# Scajaquada Creek
# Stream Assessment

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## 1. Introduction

In October 2016, students in the Watershed Analysis class at SUNY Buffalo State used the Stream Visual Assessment Protocol (SVAP) (NRCS, 1998 and 2009) to conduct a qualitative assessment of stream corridor conditions in a section of Scajaquada Creek that flows through the Forest Lawn Cemetery in the City of Buffalo, NY. The objective of this work was to assess the physical, chemical, and biological conditions of Scajaquada Creek prior to stream restoration. This assessment provides the pre-restoration baseline conditions that can be compared to performance data collected throughout the project implementation and post-restoration monitoring phases, both of which are essential for evaluating the success of any stream restoration project (Federal Interagency Stream Restoration Working Group (FISRWG), 1998). In addition, the current stream assessment will be compared to a 2013 assessment that was completed by Buffalo Niagara Riverkeeper (BNRK (BNRK, 2013).

The Scajaquada Creek watershed is 29 square miles (Figure 1.1) (Erie County Soil and Water Conservation District (ECSWCD), 2002). Starting in Lancaster, NY, the creek spans 15 miles, and five municipalities, including the Town and Village of Lancaster, the Village of Depew, the Town of Cheektowaga, and the City of Buffalo, before it empties into the Niagara River at the Black Rock Canal. It is part of the Niagara River Area of Concern (AOC) (US Army Corps of Engineers (USACE), 2015) and is listed on the New York State Department of Environmental Conservation (NYSDEC) Section 303d "List of Impaired Waters" (Perrelli and Irvine, 2013). The creek has been heavily impacted as it flows through a highly urbanized area, which has contributed to poor water quality and resulted in channelization of the stream in several locations. Scajaquada Creek flows underground at three different points: under the Galleria Mall in Cheektowaga, NY and again under west Cheektowaga and the east side of the City of Buffalo (USACE, 2015). The first section was routed underground for approximately three miles in the 1920s because the creek had become a human health hazard, filling with garbage and sewage dumped from a growing urban population (Perrelli and Irvine, 2013). Later, approximately two miles of the main branch and three miles of tributaries were channelized in an attempt to control flooding in the late 1970s to early 1980s.

Land use in the Scajaquada Creek watershed is mixed. Land use is predominantly residential (65%), with commercial/retail, industrial, open space, and hospitals/schools making up the other 35% (Figure 1.2) (ECSWCD, 2002).

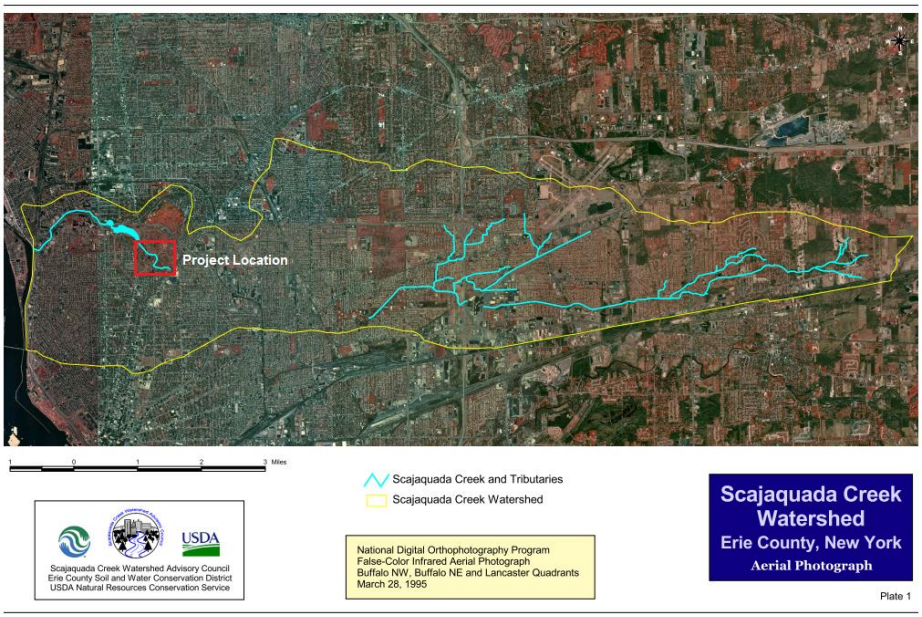


Figure 1.1 Scajaquada Creek watershed (ECSWCD, 2002).

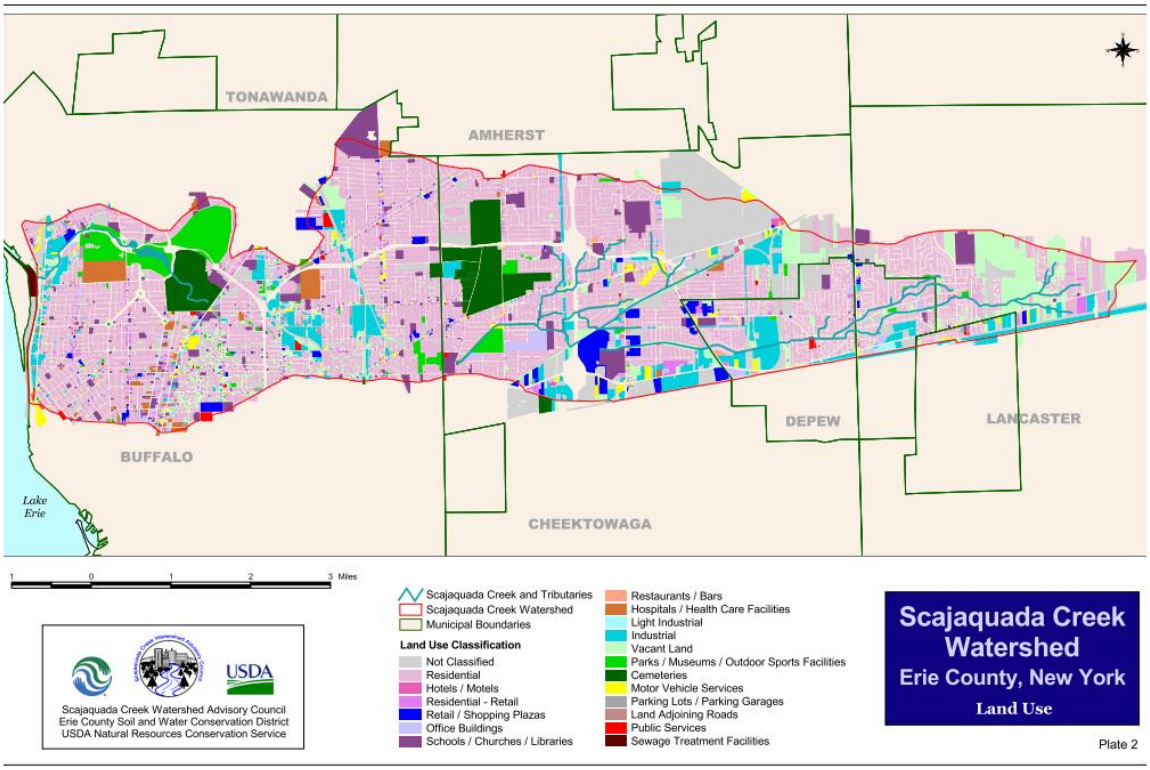


Figure 1.2 Scajaquada Creek land use (ECSWCD, 2002).

Most of the bedrock making up the Scajaquada Creek watershed consists of limestone deposits from the Middle Devonian Period, continuing over the Bertie Formation dolostone near the Black Rock Canal and shale from the Upper Silurian (Figure 1.3) (ECSWCD, 2002). Soils in the watershed consist of low glacial till moraines, with Ovid silt loam soils comprising the southern and northeastern watershed boundaries (Figure 1.4) (ECSWCD, 2002). In the central watershed, lacustrine soils and silt clay loams dominate, which are poorly to somewhat poorly drained and have seasonally high water tables (Figure 1.4) (ECSWCD, 2002). Topography drops about 100 feet, with elevations remaining fairly flat throughout the watershed (ECSWCD, 2002).

