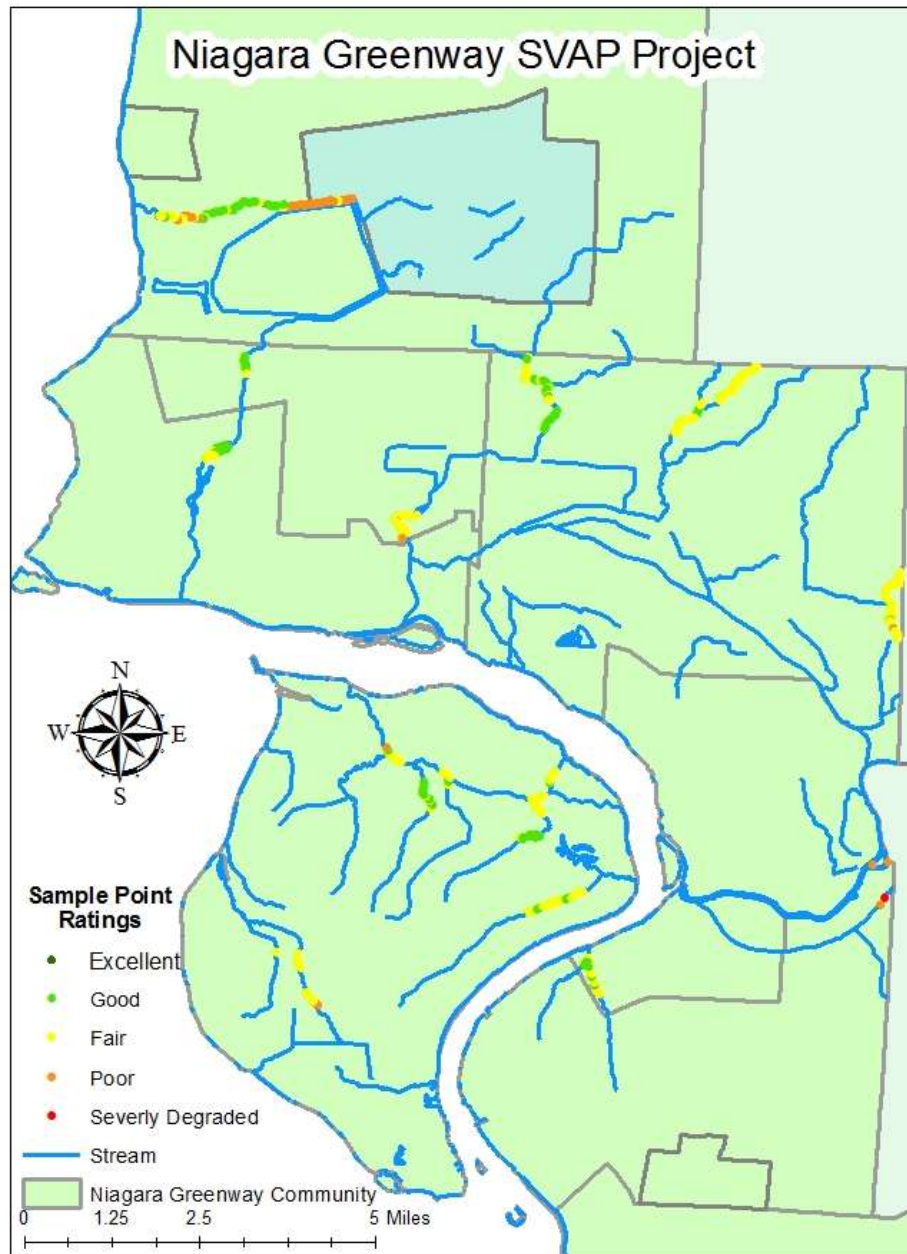


Figure 2 Overall SVAP scores in reaches of Niagara River Greenway streams.

3.1 Fish Creek

The total number of reaches assessed in Fish Creek was 72 and the average overall SVAP score was 6.0 (Fair) (range 3.5-8.3) (Figure 3). Bed substrate in Fish Creek was silt and clay with gravel and/or cobble (79% of reaches). The physical channel conditions are summarized in Table 2 and Table 3 contains a summary of conditions for each SVAP element.



Figure 3 Fish Creek overall SVAP ratings for each reach.

Table 2 Fish Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Fish	2.80 (0.75-5.0)	15.98 (8.0-25.0)	0.98 (0.4-2.5)	11.00 (5.0-18.0)

Table 3 Fish Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	2.0-9.0	5.6	2.0	Long sections of altered channel at the up- and downstream ends of the assessed creek
Riparian Zone (average)	1.0-10.0	7.2	8.5	Common introduced species include honeysuckle, multiflora rose, garlic mustard, hawthorn
Bank Condition (average)	1.0-9.0	5.1	2.0	Low scores a result of hard structures; 83% of reaches (60 reaches) have stable banks, 17% (12 reaches) are moderately unstable
Water Appearance	4.0-8.0	6.9	7.0	Water slightly turbid
Nutrient Enrichment	7.0-9.0	8.7	9.0	Fairly clear water with little to moderate algal and aquatic plant growth
Instream Fish Cover	3.0-9.0	5.0	4.0	Common cover types include LWD, overhanging vegetation, boulders/cobbles, riffles, undercut banks
Pools	1.0-10.0	5.0	5.0	Pools present, but shallow
Canopy Cover	1.0-9.0	4.5	7.0	Coldwater creek

Channel condition scores were low (2) in the upstream portion of Fish Creek (Reaches 1-26) where the creek was channelized (straightened with riprap) adjacent to the New York Power Authority (NYPA) reservoir. Scores were higher (9.0, on average) in the middle portion of Fish Creek (Reaches 27-55), indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation. Channel condition scores decreased (7-8) in the downstream reaches as the stream flowed through the Niagara Falls Country Club Golf Course (Reaches 56-62) and exhibited evidence of past channelization. Reaches 63 through 72 exhibited channel straightening, hard structures in 50% of the reaches (5 of 10 reaches), and evidence of channel incision.

Seventy-nine percent of the reaches (57 reaches) had average riparian zone scores greater than 8.5, indicating a riparian zone that extended at least two bankfull widths from the top of the channel. Scores were lower (at or near 1) in the downstream section of the creek (Reaches 56-72), indicating a narrow (i.e., less than a third of the bankfull width) riparian zone.

Purple loosestrife was observed in 60% of the reaches (43 reaches), most of which were in the upper and middle portions of the creek (Reaches 1-38). Phragmites was observed in three reaches (Reaches 22, 28, 35).

Like channel condition scores, bank condition scores were low (2) in the upstream portion of Fish Creek (Reaches 1-26) where the banks were stable, but hard structures were present on both banks in all reaches. Bank condition scores indicate moderately stable to stable banks protected by natural vegetation, wood, or rock in Reaches 27 through 55, with the exception of moderately unstable banks in Reaches 39 through 41. Streambanks were also moderately unstable in Reaches 56 through 64 (i.e., through and immediately downstream of the Niagara Falls Country Club Golf Course). Reaches 66

through 72 were all moderately stable; however, Reaches 71 and 72 had lower scores (7.0 and 5.0, respectively) because of the presence of hard structures on both banks.

Water appearance scores were generally high throughout the upper and middle portions of the creek (Reaches 1-51), indicating clear or slightly turbid water. Scores decreased (4-7), indicating conditions that were turbid most of the time to slightly turbid, in Reaches 52 through 72 where the creek flowed through the Niagara Falls Country Club Golf Course and downstream of the golf course around Military Road.

Nutrient enrichment scores generally were high (8-9) as evidenced by little algal growth and low quantities of aquatic plants. Twenty-five percent of the reaches (18 reaches) were free of algal growth and aquatic plant beds. The remaining 42 reaches either had algae, aquatic plant beds, or both. All of those reaches had moderate (7-8) to high (9) scores, indicating moderate to little algal and aquatic plant growth.

Instream fish cover scores varied throughout the assessed portion of Fish Creek. Scores were lower (3-4) in the upstream channelized portion of the creek (Reaches 1-26), indicating two to three available cover types (e.g., overhanging vegetation, boulder/cobbles, dense macrophyte beds). Scores were higher (5-9) in the middle portion of the creek upstream of the golf course, indicating an increase (i.e., at least four cover types available) in cover types. Scores were lower (3-4) in the golf course reaches (Reaches 56-62) and the downstream section of the creek.

Thirty-three percent of the reaches (24 reaches) had pool scores between 6 and 10, indicating the presence of deep and shallow pools. Pools were absent in 21% of the reaches (15 reaches), with all but two of the reaches without pools (Reaches 46 and 47) being in the upstream channelized portion of the creek.

Fish Creek is a coldwater creek and 43% of reaches (31 reaches) had high (≥ 6) canopy cover scores, indicating that ≥ 75 to 50% of the water surface was shaded within the length of the reach. Thirty-two percent of the reaches (23 reaches) had a low score (≤ 2) indicating that less than 20% of the water surface was shaded within the length of the reach. Seventeen of those 23 reaches were located in the upstream channelized portion of the creek.

Litter was evident in 50% of the reaches (36 reaches) and abundant in one reach (Reach 37). While litter was fairly common throughout the entire portion of creek assessed, it was most common in the Upper Mountain Rd. to Bronson Rd. (Reaches 34-44) and Military Rd. to Lewiston Rd. (Reaches 65-72) sections.

EAV was present in 78% of the reaches (56 reaches) and SAV was present in 93% of the reaches assessed (67 reaches).

Opportunities:

- Riparian zone and habitat conservation in the middle portion of the assessed creek (Reaches 34 through 51). Habitat conservation would preserve instream habitat, including pools, and habitat with coarse bed substrate.

- Riparian zone/canopy cover improvements in the upstream section of the stream adjacent to the NYPA power reservoir (Reaches 1-33) with possible instream habitat restoration opportunities (e.g. bed structure like pools).
- Invasive species (purple loosestrife, Phragmites) removal in the upper and middle portions of the assessed creek (Reaches 1-38).
- Environmental education/outreach and Shoreline Sweep opportunities in the area around Upper Mountain Road (Reaches 34-51) (problems: trash/debris, mowing to streamsides, recreational vehicle paths).
- Riparian zone and bank condition improvement/stabilization in the stream section flowing through the Niagara Falls Country Club (Reaches 56-64).

3.2 Gill Creek

The total number of reaches assessed in Gill Creek was 26 and the average overall SVAP score was 6.9 (Fair) (range 5.0-8.4) (Figure 4). The dominate bed substrate in Gill Creek was silt and clay (65% of reaches); however, coarser substrate (e.g., gravel, cobble, boulders) was noted in Reaches 1 through 8. The physical channel conditions are summarized in Table 4 and Table 5 contains a summary of conditions for each SVAP element.

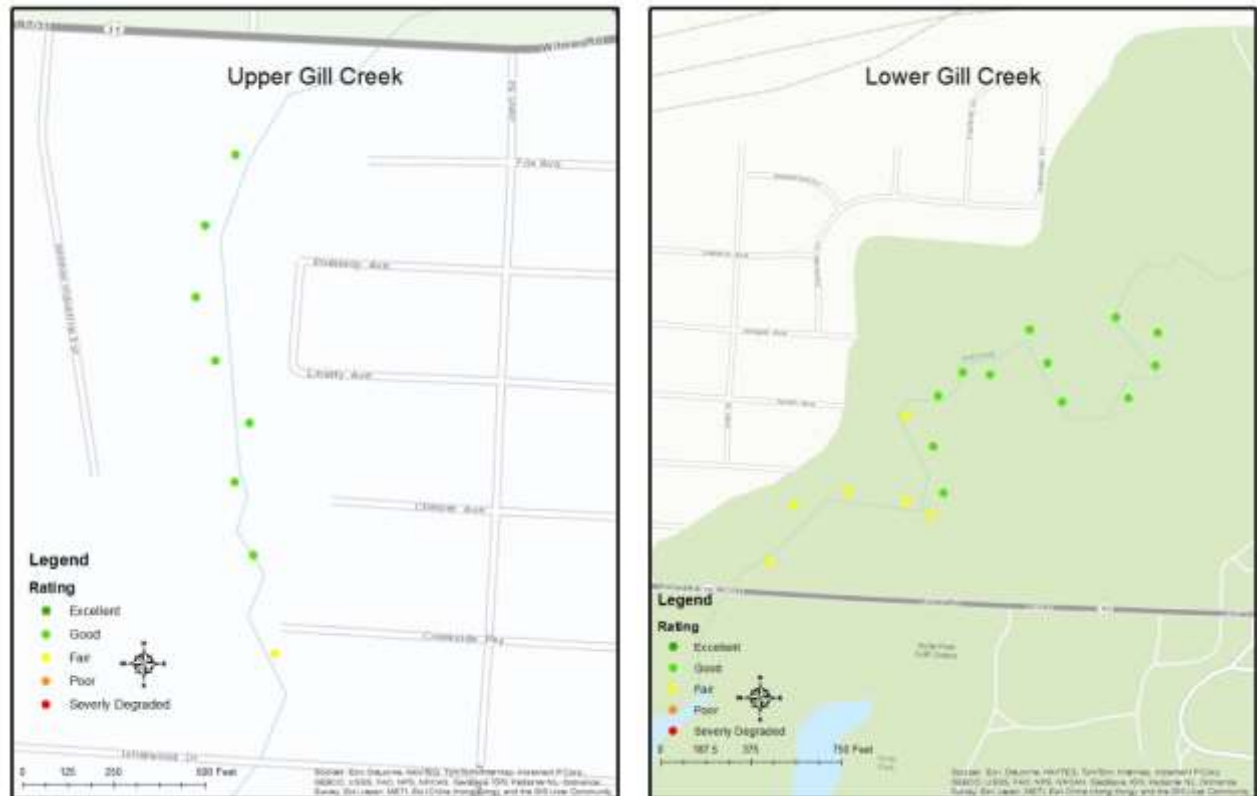


Figure 4 Gill Creek overall SVAP ratings for each reach.