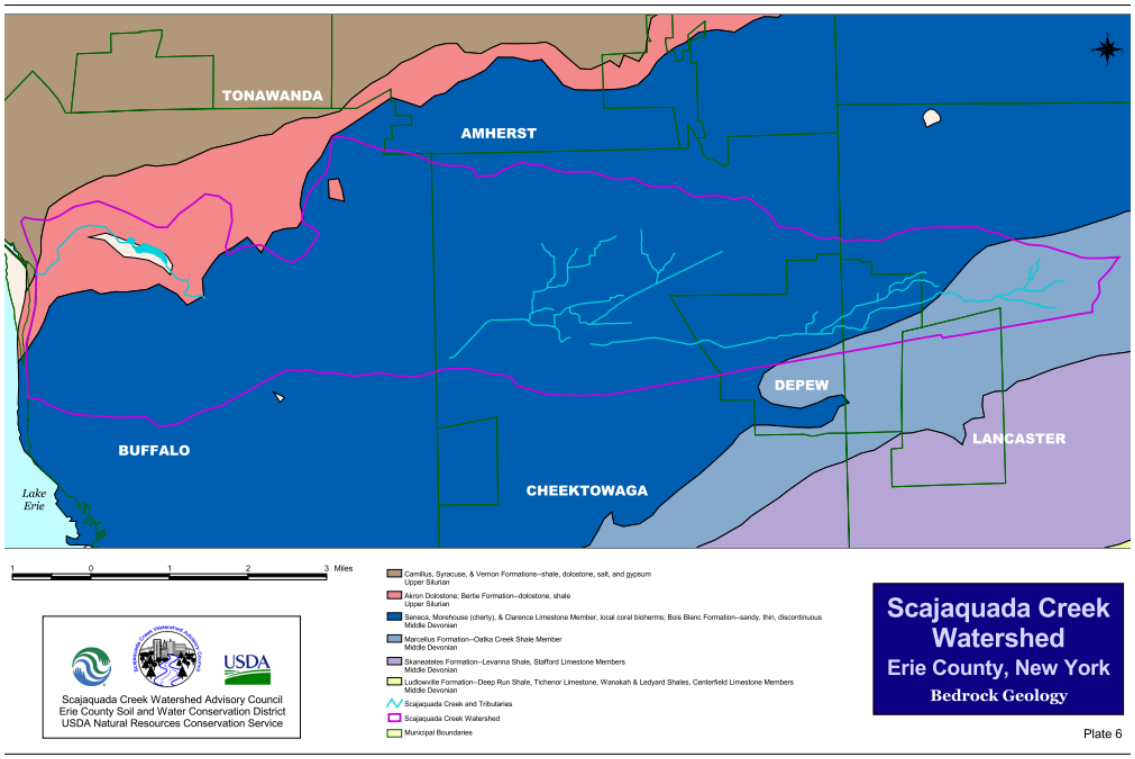


Figure 1.3 Scajaquada Creek bedrock geology (ECSWCD, 2002).

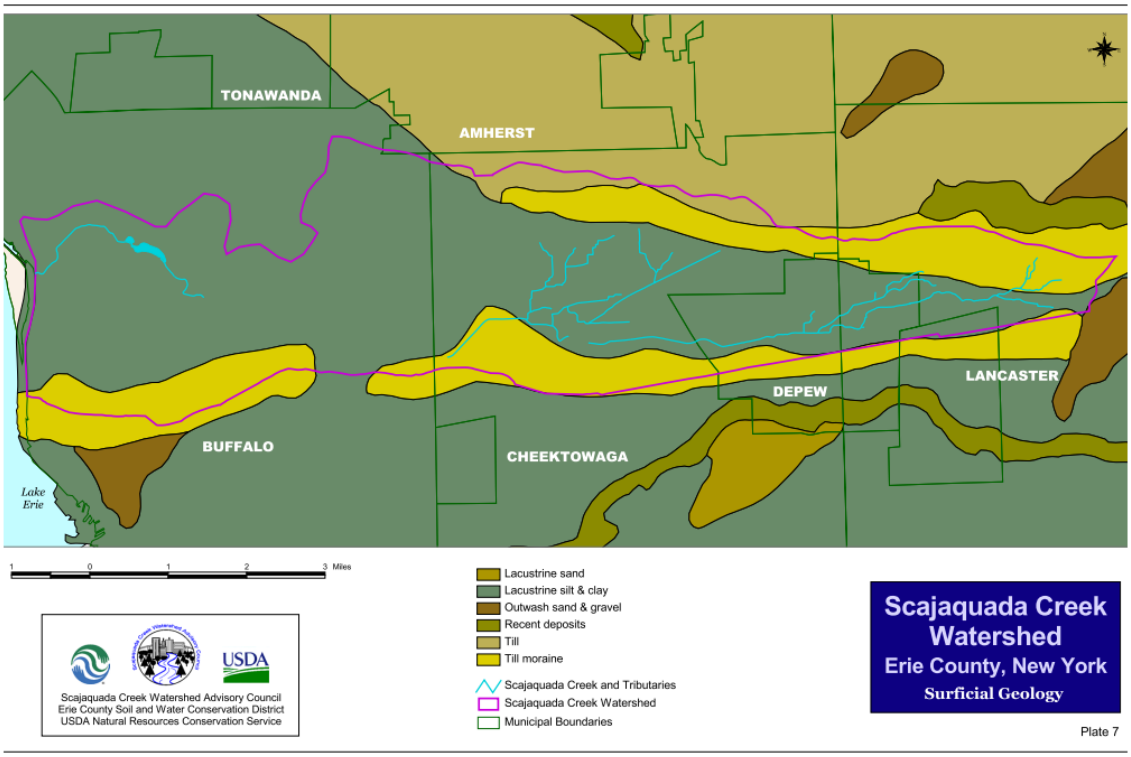


Figure 1.4 Scajaquada Creek soils (ECSWCD, 2002).

The climate in this area is fairly humid, with moderate summers and cool winters. Weather in Western New York is highly variable; extreme or rapid weather changes occur frequently, especially lake effect snow events coming from Lake Erie. Ice scour is also a common occurrence as large pieces thaw and drift downstream during the spring after harsh winters.

The U.S. Army Corps of Engineers (USACE), in conjunction with Buffalo Niagara Riverkeeper (BNRK), Forest Lawn Cemetery, and other partners, have developed a stream restoration plan for a 0.6 mile section of Scajaquada Creek (Figure 1.5) (USACE, 2015). The overall aim of the restoration project is to improve water quality, alleviate flooding, and make the creek more accessible and appealing to the public (USACE, 2015).


Figure 1.5 Map of stream restoration project area (USACE, 2015).

According to the USACE (2015) restoration plan, there are two reaches (see Figure 1.5, Reach 2 and Reach 5) where restoration work will be completed. The restoration plan for the upstream reach (Reach 2) can be seen in Figure 1.6. For later reference, please note that the BNRK (2013) reaches contained in the USACE Reach 2 are Reaches 5 through 8. The plan for Reach 2 includes streambank grading with stone "steps" and creating a more natural floodplain along the right (left and right determined by orienting downstream) streambank. The area in white on Figure 1.6 will be submerged during high flow events. During low flow events, this area will provide added green space as an improved riparian zone with shrubs and emergent vegetation which the public can access via steps that will be constructed using the existing stone wall material. In the channel itself, plans include adding bendway weirs to create an artificial meander with vegetation planted behind the weirs. The weirs will create habitat and dissipate high velocities, which will decrease erosion around

the bend at the end of this reach. The native trees and shrubs planted along the banks will add canopy cover, providing more habitat and cooling water temperatures.


Figure 1.6. Restoration plan for the upstream reach (Reach 2) (USACE, 2015). Figure source: Mr. Michael Voorhees, Biologist, USACE, Buffalo District.

The downstream reach (Reach 5) restoration involves dredging, plus planting native vegetation along both banks and creating a wetland along the right streambank (Figure 1.7). The BNRK (2013) reaches contained in the USACE Reach 5 are Reaches 20 through 22. Note that some dredging and streambank planting continues upstream into the downstream end of Reach 4 (see Figure 1.5). To restore the connection between the stream channel to the floodplain in Reach 5, all but a short segment of the stone wall on the right streambank will be removed. The remaining stone wall will be shortened to become part of a tiered or multi-level riparian zone. In addition, the ground will be graded to achieve a more natural bank slope outside of the tiered area. To address

the issue of the existing sediment bar, the reach is to be dredged. The material that is dredged will be replaced with new, coarse-grained stone to redirect flows and create flow diversity and complexity. This will also increase instream habitat and benefit benthic aquatic species. A series of bendway weirs with vegetation plantings also will contribute to instream habitat. Upland and wetland plantings and seed mixes will be added along both streambanks to enhance the riparian zone and increase canopy cover. A large wetland area will be created at the downstream end of the reach along the right streambank. The purpose of the wetland is to increase habitat, biodiversity, and flood capacity. A pedestrian bridge will connect an island in the wetland to the riparian zone.


Figure 1.7. Restoration plan for the upstream reach (Reach 5) (USACE, 2015). Figure source: Mr. Michael Voorhees, Biologist, USACE, Buffalo District.

## 2. Methods

The Stream Assessment Visual Protocol (SVAP) was used to assess Scajaquada Creek stream corridor conditions (NRCS, 1998 and 2009). The SVAP is a qualitative method used to assess of the overall health of a stream reach. The application of the SVAP requires the user to visually assess stream elements related to stream health. Each element has a scoring description associated with a numerical scale from zero to ten. The scores from each element are averaged together to yield an overall score for each reach. The higher the score, the healthier the reach. The elements assessed during this project were as follows: channel condition, riparian zone, bank condition, water appearance, nutrient enrichment, instream fish cover, pools, and canopy cover (Table 2.1 and Appendix 1 SVAP field sheet). The right and left streambanks (determined by orienting downstream) are assessed separately for the riparian zone and bank condition elements and the average score for each element is used to calculate the overall score.

Table 2.1 Description of SVAP Elements (after NRCS, 1998 and 2009)

| SVAP Element | Criteria |
|---|---|
| Channel Condition | Evidence of channelization or alteration of the stream (SVAP) and channel incision or aggradation (SVAP and SVAP2 characteristics) |
| Riparian Zone | Width of the vegetation zone from the edge of the bankfull channel out onto the floodplain (same for SVAP and SVAP2) |
| Bank Condition | Evidence of streambank instability and presence/absence of hardened streambanks (SVAP2) |
| Water Appearance | Compares turbidity and other visual characteristics with a healthy or reference stream (same for SVAP and SVAP2) |
| Nutrient Enrichment | Reflected by the types and amounts of aquatic vegetation in the water (same for SVAP and SVAP2) |
| Instream Fish Cover | Measures availability of physical habitat for fish (SVAP) |
| Canopy Cover | Percentage of the water surface shaded within the length of the reach (same for SVAP and SVAP2) |

## 2.1 SVAP versus SVAP2 Scoring Criteria

The original version of the SVAP was published in 1998 (NRCS, 1998). That version of the protocol allowed a user to assess up to 15 different elements related to stream health. SVAP2 was published in 2009 (NRCS, 2009) and the updated version provided users with more detailed scoring criteria to facilitate reaches being scored more consistently and reliably (NRCS, 2009). The overall ratings also were updated in SVAP2. The original SVAP overall ratings are <6.0 Poor, 6.1-7.4 Fair, 7.5-8.9 Good, and >9.0 Excellent (NRCS, 1998) and the SVAP2 overall ratings are 1.0-2.9 Severely Degraded, 3.0-4.9 Poor, 5.0-6.9 Fair, 7.0-8.9 Good, 9.0-10. Excellent (NRCS 2009).

The elements for the current study were assessed using mostly the SVAP2 scoring criteria or, in the case of channel condition, a combination of SVAP and SVAP2 criteria, while the assessment completed by BNRK (2013) used the original SVAP element criteria (see Table 2.1). Some element criteria were not changed from SVAP to SVAP2, thus the current and BNRK results are directly comparable. This is the case for riparian zone, water appearance, nutrient enrichment, instream fish cover, and canopy cover (Table 2.1). As mentioned above, the channel condition element was modified and, as such, was assessed using a combination of original SVAP criteria (i.e., evidence of channelization or alteration of the stream) and the more-detailed SVAP2 criteria (i.e., channel incision or aggradation) (Table 2.1). Finally, the most notable difference between this assessment and the BNRK (2013) assessment was related to the bank condition element (Table 2.1). The original SVAP element, which was assessed by BNRK (2013), was bank stability and the criteria only addressed stability, or the potential for instability. The SVAP2 criteria also assesses stability and, in addition, the criteria considers the presence of fabricated structures on the streambanks. Table 2.2 summarizes the criteria for these two different elements. With the SVAP2 criteria, low scores would be attributable to bank instability and/or the presence of fabricated structures, whereas with the original SVAP, a stable streambank with fabricated structures would receive a high score (Table 2.2).

Table 2.2 Bank Condition versus Bank Stability Criteria

| **Bank Condition (NRCS, 2009)** | | | |
|---|---|---|---|
| Banks are stable; protected by roots of natural vegetation, wood, and rock.<br><br>No fabricated structures present on bank.<br><br>No excessive erosion or bank failures.<br><br>No recreational or livestock access. | Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials.<br><br>Limited number of structures present on bank.<br><br>Evidence of erosion or bank failures, some with reestablishment of vegetation.<br><br>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.<br><br>Fabricated structures cover more than half of reach or entire bank.<br><br>Excessive bank erosion or active bank failures.<br><br>Recreational and/or livestock use are contributing to bank instability. | Banks are unstable; no bank protection with roots, wood, rock, or vegetation.<br><br>Riprap and/or other structures dominate banks.<br><br>Numerous active bank failures.<br><br>Recreational and/or livestock use are contributing to bank instability. |
| 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **Bank Stability (NRCS, 1998)** | | | |
| Banks are stable; banks are low (at elevation of active flood plain); 33% or more of eroding surface area of banks in outside bends is protected by roots that extend to the base-flow elevation. | Moderately stable; banks are low (at elevation of active flood plain); less than 33% of eroding surface area of banks in outside bends is protected by roots that extend to the baseflow elevation. | Moderately unstable; banks may be low, but typically are high (flooding occurs 1 year out of 5 or less frequently); outside bends are actively eroding (overhanging vegetation at top of bank, some mature trees falling into steam annually, some slope failures apparent). | Unstable; banks may be low, but typically are high; some straight reaches and inside edges of bends are actively eroding as well as outside bends (overhanging vegetation at top of bare bank, numerous mature trees falling into stream annually, numerous slope failures apparent). |
| 10 | 7 | 3 | 1 |

## 3. Results

Seven reaches of Scajaquada Creek were assessed in Forest Lawn Cemetery on October 1, 2016. The reaches that were assessed were as follows: Reaches 5-8 and Reaches 20-22 (Figure 3.1). As stated above, these reach numbers correspond to the reaches assessed by BNRK in 2013 (BNRK, 2013) and the reaches are contained in Reaches 2 and 5 of the USACE (2015) stream restoration document (see Figure 1.5). Each reach was approximately 160 feet long. The SVAP results were recorded on field sheets (Appendix 1) and field crews estimated bankfull and lowflow width and depth measurements and recorded dominate bed substrate (Table 3.1). A photo also was taken at the upstream end of each reach. The weather conditions on October 1st were cloudy with morning rain showers.