Table 4 Gill Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Gill	2.95 (2.0-5.0)	30.85 (15.5-50.0)	1.44 (1.0-3.0)	23.46 (10.0-40.0)

Table 5 Gill Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	2.0-9.0	8.3	9.0	Natural channel with limited riprap in Reaches 1-8
Riparian Zone (average)	3.0-9.0	7.6	9.5	Common introduced species include garlic mustard and hawthorn
Bank Condition (average)	6.0-9.0	8.0	9.0	Hard structures (i.e., riprap) noted on one bank in six reaches (Reaches 1-4, 8, 25)
Water Appearance	3.0-7.0	4.6	4.0	Water turbid most of the time
Nutrient Enrichment	7.0-9.0	8.7	9.0	Fairly clear water with little to moderate algal and aquatic plant growth
Instream Fish Cover	2.0-8.0	4.4	3.0	Common cover types include LWD, overhanging vegetation, boulders/cobbles, riffles
Pools	2.0-10.0	4.2	4.0	Pools present, but shallow
Canopy Cover	5.0-10.0	8.8	10.0	Coldwater creek upstream (Reaches 1-8) and warmwater creek downstream (Reaches 9-26)

Channel condition scores were high (≥ 6) throughout Gill Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (15 of 26 reaches) or a channel with significant recovery from channelization (10 of 26 reaches). Reach 8 had a channel condition score of 2 because the stream was channelized with hard structures to accommodate a road crossing.

Eighty-one percent of the reaches (21 reaches) had average riparian zone scores ≥ 7 , indicating a riparian zone that extended at least one bankfull width from the top of the channel. Scores were lower (3-4) in the downstream section of the creek assessed in the Hyde Park Golf Course (Reaches 24-26), indicating a narrow (i.e., less than a third of the bankfull width) riparian zone.

Purple loosestrife was observed in 19% of the reaches (five reaches) and Phragmites was noted in one reach (Reach 5).

All 26 reaches had average bank condition scores indicating moderately stable to stable banks protected by roots, natural vegetation, wood, and natural rock. Limited riprap was noted on at least one bank in six reaches (Reaches 1-4, 8, 25).

Water appearance scores varied over the length of the creek and all the low scores (3-4; creek turbid most of the time) were associated with reaches that had silt and clay bed substrate (Reaches 9-26 in the Hyde Park Golf Course). Scores were generally higher (6-7; slightly turbid water) from Fox Ave. to Isherwood Dr. (Reaches 1-8), which had coarser bed substrate, including gravel, cobble, and boulders.

Nutrient enrichment scores generally were high (7-9) as evidenced by little algal growth and low quantities of aquatic plants. Sixty-two percent of reaches (16 reaches) were free of algal growth and aquatic plant beds. Thirty-five percent of the reaches (nine reaches) had algal growth present and one reach had both aquatic plant beds and algal growth.

Instream fish cover scores were high (7-8) in the upstream portion of Gill Creek (Reaches 1-8), indicating six to seven cover types available. Those cover types included LWD, undercut banks, deep pools, overhanging vegetation, boulders/cobble, and riffles. Scores were lower (3-4) in Reaches 9-26, indicating that two to three cover types were available in those reaches.

Sixty-two percent of the reaches (16 reaches) had pool scores between 3 and 5 indicating that pools were present, but shallow (i.e., less than 1.5 times deeper than the prevailing depth).

The upstream portion of Gill Creek is a coldwater creek and canopy cover scores were high (9-10) in Reaches 1-8, indicating that greater than 75% of the water surface was shaded. The downstream portion is classified as a warmwater creek and scores in Reaches 9-26 were also high (9-10) indicating that 50% to 75% of the water surface was shaded.

Litter was evident in all the reaches and abundant in three reaches (Reaches 5, 7, 19).

EAV was present in one reach (Reach 21) and SAV was not present in any reaches.

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek, but especially in Reaches 1 through 8 between Fox Ave. and Isherwood Dr. Habitat conservation would preserve abundant instream habitat, including pools, and habitat with coarse bed substrate.
- Bank condition/stabilization in Reach 8, as a structure is threatened.
- Riparian zone improvements (e.g., planting to increase width) in the downstream section of the Hyde Park Golf Course (Reaches 24-26).
- Environmental education/outreach in the section between Fox Ave. and Isherwood Dr. (Reaches 1-8) (problems: trails along the streambank; mowing to streamsides in some reaches).
- Shoreline Sweep opportunities between Fox Ave. and Isherwood Dr. (Reaches 1-8) where litter was abundant and included large debris (e.g., shopping cart).
- Potential concrete dam removal in Reach 13 in the Hyde Park Golf Course section of stream.

3.3 Cayuga Creek

The total number of reaches assessed in Cayuga Creek was 56 and the average overall SVAP score was 6.6 (Fair) (range 4.6-8.8) (Figure 5). Bed substrate in Cayuga Creek was a mix of silt and clay (20% of reaches) and silt and clay, plus gravel and/or cobble (50% of reaches). Thirty percent of the reaches are completely gravel, cobble, or boulder. The physical channel conditions are summarized in Table 6 and Table 7 contains a summary of conditions for each SVAP element.

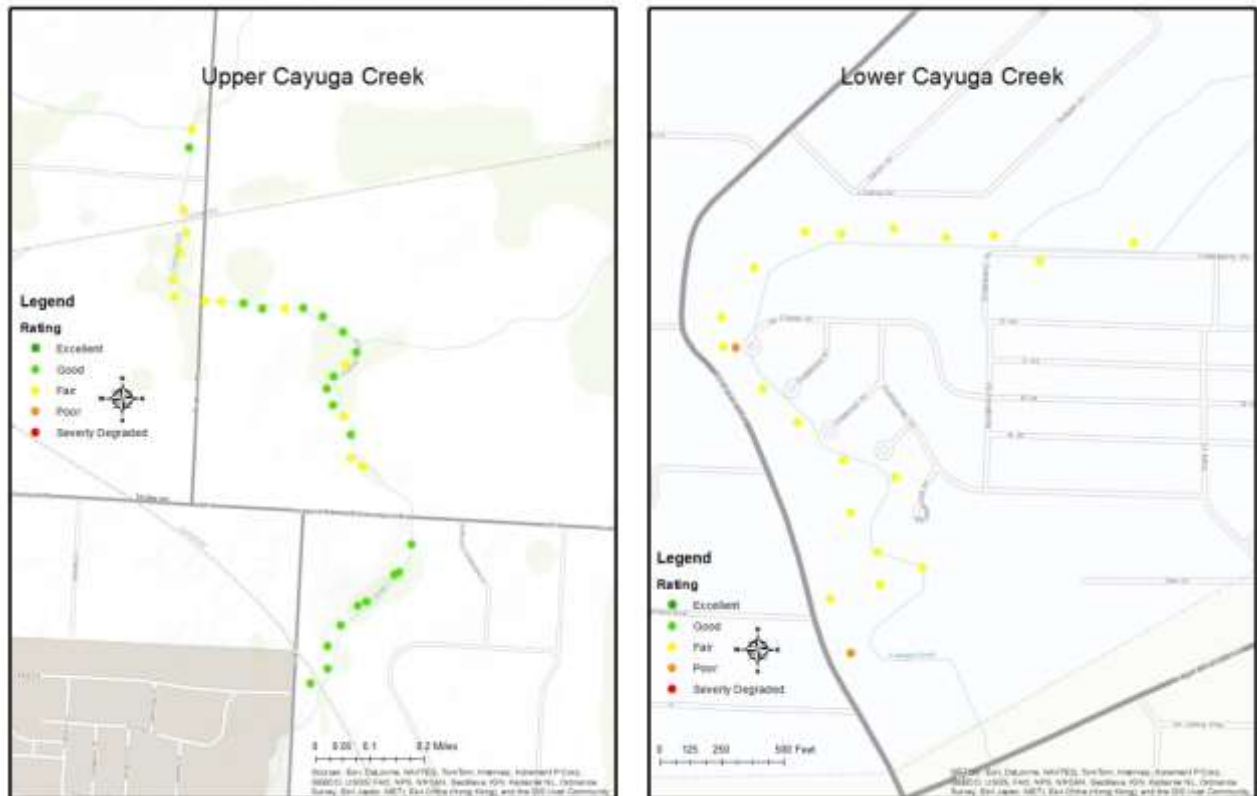


Figure 5 Cayuga Creek overall SVAP ratings for each reach.

Table 6 Cayuga Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Cayuga	3.92 (2.0-6.5)	21.57 (14.0-38.0)	1.57 (0.5-4.0)	15.16 (6.0-34.0)

Table 7 Cayuga Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	2.0-9.0	7.2	9.0	Mix of natural/recovered channel and channel with straightening/hard structures
Riparian Zone (average)	1.0-10.0	6.7	9.0	Mowing to stream edge observed in residential areas; common introduced species include reed canary grass, garlic mustard, honeysuckle, mertyl, multiflora rose
Bank Condition (average)	3.0-9.0	7.2	9.0	Predominately natural banks and banks with limited hard structures
Water Appearance	3.0-9.0	5.9	7.0	Water slightly turbid
Nutrient Enrichment	5.0-9.0	7.8	9.0	Fairly clear water with little to moderate algal and aquatic plant growth
Instream Fish Cover	3.0-9.0	5.4	5.0	Common cover types include LWD, overhanging vegetation, boulders/cobbles, dense macrophyte beds, undercut banks, riffles
Pools	2.0-9.0	5.0	5.0	Pools present, but shallow
Canopy Cover	1.0-10.0	8.1	10.	Upstream and middle portions (Reaches 1-35) are classified as a coldwater creek; Reaches 36-56 are classified as a warmwater creek

Channel condition scores were high (≥ 6) throughout upstream and middle portions of Cayuga Creek (Reaches 1-35), indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (27 of 35 reaches) or a channel with significant recovery from channelization (8 of 35 reaches). However, channel condition scores dropped in the downstream portion of the creek between Porter Rd. and Niagara Falls Boulevard (Reaches 36-56). The creek was straightened throughout that portion and most of the reaches (13 of 21 reaches) had riprap, concrete, or other hard structures present on the streambanks.

Riparian zone scores varied over the length of Cayuga Creek. In the upstream portion of the creek (Reaches 1-8), scores were low (5.6, on average), indicating a riparian zone that extended less than half the bankfull width from the top of the channel. Land use in this area was residential with lawns mowed to the stream edge and commercial (a concrete facility is located at the intersection of Walmore Rd. and Cory Dr.). Riparian zone scores were higher (8.2, on average) in the middle portion of the creek (Reaches 9-35) as the stream meandered through agricultural fields. Eighty-nine percent of the reaches in this section (24 of 27 reaches) had scores ≥ 7 , indicating a riparian zone that extended one to two bankfull widths from the top of the channel. Scores dropped (5.0, on average) in the downstream end of the creek (Reaches 36-56) where the stream once again flowed through residential and commercial land use areas.

Purple loosestrife was observed in 39% of the reaches (22 reaches), most of which were in the upper and middle portions of the creek (Reaches 1-35) Phragmites was observed in 9% of the reaches (Reaches 4, 8, 32-34) and Japanese knotweed was found in one reach (Reach 35).

Seventy-nine percent of reaches (44 reaches) had average bank condition scores indicating moderately stable to stable banks protected by roots, natural vegetation, wood, and natural rock or banks with a limited number of bank protection structures. While most (64%, or 36 reaches) of the streambanks were natural (i.e., no hard structures) on both banks, hard structures were observed on one or both sides of the channel in reaches throughout the length of the creek. Hard structures were observed on one or both banks in 23% of the reaches (8 of 35 reaches) in the upper and middle portions of the creek (Reaches 1-35) versus on 57% of the reaches (12 of 21) in the lower portion of the creek (Reaches 36-56).

Water appearance scores varied over the length of the creek and most low scores (3-4) were associated with reaches that had silt and clay (and some gravel and cobble) bed substrate. Scores were generally higher (7-9) in reaches with coarser bed substrate, including gravel, cobble, and boulders.

Nutrient enrichment scores generally were high (8-9) as evidenced by little algal growth and low quantities of aquatic plants. Twenty-five percent of the reaches (14 reaches) were free of algal growth and aquatic plant beds. The remaining 42 reaches either had algae, aquatic plant beds, or both. Most of those reaches (90%, or 38 of 42 reaches) had moderate (6-8) to high (9) scores, indicating moderate to little algal and aquatic plant growth. Eighty-three percent (35 reaches) of the reaches with algae, aquatic plant beds, or both were in the upstream and middle portions of the creek. Moreover, there were four reaches with a score of 5, indicating abundant algal and/or aquatic plant growth, that were in the upstream residential portion of the creek (Reach 5) and the middle agricultural portion (Reaches 14, 23, 24) in areas with breaks in the riparian corridor.

Instream fish cover scores varied throughout the assessed portion of Cayuga Creek. Over half the reaches (52% or 29 reaches) scored a 5 or 6, indicating four to five cover types available. Twelve reaches had six or more cover types available. Instream fish cover scores generally were higher in the upstream and middle portions of the creek (Reaches 1-35) versus the downstream section (Reaches 36-56).

Fifty-seven percent of the reaches (32 reaches) had pool scores between 3 and 5 indicating that pools were present, but shallow (i.e., less than 1.5 times deeper than the prevailing depth). Pools were absent in 13% of the reaches (seven reaches).

The upstream and middle portions of Cayuga Creek (Reaches 1-35) are classified as a coldwater creek; Reaches 36-56 are classified as a warmwater creek. In the upstream coldwater section, 92% of the reaches (33 of 36 reaches) had high (≥ 9) canopy cover scores indicating that ≥ 75 to 50% of the water surface was shaded within the length of the reach. Seventy-one percent of the reaches (15 of 21 reaches) in the downstream warmwater section had high (≥ 9) scores indicating that 50 to 75% of the water surface was shaded within the length of the reach.

Litter was evident in 75% of the reaches (42 reaches) and abundant in eight reaches, most of which were located in the downstream portion of the creek (Reaches 37-39, 43-45, 52).