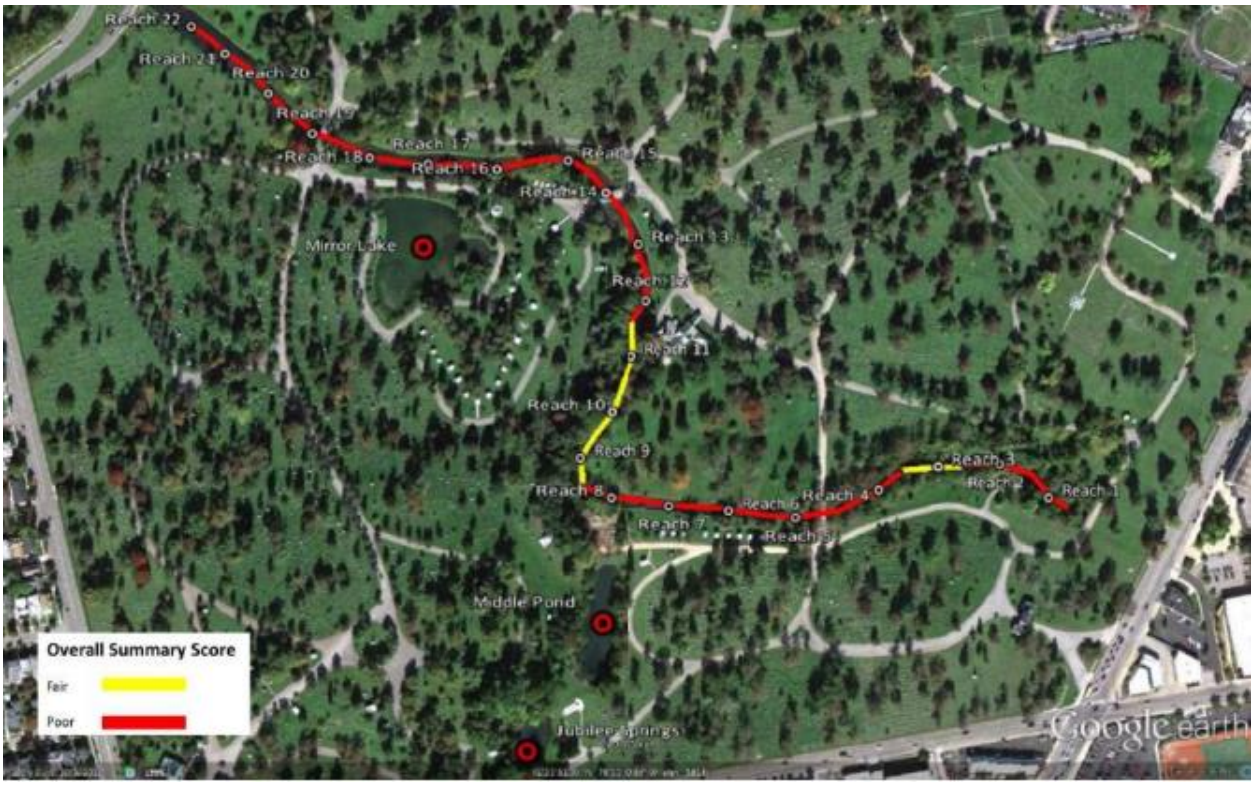


Figure 3.1 Map of the study reaches (BNRK, 2013).

Table 3.1 Physical Channel Conditions in Each Reach

| Reach | Bankfull | | Lowflow | | |
|---|---|---|---|---|---|
| | Depth (ft) | Width (ft) | Depth (ft) | Width (ft) | Dominant Bed Material |
| 5 | 5 | 40 | 0.5 | 20 | bedrock/concrete |
| 6 | 5 | 25 | 1 | 20 | bedrock/concrete |
| 7 | 4 | 15 | 0.5 | 13 | bedrock/concrete |
| 8 | 5 | 25 | 1.5 | 25 | bedrock/concrete |
| 20 | 5 | 40 | 2 | 30 | bedrock/concrete |
| 21 | 4.5 | 35 | 1.5 | 30 | bedrock/concrete |
| 22 | 5 | 35 | 2 | 30 | bedrock/concrete |

### 3.1 Reach 5

Reach 5 is located at the upstream-most section of the project area (Figure 3.2; see also Figure 1.5). Reach 5 is immediately downstream of a bridge, the channel is straightened, and the streambanks consist of stone walls. There is moderate sediment aggradation adjacent to the base of the stone walls in the channel. Grass on those bars appears to have been mowed. The riparian zone is dominated by mown grass with a few trees, especially near the downstream end of the reach along the right streambank. The overall SVAP score rating for Reach 5 is poor (score = 3.6) (Figure 3.3). The channel condition score is low (1; severely degraded) because greater than 50% of the reach is channelized with hard structures along the streambanks. There also is evidence of sediment aggradation in the channel and the channel appears to be disconnected from the floodplain. Both streambanks received fair bank condition scores (5 left bank and 6 right bank) because of the stone wall along the streambanks, some evidence of wall failures, and the presence of little to no vegetation. The lack of streamside vegetation also resulted in low riparian zone scores for both banks (1 left bank and 2 right bank; severely degraded). The water appearance score is fair (6), as turbidity is minimal and nutrient enrichment is good (7) due to minimal algal growth. Instream fish cover is poor (3) because cover is limited to cobble, overhanging vegetation, and undercut banks in the reach. Less than 20% of the water surface is shaded, which resulted in a severely degraded (1) canopy cover score.

Figure 3.2 Reach 5, located at 42.924°N, -78.85979°W.

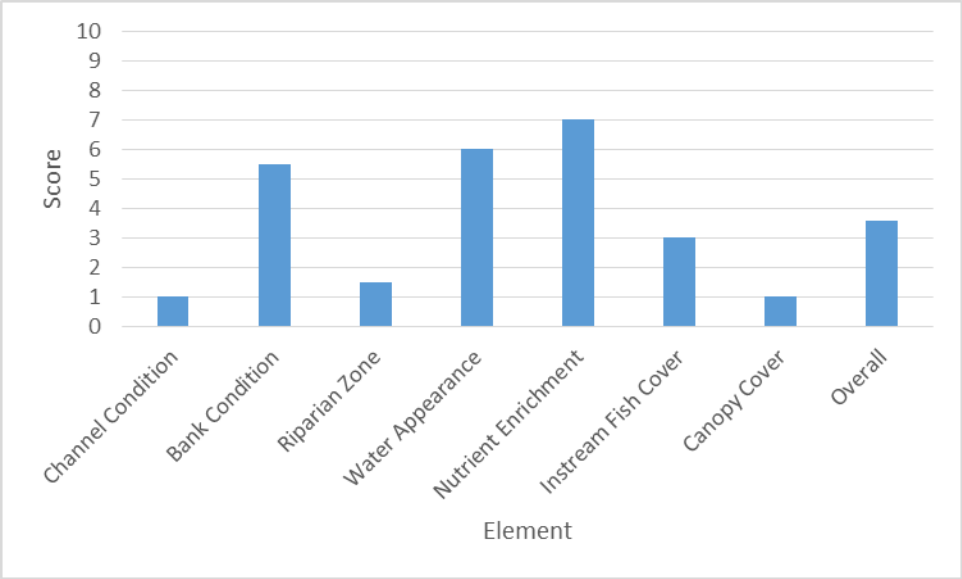


Figure 3.3 SVAP element and overall scores for Reach 5.

### 3.2 Reach 6

Reach 6 is located downstream of Reach 5 (Figure 3.4). This reach is channelized with stone block walls that are failing in multiple areas along both banks. Sediment aggradation is evident in the channel along the

base of the stone walls. Riparian vegetation consists of mown grass with a minimal number of of trees located several feet away from the top of the streambanks. The overall SVAP score rating for Reach 6 is severely degraded (score = 2.9) (Figure 3.5). The channel condition score is poor (3) because approximately 50% of the reach is channelized with hard structures along the banks. Both streambanks received low bank condition scores (2 left bank and 2 right bank; severely degraded) because of the stone wall along the streambanks, wall failures, and the presence of little to no vegetation. The lack of streamside vegetation also resulted in severely degraded riparian zone scores for both banks (1 left bank and 0 right bank). The water appearance score is fair (6), as turbidity is minimal and nutrient enrichment is good (7) due to minimal algal growth. Instream fish cover is severely degraded (1) because cover is limited to a few overhanging tree branches. Less than 20% of the water surface is shaded, which resulted in a severely degraded (0) canopy cover score.

Figure 3.4 Reach 6, located at 42.92413˚N, -78.22˚W.

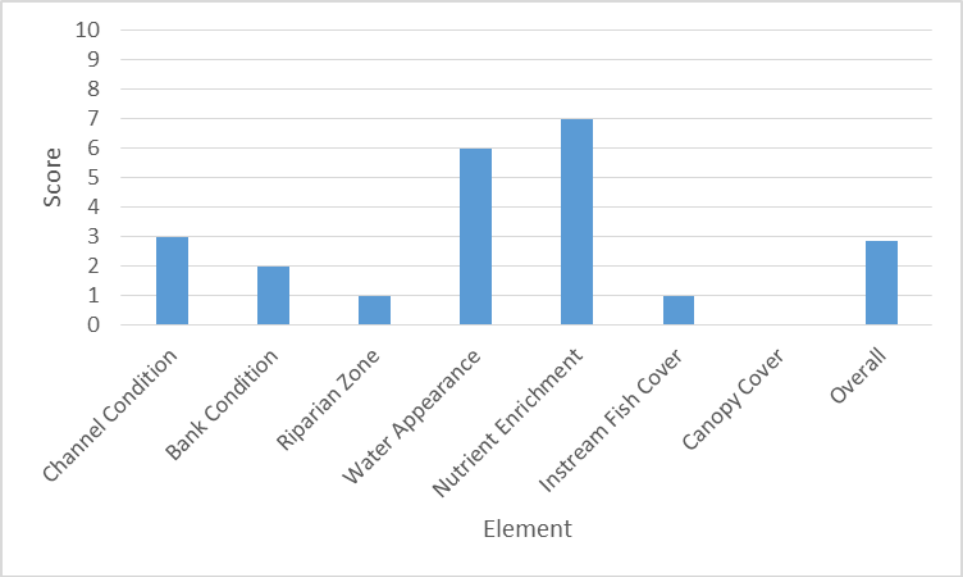


Figure 3.5 SVAP element and overall scores for Reach 6.

### 3.3 Reach 7

Reach 7 is located downstream of Reach 6 (Figure 3.6). This reach is shallow and straightened with the stream bed consisting of shale rock, mud, and silt. There is very little canopy cover with only two trees on the left bank. The riparian areas on both sides of the stream are mowed to the top of the streambanks, which have stone walls with sediment accumulation in the channel along the base of the walls. The overall SVAP score rating for Reach 7 is severely degraded (score = 2.3) (Figure 3.7). The channel condition score is severely degraded (1) because greater than 50% of the channel was straightened with hard structures. The stone wall streambanks also are steep and some bank failures are visible. Both streambanks received low bank condition scores (3 left bank and 3 right bank; poor) because of the stone wall along the streambanks, wall failures, and the presence of little to no vegetation. The lack of streamside vegetation also resulted in severely degraded riparian zone scores for both banks (1 left bank and 1 right bank). The water appearance score is poor (3), as turbid conditions are noted and nutrient enrichment is good (7) due to minimal algal growth. Instream fish cover is severely degraded (1) because cover is limited to minimal amounts of overhanging vegetation. Less than 20% of the water surface is shaded, which resulted in a severely degraded (0) canopy cover score.

Figure 3.6 Reach 7, located at 42.92432°N, -78.86079°W.

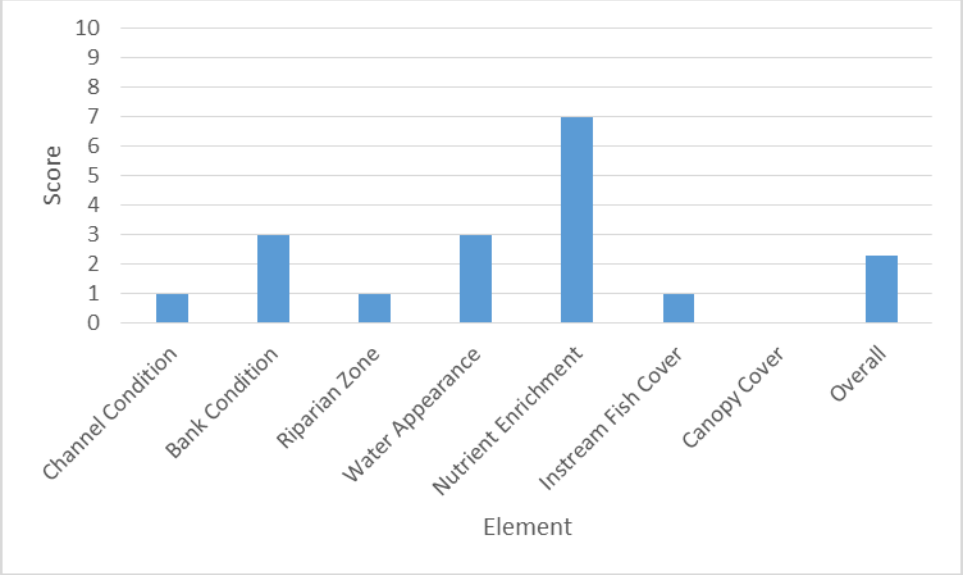


Figure 3.7 SVAP element and overall scores for Reach 7.

### 3.4 Reach 8

Reach 8 is located downstream of Reach 7 and it is the last reach in the proposed upstream restoration area (Figure 3.8; see also Figure 1.5). Like the three upstream reaches, Reach 8 is channelized and the streambanks consist of a stone wall along both banks. Sediment aggradation in the channel along the base of

the stone walls is minimal in Reach 8. The upstream area of the riparian zone is predominately mowed grass and there are trees at the downstream end of the reach. The overall SVAP score rating for Reach 8 is severely degraded (score = 2.9) (Figure 3.9). The channel condition score is severely degraded (1) because more than 50% of the reach is channelized and lined with stone blocks. As such, there is little or no connection between the floodplain and stream channel. Both streambanks received low bank condition scores (2 left bank and 1 right bank; severely degraded) because of the stone wall along the streambanks, wall failures, and the presence of little to no vegetation. The lack of streamside vegetation also resulted in severely degraded riparian zone scores for both banks (1 left bank and 0 right bank). The water appearance score is fair (5), as slightly turbid conditions are noted and nutrient enrichment is fair (6) due to moderate algal growth on stream substrate. Instream fish cover is poor (3) because cover is limited to overhanging vegetation, riffles, and large woody debris. Between 20 and 49% of the water surface is shaded, which resulted in a poor (3) canopy cover score.

Figure 3.8 Reach 8, located at 42.92459°N, -78.86149°W.