EAV was present in 59% of the reaches (33 reaches) and SAV was present in 80% of the reaches assessed (45 reaches).

Opportunities:

- Riparian zone and habitat conservation in Reaches 1 through 35. Habitat conservation would preserve abundant instream habitat and some habitat with coarse bed substrate.
- Riparian zone improvements (e.g., planting to increase width) in the Walmore Rd. and Cory Dr. section (Reaches 1-8), the Walmore to Lockport section (Reaches 9-25), and the Porter Rd. to Trailer Park and Trailer Park to Niagara Falls Blvd. sections (Reaches 36-56). These improvements would likely improve water quality conditions and, thereby, increase nutrient enrichment scores. Moreover, minimal efforts would enhance a portion of the creek with existing habitat.
- Invasive species (purple loosestrife, Japanese knotweed, Phragmites) removal in the upper and middle portions of the assessed creek (Reaches 1-35).
- Environmental education/outreach and Shoreline Sweep opportunities in the same sections (i.e., Reaches 1-8 and 36-56) (problems: trash/debris, mowing to streambanks,).
- Channel and bank condition improvements (e.g., channel realignment, addition of instream habitat structure) in the section of stream that flows through and downstream of the Cayuga Village Trailer Park (Reaches 32-56).

3.4 Bergholtz Creek and Tributary

The total number of reaches assessed in Bergholtz Creek was 41 and the average overall SVAP score was 6.2 (Fair) (range 5.1-8.1) (Figure 6). Bed substrate in Bergholtz Creek was silt and clay (49% of reaches) and silt and clay, plus gravel and/or cobble (41% of reaches). The physical channel conditions are summarized in Table 8 and Table 9 contains a summary of conditions for each SVAP element.

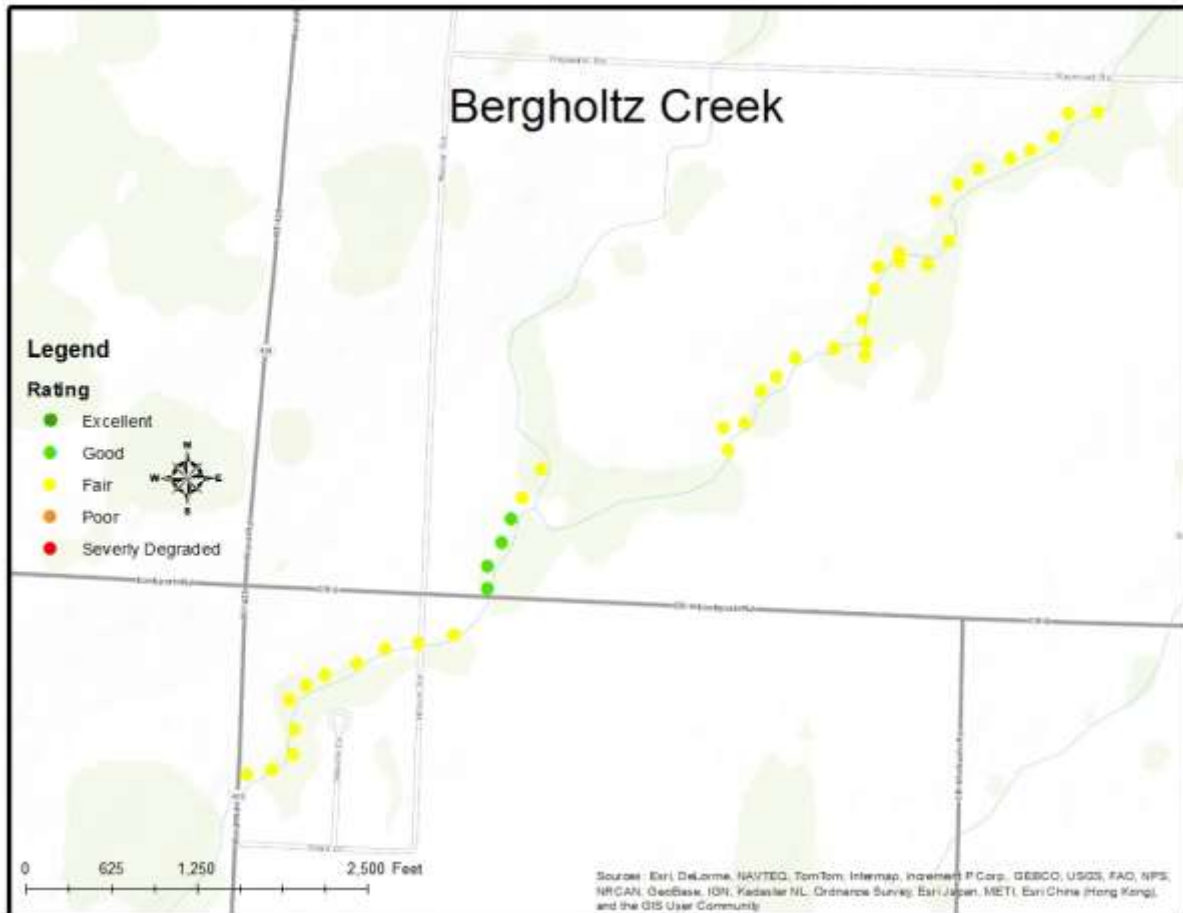


Figure 6 Bergholtz Creek overall SVAP ratings for each reach.

Table 8 Bergholtz Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Bergholtz (and tributary)	2.89 (1.50-4.25)	17.57 (5.0-25.0)	0.93 (0.25-2.50)	11.56 (2.0-16.5)

Table 9 Bergholtz Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	4.0-9.0	8.7	9.0	Natural channel with incision noted in Reaches 17 and 18
Riparian Zone (average)	1.0-9.0	7.6	9.0	Common introduced species include reed canary grass, curly pond weed, and garlic mustard
Bank Condition (average)	4.5-9.0	7.0	7.0	Hard structures observed in one reach (Reach 35)
Water Appearance	3.0-4.0	3.8	4.0	Water is turbid most of the time, likely do to silt/clay bed substrate
Nutrient Enrichment	9.0-9.0	9.0	9.0	Clear water along entire reach
Instream Fish Cover	1.0-8.0	3.9	4.0	Common cover types include LWD, overhanging vegetation, boulders/cobbles, dense macrophyte beds
Pools	2.0-7.0	3.5	2.0	Pools present, but shallow
Canopy Cover	2.0-10.0	6.1	4.0	Coldwater creek

Channel condition scores were high (8-9) throughout the assessed portion of Bergholtz Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation.

Over half of the reaches (63% or 27 reaches) had average riparian zone scores ≥ 8.5 , indicating a riparian zone that extended at least two bankfull widths from the top of the channel. Scores were lower (at or near 1) in the downstream section of the creek between Lockport Rd. to Ward Rd. (Reaches 31-39), indicating a narrow (i.e., less than a third of the bankfull width) riparian zone.

Purple loosestrife was observed in 27% of the reaches (11 reaches), most of which were at road intersections (near Raymond Rd., Reaches 1-6; near Lockport Rd., Reaches 29-32 and 37).

Eighty-five percent of reaches (35 reaches) had average bank condition scores indicating moderately stable to stable banks protected by roots, natural vegetation, wood, and natural rock. Bank condition scores were low (3-5), indicating moderately unstable banks, in the section of Bergholtz Creek between Lockport Rd. to Ward Rd. (Reaches 33-39).

Water appearance scores were low (3-4) indicating that the creek is turbid most of the time. This is likely due to the silt and clay bed substrate found throughout the assessed portion of the creek.

Nutrient enrichment scores generally were high (≥ 9) as evidenced by little algal growth and low quantities of aquatic plants. Sixty-one percent of reaches (25 reaches) were free of algal growth and aquatic plant beds. Twenty-nine percent of the reaches (12 reaches) had aquatic plant beds, 2% (one reach) had algal growth present, and 7% (three reaches) had both dense aquatic plant beds and algal growth.

Instream fish cover scores varied throughout the assessed portion of Bergholtz Creek. Over half the reaches (56% or 23 reaches) scored a 3 or 4, indicating two to three cover types available. Only six reaches (14%) had none to one cover types available (Reaches 6, 10-12, 15, 22).

Fifty-one percent of the reaches (21 reaches) had pool scores between 3 and 5 indicating that pools were present, but shallow (i.e., less than 1.5 times deeper than the prevailing depth). Pools were absent in 37% of the reaches (15 reaches).

Bergholtz Creek is a coldwater creek and 59% of reaches (24 reaches) had canopy cover scores indicating that ≥ 75 to 50% of the water surface was shaded within the length of the reach. One reach (Reach 24) had a score indicating less than 20% of the water surface was shaded within the length of the reach.

Litter was evident in 70% of the reaches (29 reaches) and abundant in one reach (Reach 35). While litter was fairly common throughout the entire portion of creek assessed, it was present in all reaches between Lockport Rd. and Ward Rd. (Reaches 29-39).

EAV was present in 80% of the reaches (33 reaches) and SAV was present in 93% of the reaches assessed (38 reaches).

Opportunities:

- Riparian zone and habitat conservation in Reaches 1 through 28. Conservation would preserve existing instream habitat, including some areas with coarse substrate (i.e., gravel, cobble).
- Riparian zone improvements (e.g., planting to increase width) in the section between Lockport Rd. and Ward Rd. (Reaches 29-39).
- Bank condition improvement/stabilization in the section between Lockport Rd. to Ward Rd. (Reaches 33-39). Note: increasing the riparian zone in this section may be all that is necessary to provide increased bank stability to the moderately unstable reaches in this section.
- Environmental education/outreach in the sections between Raymond Rd. and Lockport Rd. (Reaches 1-24) and Lockport Rd. to Ward Rd. (Reaches 29-39) (problems: upstream—agricultural fields adjacent to streamsides, some stream crossings; downstream—mowing to streamsides in residential areas).
- Shoreline Sweep opportunities between Lockport Rd. and Ward Rd. (Reaches 29-39).
- Consider removal of debris jam in Reach 9 in the Raymond Rd. to Lockport Rd. section.

3.5 Bull Creek

The total number of reaches assessed in Bull Creek was 30 and the average overall SVAP score was 6.0 (Fair) (range 4.8-7.1) (Figure 7). The dominant bed substrate in Bull Creek was silt and clay (77% of reaches). The physical channel conditions are summarized in Table 10 and Table 11 contains a summary of conditions for each SVAP element.

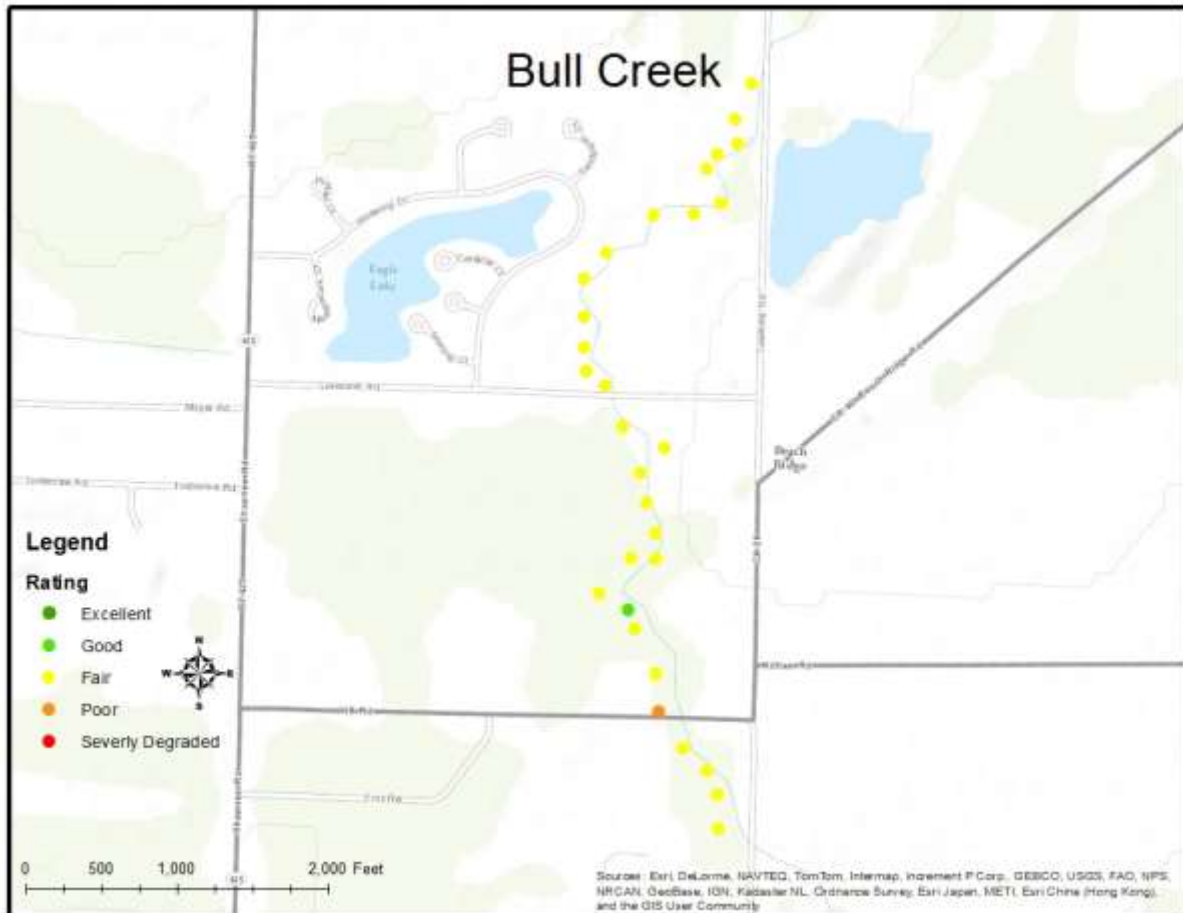


Figure 7 Bull Creek overall SVAP ratings for each reach.