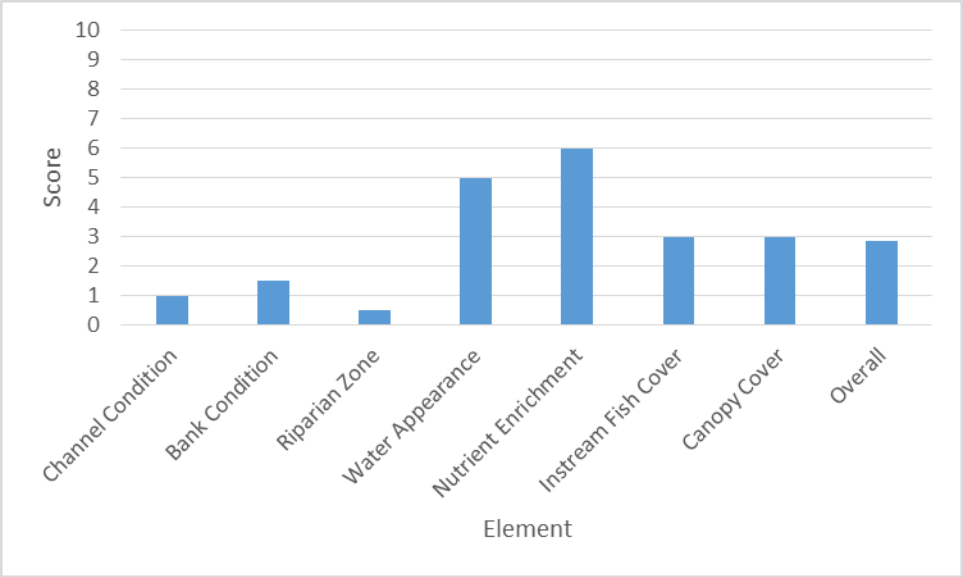


Figure 3.9 SVAP element and overall scores for Reach 8.

### 3.5 Reach 20

Reach 20 is located at the upstream end of the proposed downstream restoration area (Figure 3.10; see also Figure 1.5). Reach 20 is straightened, the stone wall along the banks continues in this area of the creek, and there is a large (about six feet wide and several feet long) bar in the channel along the base of the right bank. The riparian zone consists of mown grass and a few trees and shrubs. The overall SVAP score rating for Reach 20 is severely degraded (score = 2.1) (Figure 3.11). The channel condition score is severely degraded (0) because more than 50% of the reach is channelized and rip rap was present in the reach. Both streambanks received low bank condition scores (1 left bank and 1 right bank; severely degraded) because of the rip rap and evidence of active bank failures. The streamside vegetation is limited to mown grass with very few plants, which resulted in severely degraded riparian zone scores for both banks (0 left bank and 1 right bank). The water appearance score is poor (3), as moderately turbid conditions are noted and nutrient enrichment is fair (6) due to moderate algal growth. Instream fish cover is poor (3) because cover is limited to overhanging vegetation, cobbles, and isolated backwater pools. Less than 20% of the water surface is shaded, which resulted in a severely degraded (1) canopy cover score.

Figure 3.10 Reach 20, located at 42.9278°N, -78.86447°W.

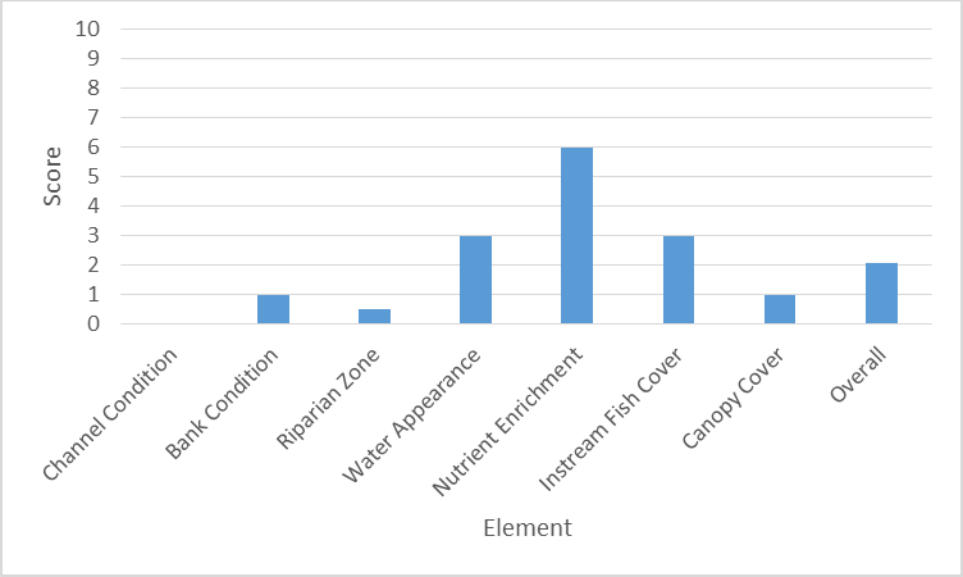


Figure 3.11 SVAP element and overall scores for Reach 20.

### 3.6 Reach 21

Reach 21 is located downstream of Reach 20 (Figure 3.12). Reach 21 is channelized and the stone walls along the streambanks continue into this reach. The riparian zone consists of mown grass and a limited number of trees. The overall SVAP score rating for Reach 21 is severely degraded (score = 2.8) (Figure 3.13). The channel

condition score is severely degraded (2) because more than 50% of the reach was channelized and rip rap was present in the reach. Both streambanks received low bank condition scores (1 left bank and 2 right bank; severely degraded) because of the rip rap and evidence of active bank failures. The streamside vegetation is limited to mown grass with a few trees, which resulted in severely degraded riparian zone scores for both banks (1 left bank and 1 right bank). The water appearance score is poor (3), as moderately turbid conditions are noted and nutrient enrichment is fair (6) due to moderate algal growth. Instream fish cover is fair (5) because cover is limited to overhanging vegetation, cobbles, boulders, and large woody debris. Less than 20% of the water surface is shaded, which resulted in a severely degraded (1) canopy cover score.

Figure 3.12 Reach 21, located at 42.92825°N, -78.8648°W.

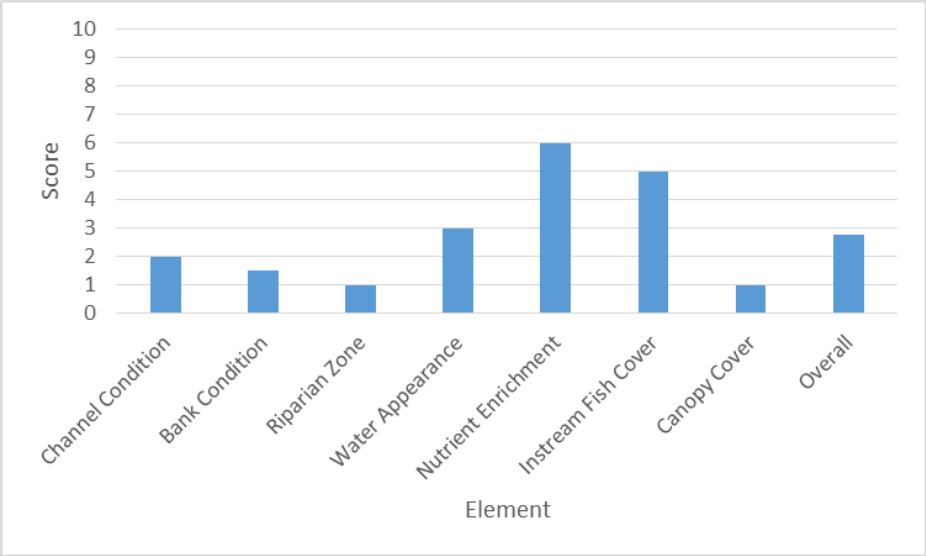


Figure 3.13 SVAP element and overall scores for Reach 21.

### 3.7 Reach 22

Reach 22 is located downstream of Reach 21 and it is the most downstream section of the second proposed restoration area (Figure 3.14; see also Figure 1.5). This reach is located immediately upstream of the Delaware Road bridge. The stone wall that dominates all the other reaches is absent in Reach 21, but there is some rock rip rap present along the bank toe. The riparian zone consists of mown grass and a few shrubs. The overall SVAP score rating for Reach 22 is poor (score = 3.7) (Figure 3.15). The channel condition score is severely degraded (2) because more than 50% of the reach is channelized and rip rap is present in the reach. Streambanks received moderate bank condition scores (8 left bank and 6 right bank; good and fair, respectively) because of minimal rip rap and gentle slopes that appear moderately stable. The streamside vegetation is limited to mown grass, which resulted in severely degraded riparian zone scores for both banks (1 left bank and 1 right bank). The water appearance score is good (7), as conditions are slightly turbid and nutrient enrichment is good (7) due to fairly clear water conditions along the entire reach. Instream fish cover is severely degraded (0), as no cover types are noted. Less than 20% of the water surface is shaded, which resulted in a severely degraded (2) canopy cover score.

Figure 3.14 Reach 22, located at 42.92853°N, -78.86523°W.

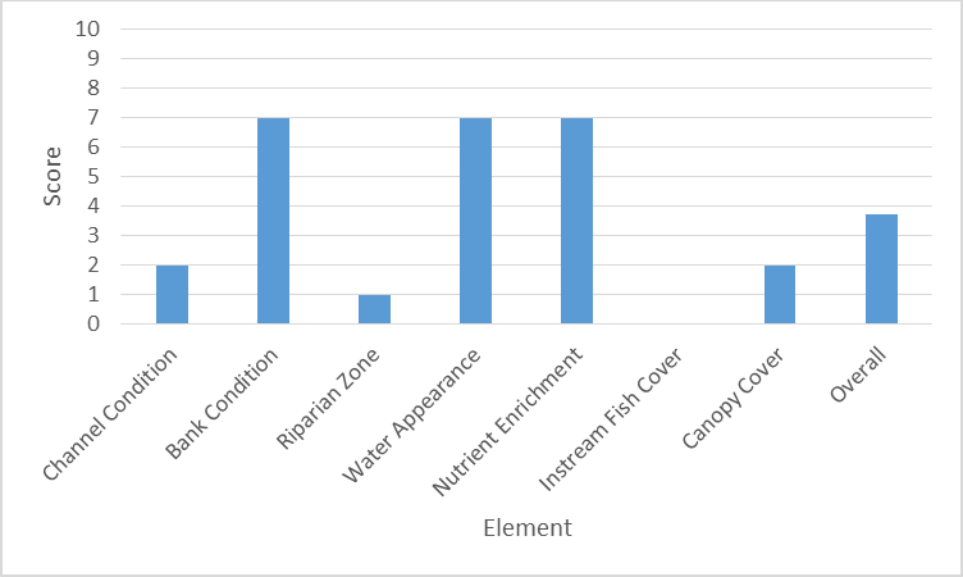


Figure 3.15 SVAP element and overall scores for Reach 22.

### 3.8 2013 versus 2016 SVAP Comparisons

The following tables (Tables 3.2-3.8) summarize the SVAP scores from the assessment done by BNRK in 2013 (BNRK, 2013) and the current assessment. Note that BNRK assessed additional elements that are not summarized here, but those element scores are included in the overall score calculation presented below

(BNRK, 2013). Despite the slight differences in the element scoring criteria, the results between the 2013 and 2016 assessments are quite similar, with the exception of one major difference: bank stability and bank condition (Tables 3.2-3.8). In 2013, bank stability was rated a 9 or 10 in each reach because the stone walls provide excellent streambank stability (BNRK, 2013). In 2016, the bank condition element received low scores because while the banks were deemed moderately stable to stable, the presence of the stone wall (i.e., riprap and/or other fabricated structures) dictates that low scores be given for that element. It is noteworthy that even with the difference between bank stability and bank condition scores, the overall scores between 2013 and 2016 are similar and confirm that these reaches of Scajaquada Creek are in poor or severely degraded condition. The low overall scores are predominantly a result of the fact that the creek is highly modified (channelized with fabricated streambank structures and a lack of instream habitat) in this area and the lack of riparian vegetation negatively impacts both the riparian zone and canopy cover element scores.

Table 3.2 Reach 5 2013 versus 2016 SVAP Comparisons

| | **2013** | | **2016** | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 2.0 | Poor | 1.0 | Severely Degraded |
| Bank Stability/Condition (average) | 10.0 | Excellent | 5.5 | Fair |
| Riparian Zone (average) | 1.0 | Poor | 1.5 | Severely Degraded |
| Water Appearance | 8.0 | Good | 6.0 | Fair |
| Nutrient Enrichment | 7.0 | Fair | 7.0 | Good |
| Instream Fish Cover | 4.0 | Poor | 3.0 | Poor |
| Canopy Cover | 2.0 | Poor | 1.0 | Severely Degraded |
| Overall Score | 5.2 | Poor | 3.6 | Poor |

Table 3.3 Reach 6 2013 versus 2016 SVAP Comparisons

| | **2013** | | **2016** | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 1.0 | Poor | 3.0 | Poor |
| Bank Stability/Condition (average) | 10.0 | Excellent | 2.0 | Severely Degraded |
| Riparian Zone (average) | 1.0 | Poor | 1.0 | Severely Degraded |
| Water Appearance | 9.0 | Excellent | 6.0 | Fair |
| Nutrient Enrichment | 9.0 | Excellent | 7.0 | Good |
| Instream Fish Cover | 3.0 | Poor | 1.0 | Severely Degraded |
| Canopy Cover | 1.0 | Poor | 0.0 | Severely Degraded |
| Overall Score | 5.0 | Poor | 2.9 | Severely Degraded |

Table 3.4 Reach 7 2013 versus 2016 SVAP Comparisons

| | 2013 | | 2016 | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 1.0 | Poor | 1.0 | Severely Degraded |
| Bank Stability/Condition (average) | 10.0 | Excellent | 3.0 | Poor |
| Riparian Zone (average) | 1.0 | Poor | 1.0 | Severely Degraded |
| Water Appearance | 8.0 | Good | 3.0 | Poor |
| Nutrient Enrichment | 7.0 | Fair | 7.0 | Fair |
| Instream Fish Cover | 2.0 | Poor | 1.0 | Severely Degraded |
| Canopy Cover | 1.0 | Poor | 0.0 | Severely Degraded |
| Overall Score | 4.7 | Poor | 2.3 | Severely Degraded |

Table 3.5 Reach 8 2013 versus 2016 SVAP Comparisons

| | 2013 | | 2016 | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 1.0 | Poor | 1.0 | Severely Degraded |
| Bank Stability/Condition (average) | 10.0 | Excellent | 1.5 | Severely Degraded |
| Riparian Zone (average) | 1.5 | Poor | 0.5 | Severely Degraded |
| Water Appearance | 8.0 | Good | 5.0 | Fair |
| Nutrient Enrichment | 7.0 | Fair | 6.0 | Fair |
| Instream Fish Cover | 7.0 | Fair | 3.0 | Poor |
| Canopy Cover | 1.0 | Poor | 3.0 | Poor |
| Overall Score | 6.0 | Poor | 2.9 | Severely Degraded |

Table 3.6 Reach 20 2013 versus 2016 SVAP Comparisons

| | 2013 | | 2016 | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 1.0 | Poor | 0.0 | Severely Degraded |
| Bank Stability/Condition (average) | 10.0 | Excellent | 1.0 | Severely Degraded |
| Riparian Zone (average) | 2.0 | Poor | 0.5 | Severely Degraded |
| Water Appearance | 2.0 | Poor | 3.0 | Poor |
| Nutrient Enrichment | 2.0 | Poor | 6.0 | Fair |
| Instream Fish Cover | 2.0 | Poor | 3.0 | Poor |
| Canopy Cover | 1.0 | Poor | 1.0 | Severely Degraded |
| Overall Score | 3.2 | Poor | 2.1 | Severely Degraded |

Table 3.7 Reach 21 2013 versus 2016 SVAP Comparisons

| | 2013 | | 2016 | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 2.0 | Poor | 2.0 | Severely Degraded |
| Bank Stability/Condition (average) | 9.0 | Excellent | 1.5 | Severely Degraded |
| Riparian Zone (average) | 1.0 | Poor | 1.0 | Severely Degraded |
| Water Appearance | 2.0 | Poor | 3.0 | Poor |
| Nutrient Enrichment | 3.0 | Poor | 6.0 | Fair |
| Instream Fish Cover | 1.0 | Poor | 5.0 | Fair |
| Canopy Cover | 1.0 | Poor | 1.0 | Severely Degraded |
| Overall Score | 3.3 | Poor | 2.8 | Severely Degraded |