Table 10 Bull Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Bull	3.21 (1.5-5.25)	21.64 (11.5-37.5)	1.46 (0.75-2.25)	15.29 (6.0-31.0)

Table 11 Bull Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	8.0-9.0	8.9	9.0	Natural channel
Riparian Zone (average)	1.0-9.0	7.5	9.0	Common introduced species include reed canary grass and honeysuckle
Bank Condition (average)	5.0-9.0	8.4	9.0	Hard structures observed in downstream reaches (Reaches 24, 25, 27)
Water Appearance	1.0-2.0	1.1	1.0	Water is very turbid, likely do to silt/clay bed substrate
Nutrient Enrichment	8.0-9.0	8.9	9.0	Clear water along entire reach
Instream Fish Cover	1.0-8.0	4.0	3.0	Common cover types include LWD, overhanging vegetation, undercut banks
Pools	1.0-8.0	2.5	2.0	Pools mostly absent, but some slow water habitat available
Canopy Cover	3.0-10.0	6.8	9.0	Warmwater creek

Channel condition scores were high (8-9) throughout the assessed portion of Bull Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation.

Over half of the reaches (60% or 18 reaches) had average riparian zone scores ≥ 8.5 , indicating a riparian zone that extended at least two bankfull widths from the top of the channel. Scores were lower (1.0-5.5) in the downstream section of the creek between Loveland Rd. to Townline Rd. (Reaches 25-30), indicating a narrow (i.e., half a bankfull channel width or less) riparian zone.

Purple loosestrife was observed in 80% of the reaches (24 reaches).

Ninety-seven percent of reaches (29 reaches) had average bank condition scores indicating moderately stable to stable banks protected by roots, natural vegetation, wood, and natural rock. Reach 26 had a bank condition score of 5 indicating moderately unstable banks. Limited riprap was noted on at least one bank in three reaches (Reaches 24, 25, 27).

Water appearance scores were very low (1-2) in all assessed reaches. As noted previously, the dominant bed substrate in Bull Creek is silt and clay and field notes indicated mucky bottom material on several occasions.

Nutrient enrichment scores generally were high (8-9) as evidenced by little algal growth and low quantities of aquatic plants. Eighty percent of reaches (24 reaches) were free of algal growth and aquatic plant beds. Seventeen percent of the reaches (five reaches) had algal growth present and one reach had aquatic plant beds.

Instream fish cover scores varied throughout the assessed portion of Bull Creek. Over half the reaches (70% or 21 reaches) scored a 3 or 4, indicating two to three cover types available.

Seventy percent of the reaches (21 reaches) had pool scores between 1 and 2 indicating that pools were absent, but some slow water habitat was available.

Bull Creek is classified as a warmwater creek and 50% of the reaches (15 reaches) had high scores (9-10) indicating that 50% to 75% of the water surface was shaded.

Litter was evident in 17 reaches (57%). Litter was more evident in the reaches between Townline and Loveland Rds. (Reaches 1-14).

EAV was present in 53% of the reaches (16 reaches) and SAV was present in 33% of the reaches assessed (10 reaches).

Opportunities:

- Riparian zone conservation throughout the assessed creek.
- Invasive species (purple loosestrife) removal throughout the assessed creek.
- Riparian zone improvements (e.g., planting to increase width) in the downstream end of the section between Loveland Rd. and Townline Rd. (Reaches 24-26).
- Shoreline Sweep opportunities between Townline Rd. and Loveland Rd. (Reaches 25-30).
- Consider removal of debris jam in Reach 10 in the Townline Rd. to Loveland Rd. section.

3.6 Ellicott Creek and Tonawanda Creek

Two reaches were assessed on both Ellicott Creek and Tonawanda Creek. The average overall SVAP score for Ellicott Creek was 3.1 (Poor) and the average overall SVAP score for Tonawanda Creek was 3.3 (Poor) (Figure 8). The dominant bed substrate in both creeks is silt and clay. The physical channel conditions are summarized in Table 12 and Table 13 contains a summary of conditions for each SVAP element.

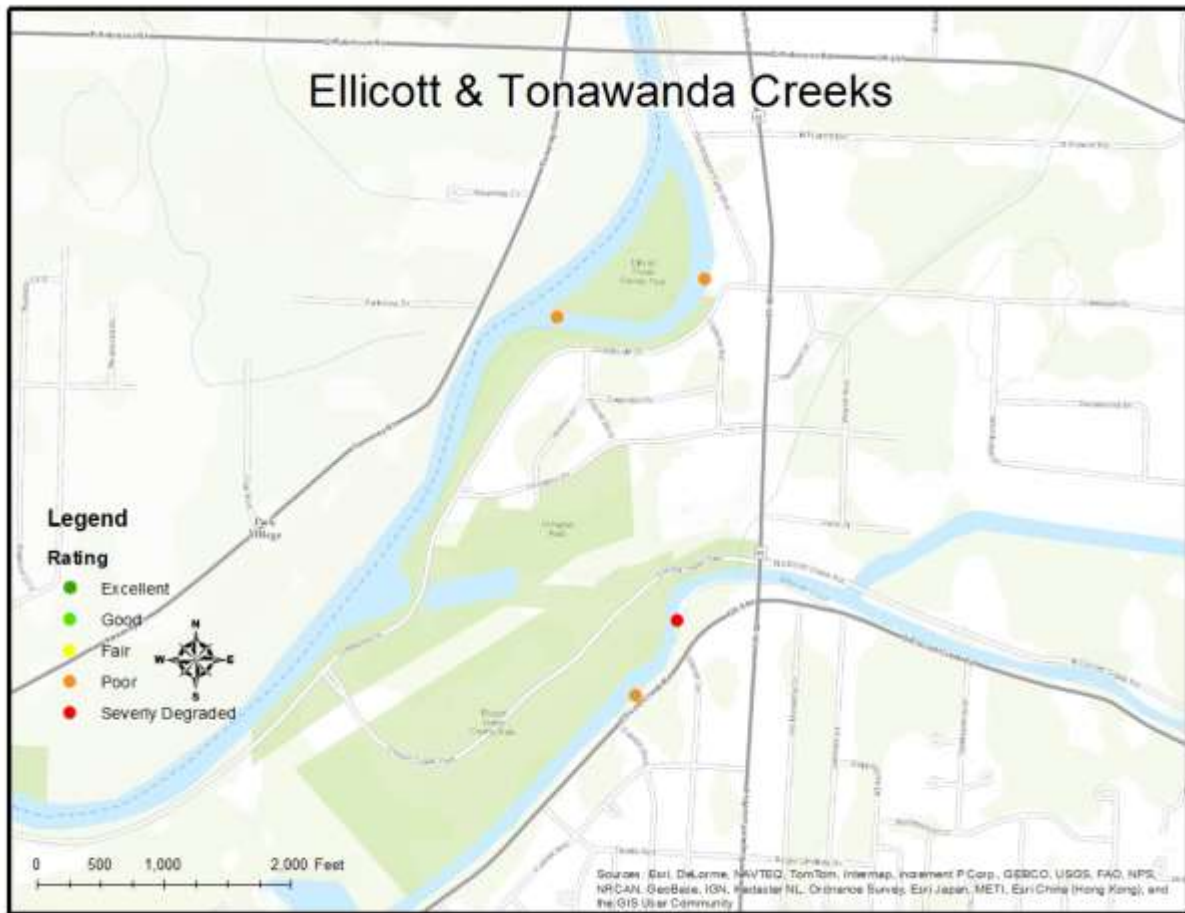


Figure 8 Ellicott and Tonawanda Creeks overall SVAP ratings for each reach.

Table 12 Ellicott and Tonawanda Creeks Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Ellicott	6.0	88.0	Not estimated	81.50
Tonawanda	10.0	164.0	Not estimated	152.0 (140.0-164.0)

Table 13 Ellicott and Tonawanda Creeks SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	2.0-2.0	2.0	2.0	Straightened channel with hard structures
Riparian Zone (average)	1.5-1.5	1.5	1.5	Common introduced species include reed canary grass
Bank Condition (average)	1.5-3.0	2.5	3.0	Hard structures observed in all reaches
Water Appearance	3.0-4.0	3.5	3.0	Water is turbid most of the time, likely do to silt/clay bed substrate
Nutrient Enrichment	8.0-9.0	8.5	9.0	Clear water along entire reach
Instream Fish Cover	1.0-3.0	2.0	1.0	Common cover types include overhanging vegetation
Pools				Not assessed due to depth
Canopy Cover	2.0-3.0	2.3	2.0	Coldwater creeks

Channel condition scores were low (2) in both reaches on both creeks because the creeks are channelized (straightened with riprap).

Riparian zone scores also were low (1.5) in both reaches on both creeks, indicating a riparian zone that was less than a third of the bankfull channel width.

Purple loosestrife and Phragmites were present in all four reaches. No water chestnut plants were observed; however, seeds were found in both reaches on Tonawanda Creek in Ellicott Island Park.

Bank condition scores were low (1.5-3.0) in all reaches, as riprap and other structures dominated the banks.

Water appearance scores were low (3-4) in all reaches, indicating that water was turbid most of the time.

Nutrient enrichment scores were high (8-9) in all four reaches as evidenced by little algal growth and low quantities of aquatic plants. One reach (Reach 2 on Ellicott Creek) had some algal growth and the other three reaches (Reach 1 on Ellicott Creek and Reaches 1 and 2 on Tonawanda Creek) had both algal growth and aquatic plant beds.

Instream fish cover scores ranged between one and three, indicating the presence of none to two cover types available. Overhanging vegetation was noted in all four reaches. Undercut banks and LWD were also noted in Reach 2 on Ellicott Creek and Reach 2 on Tonawanda Creek, respectively.

The pool element was not scored because of depth.

Both creeks are classified as coldwater creeks and canopy cover scores were low (2-3), indicating that near 20% of the water surface was shaded.

Litter was evident in Reach 1 on Ellicott Creek and Reach 1 on Tonawanda Creek.

EAV was present in three of the four reaches and SAV was present in all four reaches.

Opportunities:

- Invasive species (purple loosestrife and Phragmites) removal.
- Riparian zone improvements (e.g., planting to increase width).
- Shoreline Sweep opportunities.

3.7 Two Mile Creek and Tributary

The total number of reaches assessed in Two Mile Creek was 19 and the average overall SVAP score was 6.9 (Fair) (range 5.4-8.4) (Figure 9). Bed substrate in Two Mile Creek was mix of primarily sand and gravel (11 of 19 reaches) with some smaller sediment (clay/silt) and larger sediment (cobble). The physical channel conditions are summarized in Table 14 and Table 15 contains a summary of conditions for each SVAP element.



Figure 9 Two Mile Creek (and tributary) overall SVAP ratings for each reach.

Table 14 Two Mile Creek (and tributary) Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft)	Width Average (Range) (ft)	Depth Average (Range) (ft)	Width Average (Range) (ft)
Two Mile (and tributary)	3.58 (2.5-5.0)	29.05 (8.0-42.0)	1.37 (0.5-3.0)	23.71 (3.0-40.0)

Table 15 Two Mile Creek (and tributary) SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	2.0-9.0	7.1	8.0	Mostly natural channel with incision in upstream reaches (Reaches 1-5)
Riparian Zone (average)	5.0-9.0	8.2	9.0	Common introduced species include reed canary grass and garlic mustard
Bank Condition (average)	2.0-9.0	7.3	8.0	Moderately unstable to unstable reaches in upstream reaches (Reaches 2-5)
Water Appearance	4.0-9.0	7.3	9.0	Water is slightly turbid; scores relatively high compared to the other assessed streams
Nutrient Enrichment	8.0-9.0	8.8	9.0	Clear water along entire reach
Instream Fish Cover	3.0-8.0	5.4	6.0	Common cover types include LWD, deep pools, overhanging vegetation, riffles, undercut banks
Pools	5.0-10.0	6.8	6.0	Deep pools separated by riffles
Canopy Cover	2.0-8.0	4.2	4.0	Coldwater creek

Channel condition scores were high (≥ 6) throughout most of Two Mile Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (five of 19 reaches) or a channel with significant recovery from channelization (10 of 19 reaches). However, channel condition scores were lower in the upstream portion of the assessed stream along Two Mile Creek Rd. (Reaches 1-5) where channel incision was noted.

Over half of the reaches (63% or 12 reaches) had average riparian zone scores ≥ 8.5 , indicating a riparian zone that extended at least two bankfull widths from the top of the channel. Reach 5 had a low riparian zone score (5), indicating vegetation extending half of the bankfull channel width from the top of the bankfull channel.

Phragmites was observed in thirteen reaches (68% of reaches) throughout the assessed portion of Two Mile Creek. Japanese knotweed was observed in three reaches (Reaches 6, 7, 16) and purple loosestrife was observed in one reach (Reach 15).

Average bank condition scores were low (2.0-5.5), indicating moderately unstable to unstable banks, in the upstream portion of the assessed creek where channel incision was noted (Reaches 2-5). Average bank condition scores in the other 15 reaches indicated moderately stable to stable reaches. Limited riprap was noted on at least one bank in two reaches (Reaches 6 and 7).

Water appearance scores were relatively high (≥ 6) in the majority (89%) of assessed reaches, indicating slightly turbid water.

Nutrient enrichment scores generally were high (8-9) as evidenced by little algal growth and low quantities of aquatic plants. Fifty-eight percent of reaches (11 reaches) had algal growth present and one reach had both algal growth and aquatic plant beds.

Sixty-eight percent of the reaches (13 reaches) had an instream fish cover score ≥ 5 , indicating four or more cover types available in each reach.

Seventy-four percent of the reaches (14 reaches) had pool scores ≥ 6 , indicating that each of those reaches had at least one to two deep pools separated by riffles.

Two Mile Creek is classified as a coldwater creek and seventy-four percent of the reaches (14 reaches) had low (≥ 5) canopy cover scores, indicating that 49% or less the water surface was shaded.

Litter was evident in all reaches.

EAV was present in 53% of the reaches (10 reaches) and SAV was present in 21% of the reaches assessed (4 reaches).

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek. Habitat conservation would preserve abundant instream habitat, including deep pools, and habitat with coarse bed substrate.
- Invasive species (Phragmites, Japanese knotweed, and purple loosestrife) removal throughout the assessed portion of the creek.
- Bank and channel condition improvement/stabilization in the upstream stream section along Two Mile Creek Rd. (Reaches 1-5) to address channel incision and unstable bank conditions.
- Riparian zone improvements (e.g., planting to increase width) in the upstream end of the section between Fletcher St. and River Rd. (Reaches 9-11).
- Shoreline Sweep opportunities throughout the assessed stream.

3.8 Woods Creek and Tributaries

The total number of reaches assessed in Woods Creek was 32 and the average overall SVAP score was 6.7 (Fair) (range 4.8-8.1) (Figure 10). Dominant bed substrate in Woods Creek was silt/clay (66% of reaches) with some coarser substrate (e.g., gravel, cobble) found in the remaining 11 reaches. The physical channel conditions are summarized in Table 16 and Table 17 contains a summary of conditions for each SVAP element.



Figure 10 Woods Creek (and tributaries) overall SVAP ratings for each reach.

Table 16 Woods Creek (and tributaries) Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Average (Range) (ft.)	Width Average (Range) (ft.)	Depth Average (Range) (ft.)	Width Average (Range) (ft.)
Woods Creek (and tributaries)	2.61 (1.0-4.25)	15.66 (8.0-27.0)	1.27 (0.25-3.0)	3.37 (3.0-25.0)

Table 17 Woods Creek (and tributaries) SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	8.0-10.0	9.0	9.0	Natural channel with minimal incision noted in seven reaches
Riparian Zone (average)	1.0-10.0	7.8	10.0	Common introduced species include garlic mustard and honeysuckle
Bank Condition (average)	6.0-10.0	8.6	9.0	Natural banks present throughout assessed reaches
Water Appearance	1.0-9.0	5.0	7.0	Water is slightly turbid
Nutrient Enrichment	2.0-9.0	8.1	9.0	Clear water along entire reach, except in 12 reaches with dense aquatic plant beds
Instream Fish Cover	1.0-7.0	4.1	4.0	Common cover types include overhanging vegetation, dense macrophyte beds, undercut banks, LWD, and cobble.
Pools	1.0-10.0	3.4	2.0	Pools mostly absent, but some slow water habitat available
Canopy Cover	1.0-10.0	7.9	10.0	Warmwater creek

Channel condition scores were high (8-10) throughout most of Woods Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (28 of 32 reaches) or a channel with significant recovery from channelization (three of 32 reaches). However, minimal channel incision was noted in seven reaches, six of which were located between Autumnwood Dr. and Baseline Rd. (Reaches 10-15) and one was located between Queens Dr. to Fieldstone Dr. (Reach 3). Riprap or other hard structures were not observed in any reaches.

Fifty-three percent of the reaches (17 reaches) had high (≥ 8.5) riparian zone scores, indicating the presence of a riparian zone that extended at least two bankfull widths from the top of the bankfull channel and five reaches (16%) had a riparian zone that extended at least one full bankfull channel width from the top of the bankfull channel (scores 7-8). However, four reaches (13%) had low (≤ 4) scores, indicating a riparian zone that extended a third of the bankfull width or less from the top of the bankfull channel.

Purple loosestrife was observed in sixteen reaches (50% of reaches), most of which (12 reaches) were located in the Bedell Rd. to Veterans Park section.

All but one reach had high (≥ 6) average bank condition scores, indicating stable to moderately stable banks that were protected by roots, natural vegetation, wood, and naturally occurring rock. Reach 3 scored a 5, indicating moderately unstable banks.

Sixty-nine percent of the assessed reaches (22 reaches) had water appearance scores indicating water that was slightly turbid (scores 5-7). All of the reaches between Autumnwood Dr. and Baseline Rd. (Reaches 8-16) had low (1) water appearance scores, indicating water that is very turbid or has a muddy appearance most of the time.

Nutrient enrichment scores were high (8-9) in 88% of the reaches (28 reaches) as evidenced by little algal growth and low quantities of aquatic plants. However, twelve reaches (38%) had aquatic plant beds present and four reaches (13%) had both algal growth and aquatic plant beds and there clearly was an overabundance of lush green aquatic plants and some greenish water within the slow water sections of these reaches.

Instream fish cover scores varied throughout the assessed portion of Woods Creek. Over half the reaches (53%, or 17 reaches) scored a 3 or 4, indicating two to three cover types available.

Fifty-three percent of the reaches (17 reaches) had pool scores between 1 and 2 indicating that pools were absent, but some slow water habitat was available. However, 31% of the reaches (19 reaches) had score ≥ 5 , indicating that four or more cover types were available.

Woods Creek is a warmwater creek and 72% of the reaches (23 reaches) had canopy cover scores indicating that 50-75% of the water surface is shaded within the length of the reach. Twenty-two percent of the reaches (seven reaches) scored from 3-5, indicating the presence of an overhead canopy that covers 49-20% of the reach surface.

Litter was evident within 69% of the reaches (22 reaches) but there were no observed instances of abundant trash.

EAV was present in 84% of the reaches (27 reaches) and SAV was present in 66% of the reaches (21 reaches).

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek. Habitat conservation would preserve existing instream habitat, especially in the natural areas of Veterans Park.
- Invasive species (purple loosestrife) removal, especially in the Bedell Rd. to Veterans Park section of the creek.
- Riparian zone improvements (e.g., planting to increase width) in the upstream end of the section between Fletcher St. and River Rd. (Reaches 9-11).

3.9 Gun Creek

The total number of reaches assessed in Gun Creek was 32 and the average overall SVAP score was 6.6 (Fair) (range 5.0-8.3) (Figure 11). Dominant bed substrate in Gun Creek was silt/clay (88% of reaches) with some coarser substrate (e.g., gravel) found in the remaining four reaches. The physical channel conditions are summarized in Table 18 and Table 19 contains a summary of conditions for each SVAP element.

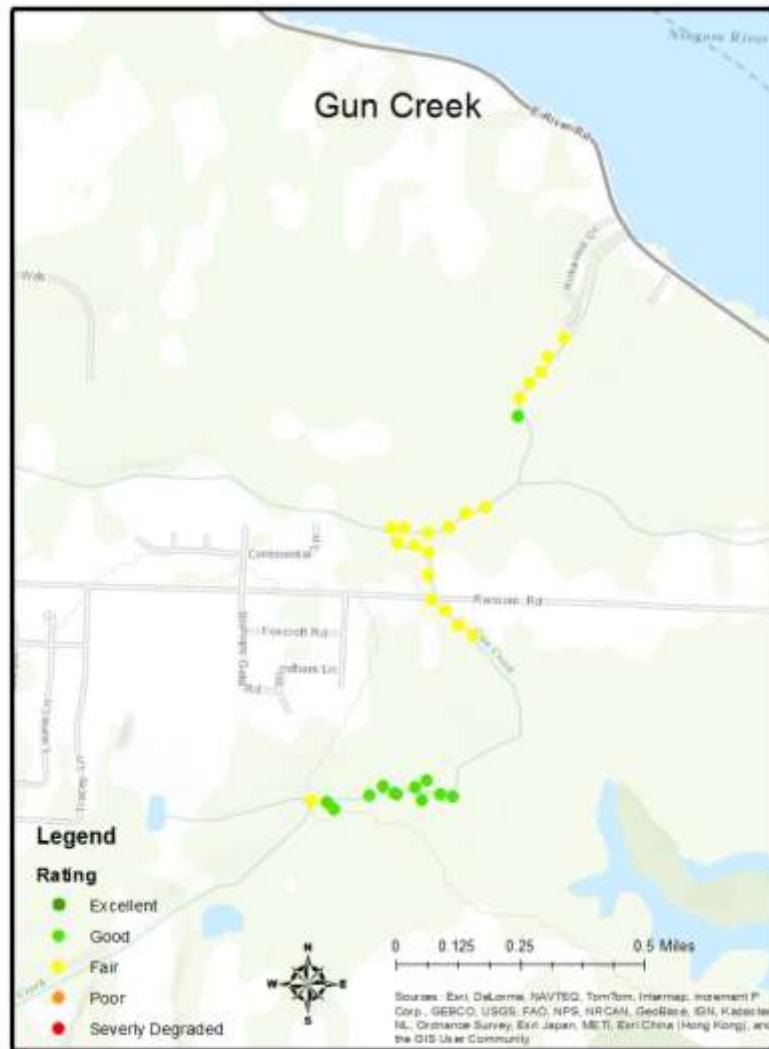


Figure 11 Gun Creek overall SVAP ratings for each reach.

Table 18 Gun Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Avg. (Range) (ft.)	Width Average (Range) (ft.)	Depth Average (Range) (ft.)	Width Average (Range) (ft.)
Gun Creek	2.76 (0.5-6.5)	26.22 (5.0-75.0)	1.01 (0.1-2.75)	17.00 (1.0-50.0)

Table 19 Gun Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	4.0-9.0	7.6	8.0	Mostly natural channel with minimal incision present in Reaches 24-26 and aggradation in Reaches 20-22 and 24
Riparian Zone (average)	6.0-10.0	9.6	10.0	Common introduced species include garlic mustard, honeysuckle, and multiflora rose
Bank Condition (average)	4.5-9.0	7.6	9.0	Moderately stable to stable banks throughout assessed stream
Water Appearance	3.0-9.0	6.1	9.0	Water is clear or turbid most of the time
Nutrient Enrichment	3.0-9.0	6.9	9.0	Dense aquatic plants present in 47% of reaches (15 reaches)
Instream Fish Cover	1.0-6.0	3.7	4.0	Common cover types include LWD, undercut banks, dense macrophyte beds, and isolated/backwater pools
Pools	0.0-8.0	3.2	1.0	Pools present but shallow
Canopy Cover	3.0-10.0	7.9	9.0	Warmwater creek

Channel condition scores were high (≥ 6) throughout most of Gun Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (10 of 32 reaches) or a channel with significant recovery from channelization (17 of 32 reaches). However, minimal channel incision was noted in three reaches (Reaches 24-26) and minimal aggradation was noted in four reaches (Reaches 20-22 and 24), all of which were in the Ransom Rd. to Kirkwood Dr. stream section. Riprap or other hard structures were not observed in any reaches.

Average riparian zone scores were high (9.5, on average) with 84% of the reaches (27 reaches) having a riparian zone that extended at least two bankfull widths from the top of the bankfull channel and 13% of the reaches (four reaches) had a riparian zone that extended at least one bankfull width from the top of the channel. Only Reach 25 showed evidence of a riparian zone with vegetation that extended only half of the bankfull channel width.

Purple loosestrife was observed in 31% of the assessed reaches (10 reaches). Phragmites was observed in one reach (Reach 17). Most (70%) of the purple loosestrife and the Phragmites was observed immediately upstream (Reaches 13-16) and downstream (Reaches 17-19) of Ransom Rd.

Over three quarters of the assessed reaches (88% or 28 reaches) had average bank condition scores indicating stable to moderately stable banks that were protected by roots, natural vegetation, wood, and naturally occurring rock.

Water appearance scores were relatively high (7.6, on average), indicating clear to slightly turbid water, in the upstream portion of the assessed stream (Reaches 1-16). Scores decreased (4.5, on average) in the downstream section between Ransom Rd. and Kirkwood Dr. (Reaches 17-32), indicating that the water was turbid most of the time.

Nutrient enrichment scores were generally high (6.9, on average) with 63% of the reaches (20 reaches) having clear to fairly clear water with little algal growth present and/or a diverse aquatic plant community. The remaining 12 reaches scored in the 3-5 range due to the presence of an overabundance of lush green aquatic plants that at times clogged the stream reaches.

The majority of reaches (69%, or 22 reaches) had instream fish cover scores in the 3-5 range, indicating two to three cover types available.

Forty-four percent of the reaches (14 reaches) had pool scores between 0 and 3, indicating that pools were absent, but some slow water habitat was available. Scores were slightly higher, on average, in the upstream section of the assessed stream (Reaches 1-16; average score 4.0, pools present, but shallow) versus the downstream section of the stream (Reaches 17-32; average score 2.3).

Gun Creek is a warmwater creek and 75% of the reaches (24 reaches) had canopy cover scores indicating that 50 to 75% of the water surface is shaded within the length of the reach. The remaining 25% of the reaches scored from 3 to 5, indicating a canopy covering 49 to 20% of the reach surface.

Litter was evident within 44% of the reaches (14 reaches) but there were no observed instances of abundant trash.

EAV was present in 88% of the reaches (28 reaches) and SAV was present in 56% of the reaches (18 reaches).

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek. Habitat conservation would preserve existing instream habitat, especially in the natural areas.
- Invasive species (purple loosestrife, Phragmites) removal, especially up- and downstream of Ransom Rd.
- Environmental education/outreach throughout the assessed stream to address bank stability and riparian zone issues (e.g., mowing to streamsides in residential areas and limited litter issues).

3.10 Big Six Mile Creek and Tributary

The total number of reaches assessed in Big Six Mile Creek was 13 and the average overall SVAP score was 6.0 (Fair) (range 4.5-6.9) (Figure 12). Dominant bed substrate in Woods Creek was silt/clay (100% of reaches). The physical channel conditions are summarized in Table 20 and Table 21 contains a summary of conditions for each SVAP element.

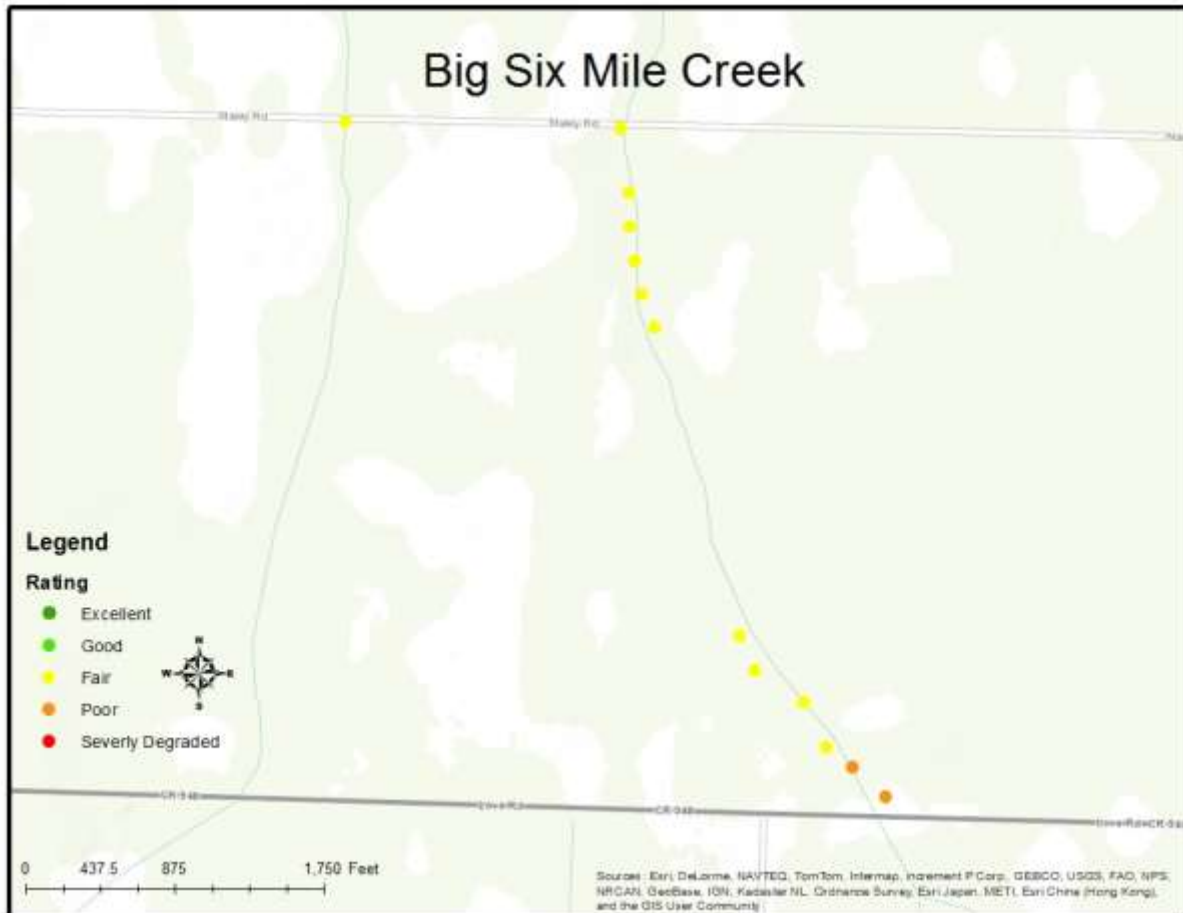


Figure 12 Big Six Mile Creek (and tributary) overall SVAP ratings for each reach.

Table 20 Big Six Mile Creek (and tributary) Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Avg. (Range) (ft.)	Width Average (Range) (ft.)	Depth Average (Range) (ft.)	Width Average (Range) (ft.)
Big Six Mile (and tributary)	2.02 (0.50-2.50)	12.73 (1.5-18.0)	0.74 (0.16-1.25)	5.52 (1.0-12.0)

Table 21 Big Six Mile Creek (and tributary) SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	9.0-9.0	9.0	9.0	Natural channel
Riparian Zone (average)	1.0-10.0	8.4	10.0	Common introduced species: honeysuckle in one reach (Reach 2)
Bank Condition (average)	8.0-9.0	8.9	9.0	Moderately stable to stable banks with no hard structures observed
Water Appearance	3.0-4.0	3.5	4.0	Water turbid most of the time
Nutrient Enrichment	2.0-9.0	6.2	8.0	Dense aquatic plants present in 8 of 13 reaches (62%)
Instream Fish Cover	1.0-4.0	3.0	3.0	Common cover types include overhanging vegetation and dense macrophyte beds.
Pools	0.0-6.0	1.5	1.0	Pools absent, but some slow water habitat present
Canopy Cover	1.0-10.0	7.2	9.0	Warmwater creek

Channel condition scores were high (9) throughout the assessed portion of Big Six Mile Creek, indicating the presence of a natural channel with established vegetation and no evidence of incision or aggradation. Riprap or other hard structures were not observed in any reaches.

Average riparian zone scores of 8.5 or above were given on 85% reaches assessed (11 reaches). This indicates a riparian zone that extended at least two bankfull widths from the top of the channel. Moreover, an introduced species was only observed in one reach (Reach 2), otherwise, only native species were observed in all other reaches. Scores were lower (1) at the two most upstream reaches near Love Rd. (Reaches 1 and 2), indicating a narrow (i.e., less than a third of the bankfull width) riparian zone.

Purple loosestrife was observed in two reaches (15% of the reaches) located immediately downstream of Love Rd. (Reaches 1 and 2).

All of the 13 assessed reaches had high average bank condition scores (8-9) indicating stable to moderately stable banks that were protected by roots, natural vegetation, wood, and naturally occurring rock.

Water appearance scores were low (3-4) indicating that the water was turbid most of the time. This is likely due to the silt and clay substrate observed in all of the assessed reaches.

Nutrient enrichment scores were generally high (≥ 6) with 54% of the reaches (seven reaches) having clear to fairly clear water with little algal growth present and a diverse aquatic plant community. The remaining 46% of the reaches (six reaches) also had fairly clear water, but experienced an overabundance of lush green aquatic plants that sometimes clogged the stream.

Instream fish cover scores were low (3-4) throughout the assessed portion of Big Six Mile Creek. Ninety-two percent of the reaches (12 reaches) indicated two to three cover types available, while one reach only contained one cover type (Big Six Mile Creek tributary Reach 1).

Ninety-two percent of the reaches (12 reaches) had pool scores between 0 and 3 indicating that pools were absent or present, but shallow (i.e., less than 1.5 times deeper than the prevailing depth). One reach had a pool score of 6 (Reach 4) due to the presence of one to two pools with greater than 30% of the pool bottom obscured by wood, or other cover.

Big Six Mile Creek is a warmwater creek and fifty-four percent of the reaches (seven reaches) had canopy cover scores indicating that 50 to 75% of the water surface was shaded within the length of the reach. Thirty-one percent of the reaches (four reaches) had canopy cover scores indicating that >75% of the reach's water surface was shaded. Two reaches (Reaches 1 and 2) indicated a canopy cover of <20%.

Litter was evident within 46% of the reaches (six reaches) but there were no observed instances of abundant trash. All six reaches were immediately downstream of Love Rd. (Reaches 1-6).

EAV was present in 100% of the reaches (13 reaches) and SAV was present in 69% of the reaches (nine reaches).

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek. Habitat conservation would preserve existing instream habitat, especially in natural areas.
- Invasive species (purple loosestrife) removal near Love Rd.
- Environmental education/outreach throughout the assessed stream to address minimal riparian zone issues (e.g., mowing to streambanks in residential areas and limited litter issues).

3.11 Spicer Creek

The total number of reaches assessed in Spicer Creek was 23 and the average overall SVAP score was 6.5 (Fair) (range 5.5-7.4) (Figure 13). Bed substrate in Spicer Creek is silt/clay (52% of reaches) or silt/clay with gravel or cobble (48% of reaches). The physical channel conditions are summarized in Table 22 and Table 23 contains a summary of conditions for each SVAP element.

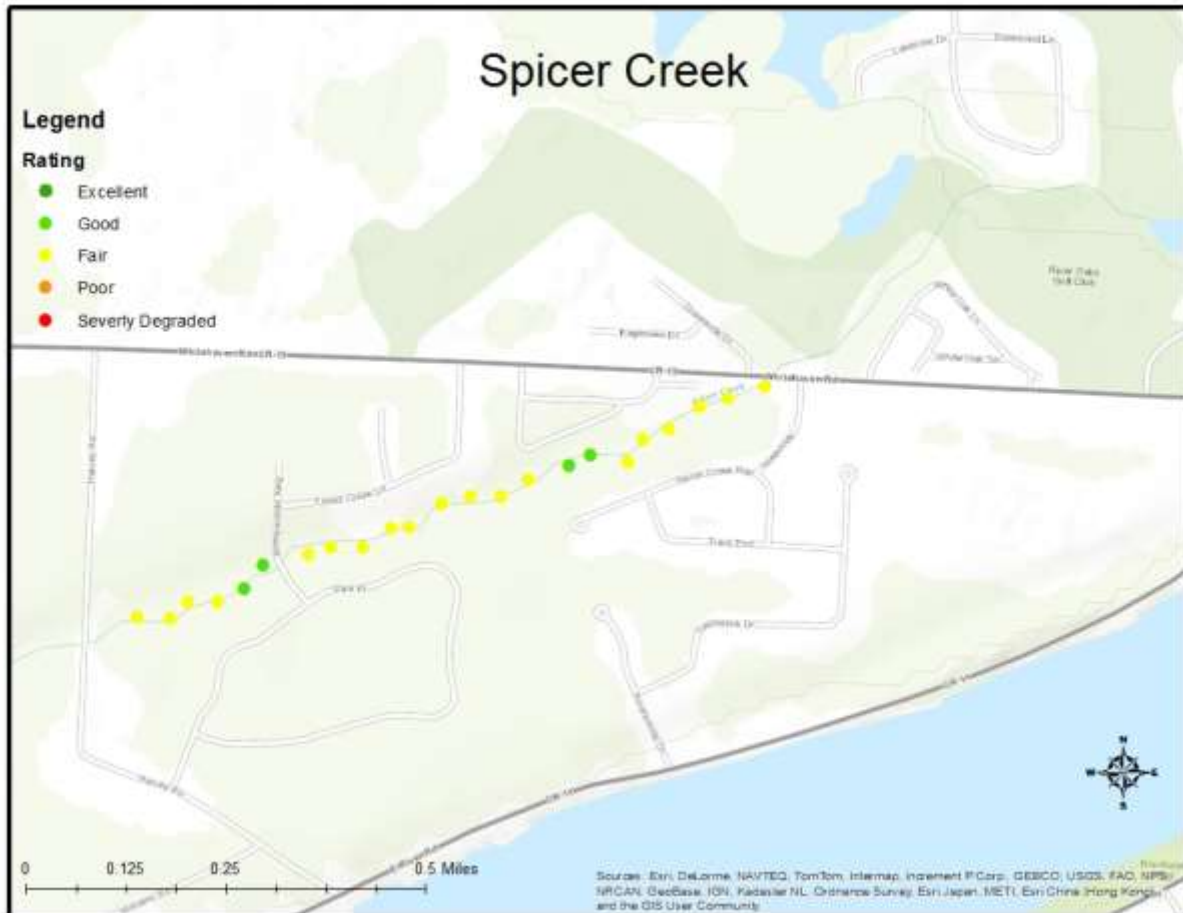


Figure 13 Spicer Creek overall SVAP ratings for each reach.

Table 22 Spicer Creek Physical Channel Conditions

Creek	Bankfull		Lowflow	
	Depth Avg. (Range) (ft.)	Width Average (Range) (ft.)	Depth Average (Range) (ft.)	Width Average (Range) (ft.)
Spicer Creek	3.57 (1.50-4.50)	18.96 (14.0-40.0)	0.68 (0.25-2.0)	10.61 (6.0-12.0)

Table 23 Spicer Creek SVAP Element Summaries

SVAP Element	Range	Average	Mode	Notes
Channel Condition	7.0-9.0	9.0	8.8	Natural channel throughout with minimal incision in Reaches 18 and 19
Riparian Zone (average)	4.5-10.0	7.5	9.0	Common introduced species include garlic mustard, honeysuckle, multiflora rose
Bank Condition (average)	5.0-8.0	6.3	5.0	Recreational use contributes to bank instability
Water Appearance	4.0-7.0	5.3	5.0	Water slightly turbid
Nutrient Enrichment	2.0-9.0	8.2	9.0	Clear water along entire reach, except dense aquatic plants present in 17% of reaches (4 reaches)
Instream Fish Cover	1.0-6.0	3.3	3.0	Common cover types include LWD, overhanging vegetation, undercut banks, boulders/cobble, and dense macrophyte beds
Pools	1.0-7.0	3.5	3.0	Pools present but shallow
Canopy Cover	9.0-10.0	9.0	9.0	Warmwater creek

Channel condition scores were high (≥ 7) throughout the assessed portion of Spicer Creek, indicating the presence of a natural channel with established vegetation and little or no evidence of incision or aggradation (20 of 23 reaches) or a channel with significant recovery from channelization (3 of 23 reaches). Reaches 18 and 19 showed evidence of minimal incision. Riprap or other hard structures were not observed in any reaches.

Average riparian zone scores were ≥ 7.5 in 61% of reaches assessed (14 reaches), indicating a riparian zone that extended at least one bankfull width from the top of the channel and half of those reaches (seven reaches) had an average score of 9 or greater indicating a riparian zone that extended at least two bankfull widths from the top of the bankfull channel. The remaining nine reaches scored below a 7 due to gaps in riparian vegetation that exceeded 10% of the reach length.

Phragmites was observed in four reaches. Purple loosestrife was observed to be present upstream of the assessed reaches but none was found in the assessed reaches.

Sixty-nine percent of the assessed reaches (16 reaches) had high (≥ 6) average bank condition scores, indicating stable to moderately stable banks that are protected by roots, natural vegetation, wood, and naturally occurring rock. Six reaches (26% of the reaches) had low (5) scores, indicating moderately unstable banks with little protection of banks from natural wood, vegetation, or rock. All of those reaches were located between Harvey Rd. and Bonnywoods Crossing (Reaches 1-6).

Water appearance scores were high (≥ 5) in 91% of assessed reaches, indicating that the water was slightly turbid most of the time. This is likely due to the dominance of the silt and clay bed substrate.

Nutrient enrichment scores were generally high (8.1, on average) with 91% of the reaches (21 reaches) having clear to fairly clear water with little algal growth present and/or a diverse aquatic plant community. However, Bonnywoods Crossing to Whitehaven Rd. Reaches 14 and 15 scored in the 2 to 3 range due to an overabundance of lush green aquatic plants that almost clogged the stream reaches at times.

Instream fish cover scores were low (3-4) throughout the assessed portion of Spicer Creek. Seventy percent of the reaches (16 reaches) indicated two to three cover types available. Three reaches (13% of reaches) had scores (5-6) indicating four to five cover types available.

Sixty-one percent of the reaches (14 reaches) scored between 3 and 5, indicating the presence of shallow pools, while 26% of the reaches (6 reaches) had pool scores between 0 and 2, indicating the absence of pools, but the presence of other slow water habitat.

Spicer Creek is a warmwater creek and all of the reaches (23 reaches) had high (9) canopy cover scores indicating that 50 to 75% of the water surface was shaded within the length of the reach.

Litter was evident in 43% of the reaches (10 reaches), but there were no observed instances of abundant trash.

EAV was present in 35% of the reaches (eight reaches) and SAV was present in 17% of the reaches (four reaches).

Opportunities:

- Riparian zone and habitat conservation throughout the assessed creek. Habitat conservation would preserve existing instream habitat. The area upstream of the assessed reaches is undeveloped and also provides an opportunity for land use management and conservation opportunities.
- Bank condition/stabilization in the Harvey Rd. and Bonnywoods Crossing section (Reaches 1-6).
- Invasive species (Phragmites) removal in Reaches 2, 6, 7, and 23.
- Environmental education/outreach throughout the assessed stream to address riparian zone and bank stability issues (e.g., mowing to streambanks in residential areas, recreational activities, and limited litter issues).

3.12 QA/QC

Thirty reaches on seven of the study streams were assessed twice during this study. The initial assessments took place in May and June and the same reaches were re-assessed in late July and early August (Table 24).

Overall SVAP scores were the same (i.e., within the same SVAP rating range) in 90% of the reaches (27 out of 30 reaches) that were assessed twice, demonstrating that the SVAP was interpreted and applied consistently over the course of this study.

Table 24 QA/QC Results

Stream	Number of reaches assessed	Date of initial assessment	Date of second assessment
Fish	6	June 4, 6, 18	July 26, 2013
Gill	2	June 18, 2013	July 26, 2013
Cayuga	9	May 23, 24, 31, 2013	August 12, 2013
Bergholtz	4	June 20, 21, 2013	August 15, 2013
Bull	3	June 19, 2013	August 15, 2013
Two Mile	4	June 5, 2013	July 31, 2013
Two Mile tributary	2	June 4, 2013	July 31, 2013

3.13 Water Quality

Water quality data was collected one time in 56 of the 348 reaches assessed during this study (Appendix E). Three water quality readings in each reach allowed for calculation of a reach-averaged value for each parameter in 54 of the 56 reaches; however, stream depth limited data collection to two points in Spicer Creek Reach 23 and two points in Two Mile Creek tributary Reach 1.

All the streams sampled in this study have been classified by the New York State Department of Environmental Conservation (NYSDEC) as either Class B or C (Table 25) (NYSDEC, 2000). Dissolved oxygen and pH results from this study are discussed in terms of NYSDEC surface water standards, which vary for different stream classes (NYSDEC, 1999).

Table 25 NYSDEC Water Quality Classes for Study Streams

Creek	Water Quality Class
Fish	Class C
Gill	Class C
Cayuga	Class C
Bergholtz (and tributary)	Class C
Bull	Class C
Tonawanda	Class C
Ellicott	Class B
Two Mile (and tributary)	Class B
Woods (and tributaries)	Class B
Gun	Class B
Big Six Mile (and tributary)	Class B
Spicer	Class B

Temperature

Reach-averaged temperature values ranged from 58.12 to 81.96°F (Figure 14). Temperature values were within normal ranges for tributaries to the Niagara River during summer months (URS and Gomez and Sullivan, 2005).

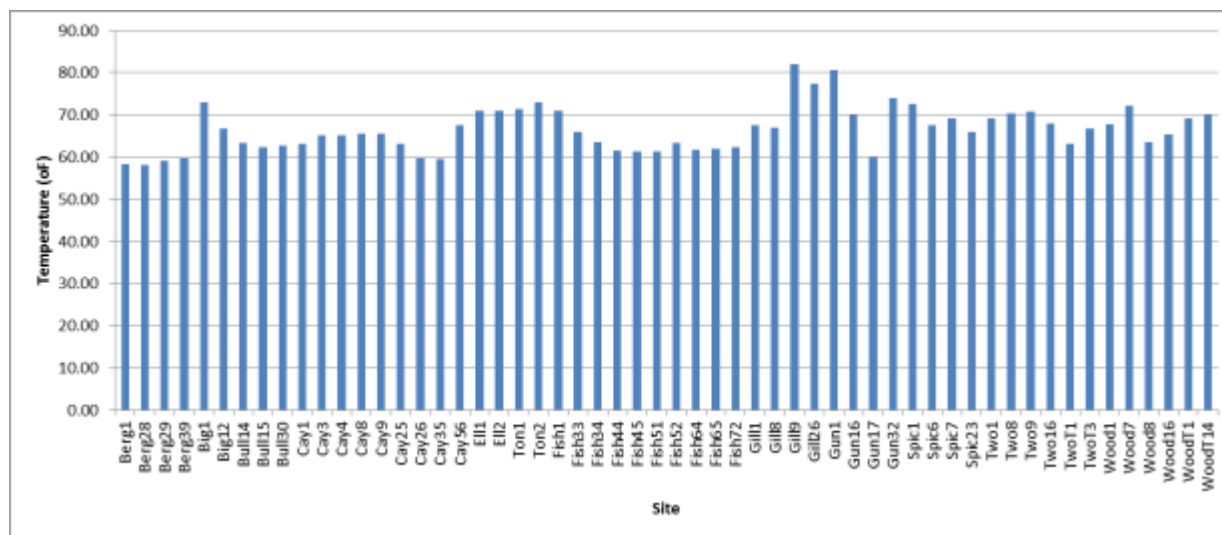


Figure 14 Reach-averaged temperatures at each site.

Conductivity

Conductivity is the measure of electrical flow through a solution and it is dependent on the amount of dissolved ions (e.g., sodium, calcium) in the solution. Low conductivity indicates low dissolved ions and

high conductivity indicates high dissolved ions. Conductivity in freshwater streams will vary based on factors like soil and bedrock material and groundwater versus precipitation inputs and most streams have conductivity values that range between 0.500 to 1.5 mS/cm (Behar, 1997). The optimal range of conductivity values to support a diverse aquatic community is 0.150 to 0.500 mS/cm (Behar, 1997). Conductivity values for this study ranged from 0.136 to 2.268 mS/cm (Figure 15) and values measured during this study were similar to those reported previously in Niagara River tributaries (URS and Gomez and Sullivan, 2005). Moreover, 80% of the reaches (45 reaches) had conductivity values within the normal range of freshwater streams (i.e., 0.500 to 1.5 mS/cm) (Behar, 1997). Only 20% of the reaches (11 reaches) had conductivity values in the optimal range to support a diverse aquatic community (i.e., 0.150 to 0.500 mS/cm) (Behar, 1997).

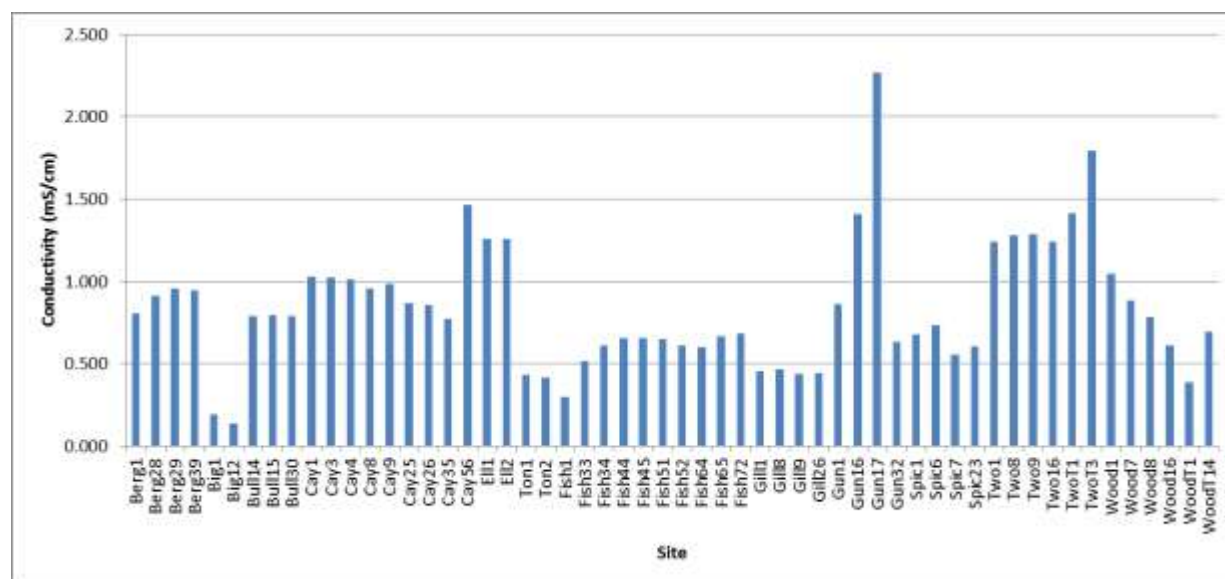


Figure 15 Reach-averaged conductivity values at each site.

Dissolved Oxygen

Dissolved oxygen concentrations ranged from 5.44 to 21.64 mg/l, although the 21.64 mg/l concentration from Gill Creek Reach 9 may have been an erroneous reading (Figure 16). Excluding Gill Creek Reach 9, DO concentrations ranged from 5.44 to 13.31 mg/l. The NYSDEC DO water quality standards for Class B and C streams are in Table 26. DO concentrations at all 37 sites were greater than 5.0 mg/l, which is the minimum DO concentration for trout waters. Generally, DO concentrations between 4 and 7 mg/l are good for many aquatic animals, although low for coldwater fish and concentrations between 7 and 11 mg/l are very good for most stream fish (Behar, 1997). DO concentrations were between 5 and 11 mg/l in 91% of the reaches (51 reaches). DO concentrations measured during this study were similar to those measured previously in Niagara River tributaries (URS and Gomez and Sullivan, 2005).

Table 26 NYSDEC DO Water Quality Standards

Condition	DO Standard
Trout spawning waters (TS)	DO concentration not less than 7.0 mg/l from other than natural conditions
Trout waters (T)	Minimum daily average not less than 6.0 mg/l and never less than 5.0 mg/l
Non-trout waters	Minimum daily average not less than 5.0 mg/l and never less than 4.0 mg/l

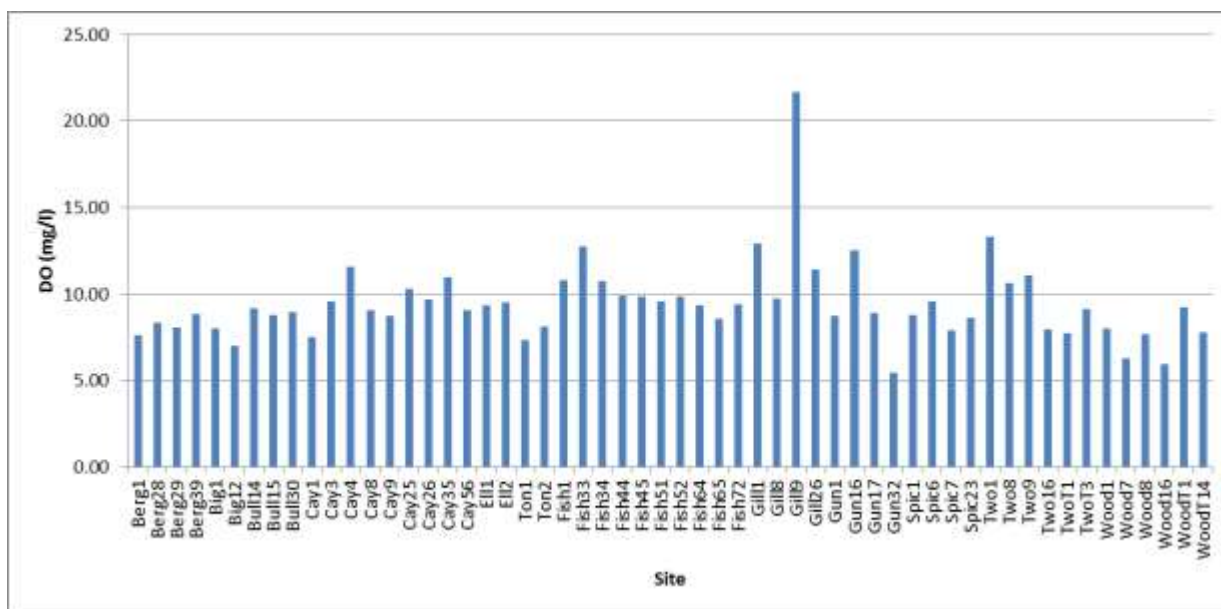


Figure 16 Reach-averaged DO concentrations at each site.

pH

pH values ranged from 6.5 to 8.72, indicating that all the creeks were near neutral (7.0) to slightly alkaline (Figure 17). The NYSDEC water quality standard for pH says that for Class B and C streams pH should be between 6.5 and 8.5. pH was only above 8.5 in three reaches: Tonawanda Creek Reach 2 (pH 8.57), Cayuga Creek Reach 56 (pH 8.66), and Gill Creek Reach 9 (pH 8.72). pH values measured during this study were similar to those measured previously in Niagara River tributaries (URS and Gomez and Sullivan, 2005).

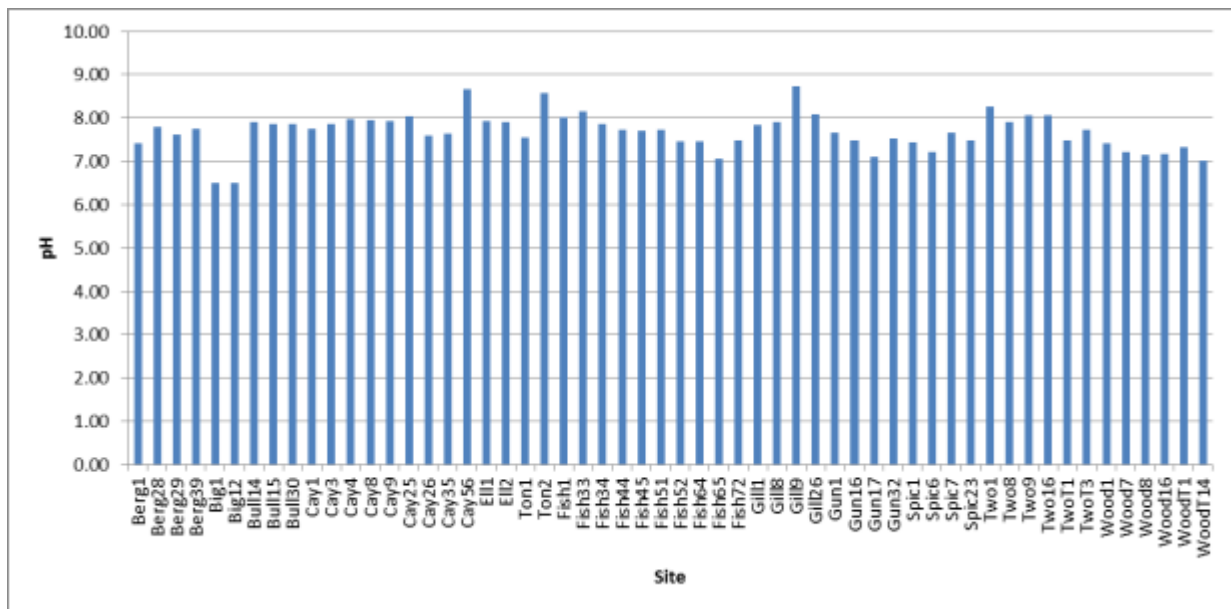


Figure 17 Reach-averaged pH values at each site.

Turbidity

Turbidity ranged from 2.93 to 806.10 NTU, although field notes indicate that many high turbidity readings were a result of bed sediment being disturbed by the field crew (see Appendix E; Figure 18). The 2005 study by URS and Gomez and Sullivan reported turbidity results for sites on nine Niagara River streams (Fish, Gill, Cayuga, Tonawanda, Ellicott, Woods, Gun, Big Six Mile, and Spicer Creeks). Average dry weather turbidity results from URS and Gomez and Sullivan (2005) ranged from 1.88 NTU for a site on Gill Creek and 45.73 NTU for a site on Woods Creek. Results from this study fall within that range of turbidity readings in 64% of the reaches (36 reaches).

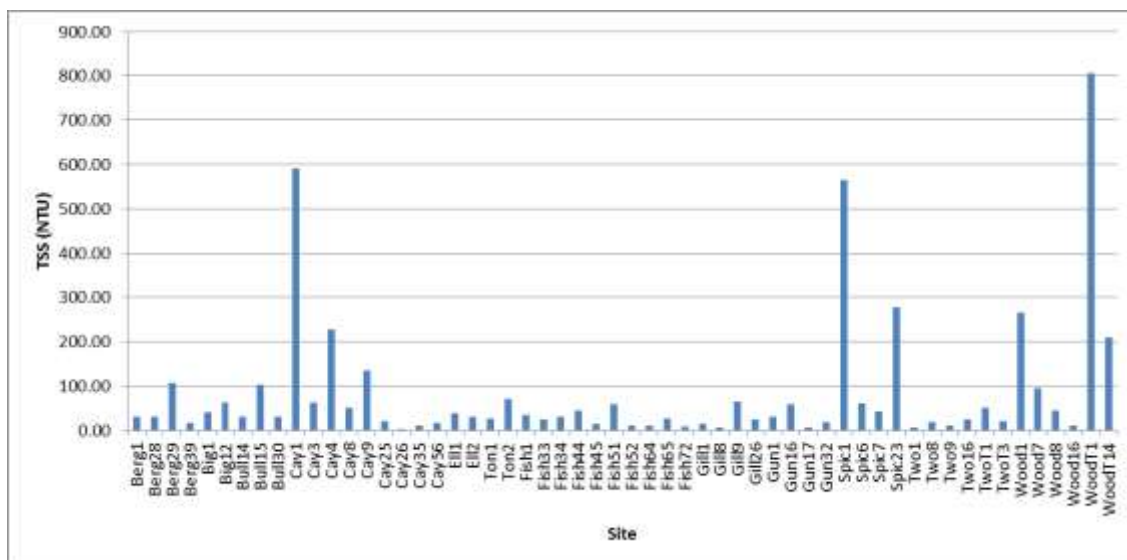


Figure 18 Reach-averaged turbidity values at each site.

4. ACKNOWLEDGEMENTS

The hard work of field crew members Jerry Krajna, Katie Bauer, and Megan Klein is greatly appreciated. Jerry Krajna also made all the GIS maps.

5. REFERENCES

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NRCS. 1998. Stream Visual Assessment Protocol. Technical Note 99-1, 42 pp.

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NYSDEC. 1999. Title 6, Part 703 of the New York Code, Rules, and Regulations (6NYCRR Part 703) entitled, *Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations*.

NYSDEC. 2000. New York State Water Quality 2000. Division of Water.

URS and Gomez and Sullivan. 2005. Surface Water Quality of the Niagara River and its US Tributaries. Report to the New York Power Authority, 58 pgs.

Appendix A SVAP Element Descriptions and Scores (after NRCS, 1998 and 2009)

Channel Condition

Natural channel with established vegetation. No channelization (with or without straightening and/or with or without riprap/concrete/other hard structures). No evidence of incision (e.g., downcutting; vertical banks). No evidence of aggradation (e.g., filling in; lateral migration/bank erosion; wide, shallow channel; multiple bars in channel).	Evidence of past channelization OR incision, but with significant recovery of channel form and vegetation. Bankfull channel and floodplain are connected in most areas; inundated seasonally. Minimal aggradation; some lateral migration and bank erosion; minimal bar formation (< 3 bars).	Altered channel; <50% of the reach channelized and/or with hard structures. Bankfull channel appears to be disconnected from the floodplain, with infrequent or no inundation. Active incision evident; steep banks with some bank failures, point bars located adjacent to steep banks. Moderate aggradation; moderate lateral migration and bank erosion, deposition of sediments causing channel to be very shallow in places; 3-4 bars in channel.	Altered channel; >50% of the reach channelized and/or with hard structures. Little or no connection between floodplain and stream channel and no inundation. Active incision; steep banks and bank failures prominent; headcuts or surface cracks on banks; point bars, if present, located adjacent to steep banks Severe aggradation; severe lateral channel migration and bank erosion; deposition of sediments causing channel to be very shallow in reach; braided channels (5 or more bars in channel).
10 9	8 7 6	5 4 3	2 1 0

Note on field sheet: channelization (with or without straightening AND with or without riprap/concrete/other hard structures), channel incision, aggradation/widening

Riparian Zone

Vegetation* extends at least two bankfull channel widths from the top of the bankfull channel. Vegetation is generally contiguous along the entire length of the reach.	Vegetation extends one bankfull channel width from the top of the bankfull channel. Vegetation gaps do not exceed 10% of the reach length.	Vegetation extends half of the bankfull channel width from the top of the bankfull channel. Vegetation gaps do not exceed 30% of the reach length.	Vegetation extends a third of the bankfull channel width from the top of the bankfull channel. Vegetation gaps exceed 30% of the reach length.	Vegetation extends less than a third of the bankfull channel width from the top of the bankfull channel. Vegetation gaps exceed 30% of the reach length.
10 9	8 7	6 5	4 3 2	1 0

*Vegetation can be native or introduced vegetation that functions like native plants. Note on field sheet: native and/or introduced vegetation; also note riparian zone width

Bank Condition

Banks are stable; protected by roots of natural vegetation, wood, and rock. No fabricated structures present on bank. No excessive erosion or bank failures. No recreational or livestock access.	Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials. Limited number of structures present on bank. Evidence of erosion or bank failures, some with reestablishment of vegetation. Recreational use and/or grazing do not negatively impact bank condition.	Banks are moderately unstable; very little protection of banks by roots of natural wood, vegetation, or rock. Fabricated structures cover more than half of reach or entire bank. Excessive bank erosion or active bank failures. Recreational and/or livestock use are contributing to bank instability.	Banks are unstable; no bank protection with roots, wood, rock, or vegetation. Riprap and/or other structures dominate banks. Numerous active bank failures. Recreational and/or livestock use are contributing to bank instability.
10 9	8 7 6	5 4 3	2 1 0

Note on field sheet: whether bank conditions are natural or if the banks have fabricated structures, e.g., riprap/concrete/other hard structures. Also note if recreational use or livestock access is negatively impacting bank condition.

Water Appearance

Water is very clear, or clarity appropriate to site. Submerged objects (rocks, wood) are visible at depths 3 to 6 ft.* No oil sheen on surface; no evidence of metal precipitates in stream.	Water is slightly turbid (cloudy), especially after storm event, but clears after weather clears. Submerged objects are visible at depth 1.5 to 3 ft. No oil sheen on surface; no evidence of metal precipitates in stream.	Water is turbid most of the time. Submerged objects visible to depth 0.5 to 1.5 ft. and/or Oil sheen is present on water surface or areas of slackwater and/or There is evidence of metal precipitates in stream.	Water is very turbid or has a muddy appearance most of the time. Objects visible to depth <0.5 ft. and/or Oil sheen is present on water surface or areas of slackwater.
10 9 8	7 6 5	4 3 2	1 0

*Use depth that the objects are visible to only if the stream is deep enough to evaluate turbidity using this approach.

Nutrient Enrichment

Clear water along entire reach. Little algal growth present. Diverse aquatic plant community includes low quantities of many species of aquatic plants.	Fairly clear or slightly greenish water along entire reach. Moderate algal growth on stream substrates.	Greenish water along entire reach, especially in slow sections. Abundant algal growth, especially during warmer months. Overabundance of lush green aquatic plants, especially in slow sections.	Water is a pea green color. Severe algal blooms create thick algal mats in stream. Dense stands of aquatic plants clog stream.
10 9	8 7 6	5 4 3	2 1 0

Note on field sheet: algal growth, dense aquatic beds, or both.

Instream Fish Cover

>7 cover types available	6 to 7 cover types available	4 to 5 cover types available	2 to 3 cover types available	None to 1 cover type available
10 9	8 7	6 5	4 3	2 1 0

Cover types: Logs/large woody debris, deep pools, overhanging vegetation, boulders/cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, isolated/backwater pools, other: _____.

Pools—low gradient (<2%) streams

More than two deep* pools separated by riffles. Greater than 30% of the pool bottom obscured by depth, wood, or other cover. Shallow* pools also present.	One or two deep pools separated by riffles. Greater than 30% of the pool bottom obscured by depth, wood, or other cover. At least one shallow pool present.	Pools present, but shallow. Only 10–30% of pool bottoms are obscured due to depth, wood, or other cover.	Pools absent, but some slow water habitat is available. No cover, entire stream bottom is visible. or Reach is dominated by shallow continuous pools or slow water.
10 9	8 7 6	5 4 3	2 1 0

* A *deep* pool is 1.6 to 2 times deeper than the prevailing depth, while a *shallow* pool is less than 1.5 times deeper than the prevailing depth.

Canopy Cover—score only if applicable**Coldwater fishery*

> 75% of water surface shaded within the length of the reach.	75% to 50% of water surface shaded within the length of the reach.	49 to 20% of water surface shaded within the length of the reach.	< 20% of water surface shaded within the length of the reach.
10 9	8 7 6	5 4 3	2 1 0

Warmwater fishery

50% to 75% of water surface shaded within the length of the reach.	> 75% of water surface shaded within the length of the reach.	49 to 20% of water surface shaded within the length of the reach.	< 20% of water surface shaded within the length of the reach.
10 9	8 7 6	5 4 3	2 1 0

*Do not assess if active channel width is > 50 ft wide and if woody vegetation is naturally absent (e.g., wet meadow)

Appendix B Field Data Sheet



Weather conditions today Past 2-5 days

Dominant bed substrate	silt/clay	sand	gravel	cobble	boulder	bedrock/concrete
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Condition:	Natural	Riprap/concrete/other hard structures
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Assessment scores, continued (0— Severely Degraded to 10—Excellent) ******(orient left & right facing downstream)**

Water Appearance

10	9	8	7	6	5	4	3	2	1	0
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Nutrient Enrichment

10	9	8	7	6	5	4	3	2	1	0
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Algal growth

Dense aquatic plant beds

Both

Instream Fish Cover

10	9	8	7	6	5	4	3	2	1	0
----	---	---	---	---	---	---	---	---	---	---

Cover types: Logs/large woody debris, deep pools, overhanging vegetation, boulders/cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, isolated/backwater pools, other: _____.

Pools

10	9	8	7	6	5	4	3	2	1	0
----	---	---	---	---	---	---	---	---	---	---

Canopy Cover—*Score only if applicable (do not assess if bankfull channel is > 50 ft wide or woody vegetation is naturally absent e.g., wet meadow)*

Coldwater fishery

10	9	8	7	6	5	4	3	2	1	0
----	---	---	---	---	---	---	---	---	---	---

Warmwater fishery

10	9	8	7	6	5	4	3	2	1	0
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Additional notes:

Litter or trash (circle):	none is present	evident, but not prominent	abundant trash/waste
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Circle any introduced species found in the reach:

Phragmites

Japanese Knotweed

Purple loosestrife

Water chestnut

Hydrilla

Emergent Aquatic Vegetation (EAV)

Presence

Absence

Submerged Aquatic Vegetation (SAV)

Presence

Absence

Appendix C Reach SVAP Scores

See Excel file Appendix C Reach SVAP Scores

Appendix D Photo Index