Table 3.8 Reach 22 2013 versus 2016 SVAP Comparisons

| | 2013 | | 2016 | |
|---|---|---|---|---|
| **SVAP Element** | **Score** | **Rating*** | **Score** | **Rating+** |
| Channel Condition | 2.0 | Poor | 2.0 | Severely Degraded |
| Bank Stability/Condition (average) | 10.0 | Excellent | 7.0 | Good |
| Riparian Zone (average) | 1.0 | Poor | 1.0 | Severely Degraded |
| Water Appearance | 3.0 | Poor | 7.0 | Good |
| Nutrient Enrichment | 2.0 | Poor | 7.0 | Good |
| Instream Fish Cover | 1.0 | Poor | 0.0 | Severely Degraded |
| Canopy Cover | 1.0 | Poor | 2.0 | Severely Degraded |
| Overall Score | 3.2 | Poor | 3.7 | Poor |

* Ratings (NRCS, 1998)—Poor, Fair, Good, Excellent

+ Ratings (NRCS, 2009)—Severely Degraded, Poor, Fair, Good, Excellent

## 4. Conclusions

The objective of this study was to assess the physical, chemical, and biological conditions of Scajaquada Creek prior to stream restoration. The SVAP (NRCS, 1998 and 2009) was used to qualitatively assess several elements related to overall stream health. This assessment provides the pre-restoration baseline conditions that can be compared to performance data collected throughout the project implementation and post-restoration monitoring phases. This report also compared the results from the current 2016 SVAP assessment to a SVAP assessment that was completed by BNRK in 2013 (BNRK, 2013).

The main impairments in Scajaquada Creek are linked to a highly modified stream channel (channelized with fabricated streambank structures and a lack of instream habitat) and the lack of riparian vegetation, which negatively impacts both the riparian zone and canopy cover element scores. The proposed restoration plan addresses those impairments as follows:

- Enhance and preserve riparian buffers: decrease overland runoff, improve water quality, and increase habitat.
- Create or add meandering planform via bendway weirs: restore the creek to a more natural flow pattern.
- Add emergent/submergent vegetation: increase fish habitat and decrease water temperature.
- Dredge creek: decrease bacterial contamination and botulism. This is especially important in the study reach as the water is deep and has low velocity, causing high sedimentation.
- Replace dredged material: increase instream habitat, redirect, and diversify flow.
- Add floodplain improvements: create a more natural slope, in conjunction with riparian habitat, to allow the creek to flood naturally without causing property damage.
- Discontinue shoal maintenance: prevent mowing of grass in the channel to reduce nutrient inputs into the creek.
- Create emergent wetland: increase habitat and biodiversity and increase flood capacity.

Given the impairments in the creek and the proposed stream restoration project, SVAP scores from post-restoration implementation monitoring should increase.

## 5. References


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Appendix 1
SVAP Field Sheet

# Stream Visual Assessment Protocol

Field Crew _____ Date _____Time _____

Stream Name ___Scajaquada Creek_____ Reach Name_____

Reach GPS Coordinates _____ Photo number(s)_____

Weather conditions today _____ Past 2-5 days _____

_____

Reach length _____ ft; Lowflow channel depth _____ ft; Lowflow channel width _____ ft

Bankfull channel depth _____ ft; Bankfull channel width _____ ft

Dominant bed substrate _____ silt/clay _____ sand _____ gravel _____ cobble _____ boulder _____ bedrock/concrete

## Channel Condition

| | | | |
|---|---|---|---|
| Natural channel with established vegetation.<br><br>No channelization (with or without straightening and/or with or without riprap/concrete/other hard structures).<br><br>No evidence of incision (e.g., downcutting; vertical banks).<br><br>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.<br><br>Bankfull channel and floodplain are connected in most areas; inundated seasonally.<br><br>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.<br><br>Bankfull channel appears to be disconnected from the floodplain, with infrequent or no inundation.<br><br>Active incision evident; steep banks with some bank failures, point bars located adjacent to steep banks.<br><br>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.<br><br>Little or no connection between floodplain and stream channel and no inundation.<br><br>Active incision; steep banks and bank failures prominent; headcuts or surface cracks on banks; point bars, if present, located adjacent to steep banks<br><br>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 |

Channelization: Straightened Yes No Riprap/concrete/other hard structures Yes No

Channel incision and/or Aggradation/widening

## Bank Condition **(orient left & right facing downstream)**

| | | | |
|---|---|---|---|
| Banks are stable; protected by roots of natural vegetation, wood, and rock.<br><br>No fabricated structures present on bank.<br><br>No excessive erosion or bank failures.<br><br>No recreational or livestock access. | Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials.<br><br>Limited number of structures present on bank.<br><br>Evidence of erosion or bank failures, some with reestablishment of vegetation.<br><br>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.<br><br>Fabricated structures cover more than half of reach or entire bank.<br><br>Excessive bank erosion or active bank failures.<br><br>Recreational and/or livestock use are contributing to bank instability. | Banks are unstable; no bank protection with roots, wood, rock, or vegetation.<br><br>Riprap and/or other structures dominate banks.<br><br>Numerous active bank failures.<br><br>Recreational and/or livestock use are contributing to bank instability. |
| LB: 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| RB: 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

| | | |
|---|---|---|
| LB Condition: | Natural or Riprap/concrete/other hard structures | Bank slope class: gentle; moderate; steep; undercut ($0\text{-}29^{o}$; $30\text{-}49^{o}$; $50\text{-}90^{o}$; portion of bank > $90^{o}$) |

| | | |
|---|---|---|
| RB Condition: | Natural or Riprap/concrete/other hard structures | Bank slope class: gentle; moderate; steep; undercut ($0\text{-}29^{o}$; $30\text{-}49^{o}$; $50\text{-}90^{o}$; portion of bank > $90^{o}$) |

### Riparian Zone **(orient left & right facing downstream)**

| | | | | |
|---|---|---|---|---|
| Vegetation extends at least two bankfull channel widths from the top of the bankfull channel.<br><br>Vegetation is generally contiguous along the entire length of the reach. | Vegetation extends one bankfull channel width from the top of the bankfull channel.<br><br>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.<br><br>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.<br><br>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.<br><br>Vegetation gaps exceed 30% of the reach length. |
| LB: 10 9 | 8 7 | 6 5 | 4 3 2 | 1 0 |
| RB: 10 9 | 8 7 | 6 5 | 4 3 2 | 1 0 |

### Water Appearance

| | | | |
|---|---|---|---|
| Water is very clear, or clarity appropriate to site.<br><br>Submerged objects (rocks, wood) are visible at depths 3 to 6 ft.*<br><br>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.<br><br>Submerged objects are visible at depth 1.5 to 3 ft.<br><br>No oil sheen on surface; no evidence of metal precipitates in stream. | Water is turbid most of the time.<br><br>Submerged objects visible to depth 0.5 to 1.5 ft.<br>and/or<br>Oil sheen is present on water surface or areas of slackwater<br>and/or<br>There is evidence of metal precipitates in stream. | Water is very turbid or has a muddy appearance most of the time.<br><br>Objects visible to depth <0.5 ft.<br>and/or<br>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.<br><br>Little algal growth present.<br><br>Diverse aquatic plant community includes low quantities of many species of aquatic plants. | Fairly clear or slightly greenish water along entire reach.<br><br>Moderate algal growth on stream substrates. | Greenish water along entire reach, especially in slow sections.<br><br>Abundant algal growth, especially during warmer months.<br><br>Overabundance of lush green aquatic plants, especially in slow sections. | Water is a pea green color.<br><br>Severe algal blooms create thick algal mats in stream.<br><br>Dense stands of aquatic plants clog stream. |
| 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

Algal growth Dense aquatic plant beds 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: _____.

### Canopy Cover—*score only if applicable**

*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)

### Additional Notes: