

Project Name	Brown's Creek Stream Visual Assessment & Geomorphic Survey	Date	05/2/2023
To / Contact info	BCWD Board of Managers		
Cc / Contact info	Karen Kill, District Administrator		
From / Contact info	Mike Majeski & Dan Mosing		
Regarding	SVAP & Geomorphic Data Assessment and Drone Flight Upstream of Manning Avenue		

Background

In response to specific questions related to sediment contributions to Brown's Creek and habitat quality, the District has made a commitment to conduct reoccurring riparian assessments and geomorphic surveys of Brown's Creek to better understand how the channel condition and riparian vegetation changes over time. The BCWD 2017-2026 Watershed Management Plan includes "monitoring the geomorphology of Brown's Creek and its tributaries on a biennial basis" for the purposes of evaluating stream health and identifying potential sediment loads to the creek.

Within the last five years the BCWD has investigated the use of drones to supplement the riparian assessments. The drone flights are useful for identifying areas of bank erosion and channel obstructions and allow the District to efficiently locate obstructions and other stream-related issues along the channel in remote reaches and wetland areas that are difficult to traverse on foot, especially the wetland-dominated reach upstream of Manning Avenue.

EOR conducted baseline geomorphic surveys along Brown's Creek in 2007 & 2008 as part of the Brown's Creek TMDL project, and baseline visual stream assessments were completed in 2016. Following BCWD Board approval to replicate the visual assessments and geomorphic surveys, EOR completed the stream visual assessments in 2021 and the geomorphic stream surveys in 2022. The field work included a drone survey upstream of Manning Avenue, visual stream assessments from Manning Avenue to the St. Croix River, and geomorphic surveys at historic locations to monitor channel change over time. In addition, the data collected from this assessment was used by the District in 2022 to pursue funding for District stream projects over the next 5 years for the 2017-2026 Watershed Management Plan. The following memo summarizes the findings of the field assessment.



Stream Visual & Drone Assessments

Drone Survey Upstream of Manning Avenue

A drone flight was conducted on April 11, 2022 from Manning Avenue upstream to the headwaters north of 110th Street. Minor channel obstructions were observed from the drone including two small beaver dams at the same locations identified in 2016. No significant channel obstructions or signs of bank erosion were observed, but one new tributary crossing was identified upstream of Manning Avenue, southwest of 97th St. N. Select images taken from the drone flight are included in Appendix A, and the complete drone flight video has been archived at the BCWD office.

Stream Visual Assessment

The Stream Visual Assessment Protocol (SVAP) was used to assess the creek from Manning Avenue to the St. Croix River. The SVAP is a stream assessment tool developed by the NRCS to evaluate the overall condition of wadeable streams, their riparian zones, and their instream habitats. Since publication of the initial version of the SVAP in 1998, the protocol was re-issued in 2009 as SVAP2 and has taken on broader applications as a tool to evaluate quality criteria for conservation planning, identify potential resource concerns, and assess trends in stream and riparian conditions over time. The tool assesses visually apparent physical, chemical, and biological features within a specified reach of a stream corridor. Due to its qualitative nature, the protocol may not detect all causes of resource concerns, especially if such causes are a result of land use changes in the watershed.

Each stream reach was assessed by eleven SVAP2 elements (described in Appendix B) and rated with a value of 1 to 10. Generally, a score of 10 is of reference reach quality, a score of 5 has moderate impacts, and a score of 1 indicates the stream is severely impacted. Twenty-eight stream reaches were assessed from Manning Avenue to the St. Croix River (Figure 1). The lowest score of the all the reaches assessed was 4.9. This reach is associated with a private parcel immediately north of Highway 96 where the stream banks have been stabilized with rock riprap and the adjacent riparian corridor was comprised of mowed lawn. Although the stream banks are very stable in this reach, the SVAP2 adversely scores rock riprap due to its negative influence on near-stream habitat such as overhanging vegetation and undercut banks. In addition, the presence of mowed lawn within the floodplain negatively impacts the scores of other elements including riparian vegetation quantity and quality. The highest scores from the assessment included two consecutive reaches downstream of Highway 96 (scores of 9.0) and four consecutive reaches in the Brown's Creek gorge (scores of 9.1). Both areas are located in high quality riparian corridors with diverse native vegetation and very good instream habitat. These sites have stable stream banks, a functional and connected floodplain, and diverse instream habitats with exposed substrates that support a variety of macroinvertebrates. Reaches that scored "Fair" included the creek section recently proposed for stream restoration between McKusick Road and the Brown's Creek State Trail. These reaches contained an incised channel, a disconnected floodplain, eroding banks, and poor riparian vegetation dominated by invasive species including common buckthorn, honeysuckle, and Amur maple. See Appendix B for scores of all 28 reaches assessed.

Geomorphic Surveys

Geomorphic surveys were conducted at the same locations where baseline geomorphic surveys were completed in 2007 and 2008 and extended from Manning Avenue to the St. Croix River (see cross section plots on pages 4-8). Bank erosion rates measured at established creek cross section locations ranged from 0.1 to 0.2 feet/year, with localized bank erosion rates at a few cross sections that were near 0.5 feet/year. In the Brown's Creek gorge, bank erosion rates were very low (less than 0.1 feet/year) due to presence of bedrock and coarse substrates that protect the stream banks. Variables that affect the observed bank erosion rates include bank cover (vegetation, wood, or rock), the degree of channel incision, channel sinuosity, bank soils composition (silt/clay versus peat or sandy loam), and channel slope. Based on the cross sections surveyed between 2007/2008 and 2022, a greater amount of bank erosion has occurred between Millbrook and the Oak Glen golf course, and at a localized reach north of Oak Glen golf course compared to other reaches surveyed. Although

sediment and nutrient loading calculations from these reaches were beyond the scope of this effort, the proposed Brown's Creek Park Restoration project overlaps a significant portion of this eroded section and will reduce sediment and nutrient loads to Brown's Creek. Future stream restoration efforts should focus on the reach upstream of the western McKusick Road crossing and the reach north of Oak Glen golf course upstream of the Stone Arch Bridge.

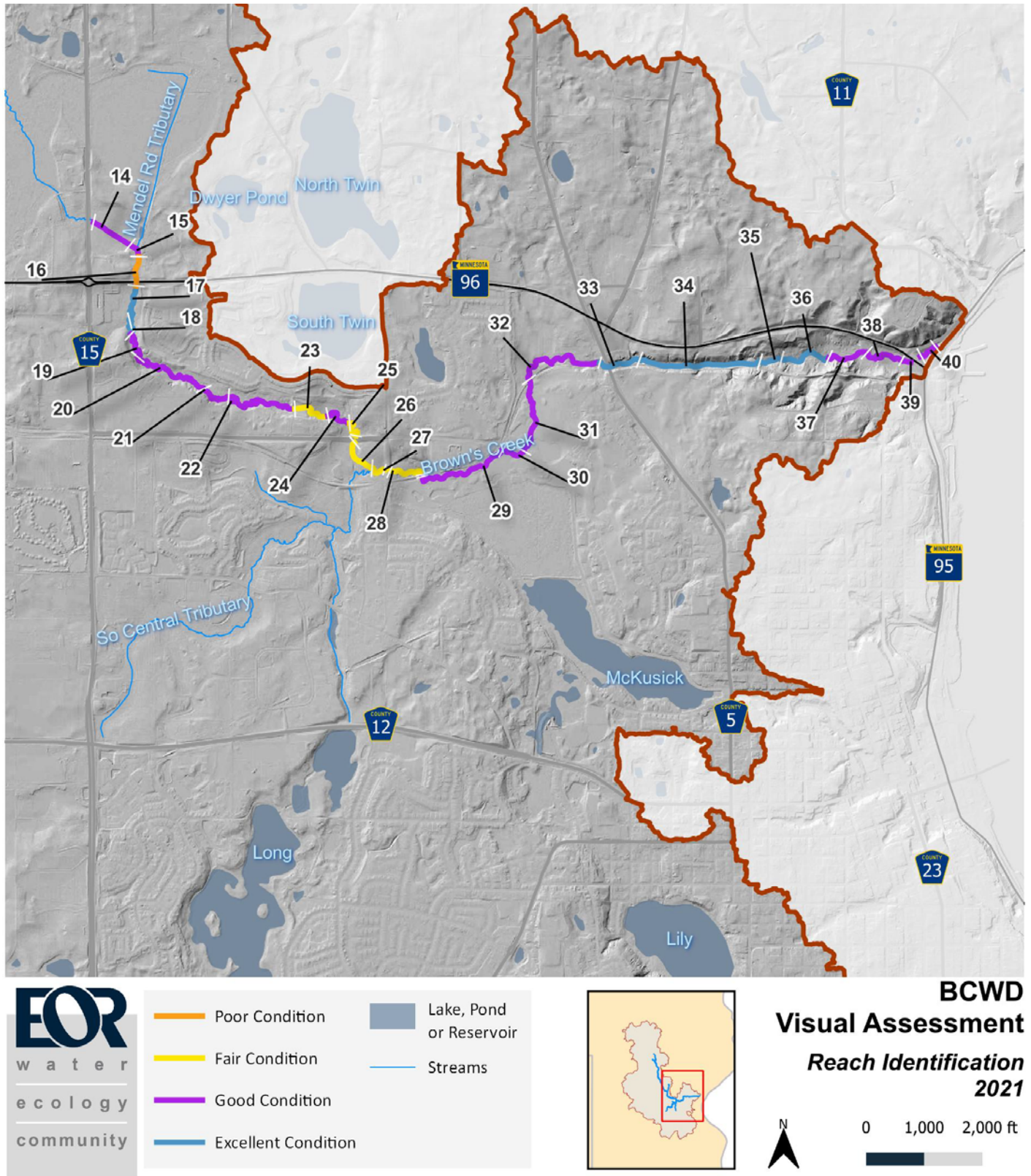
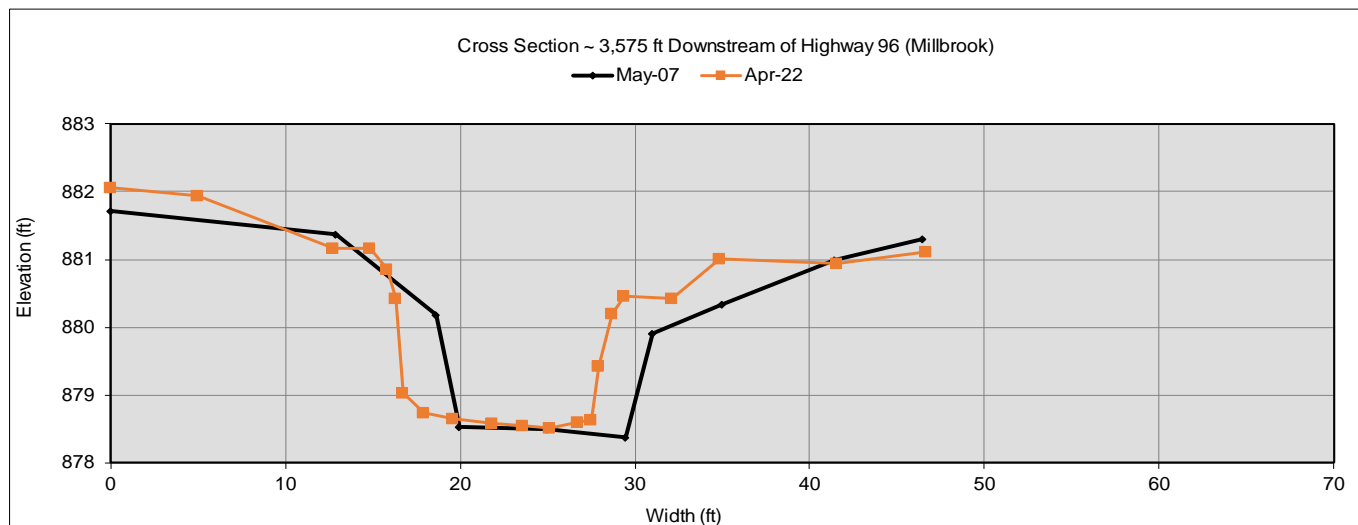
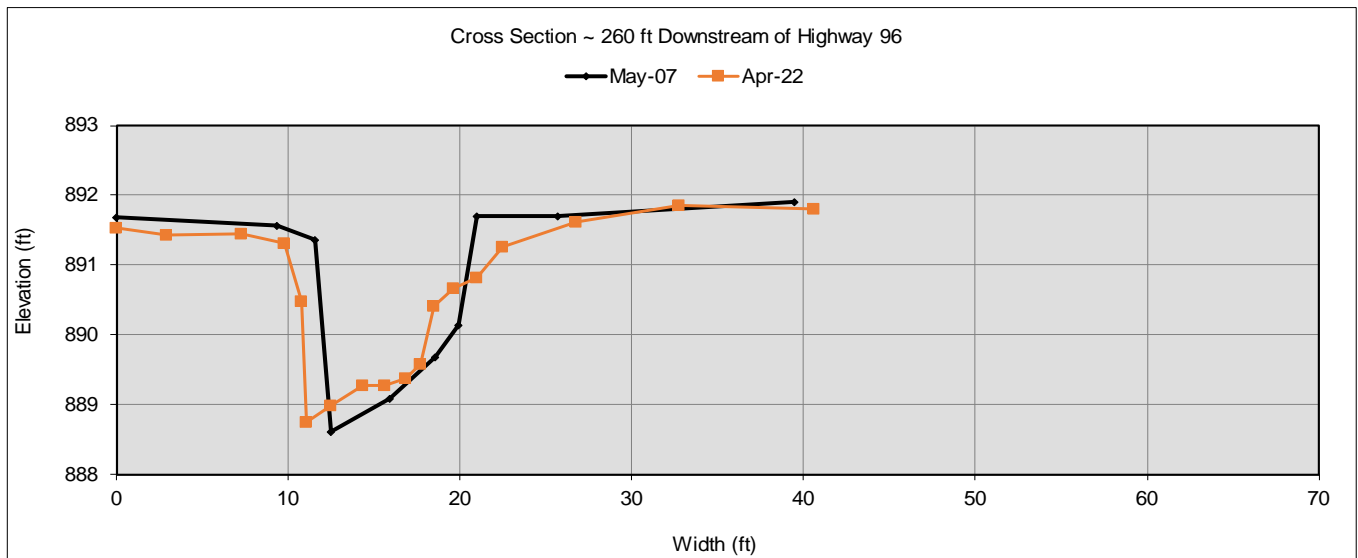
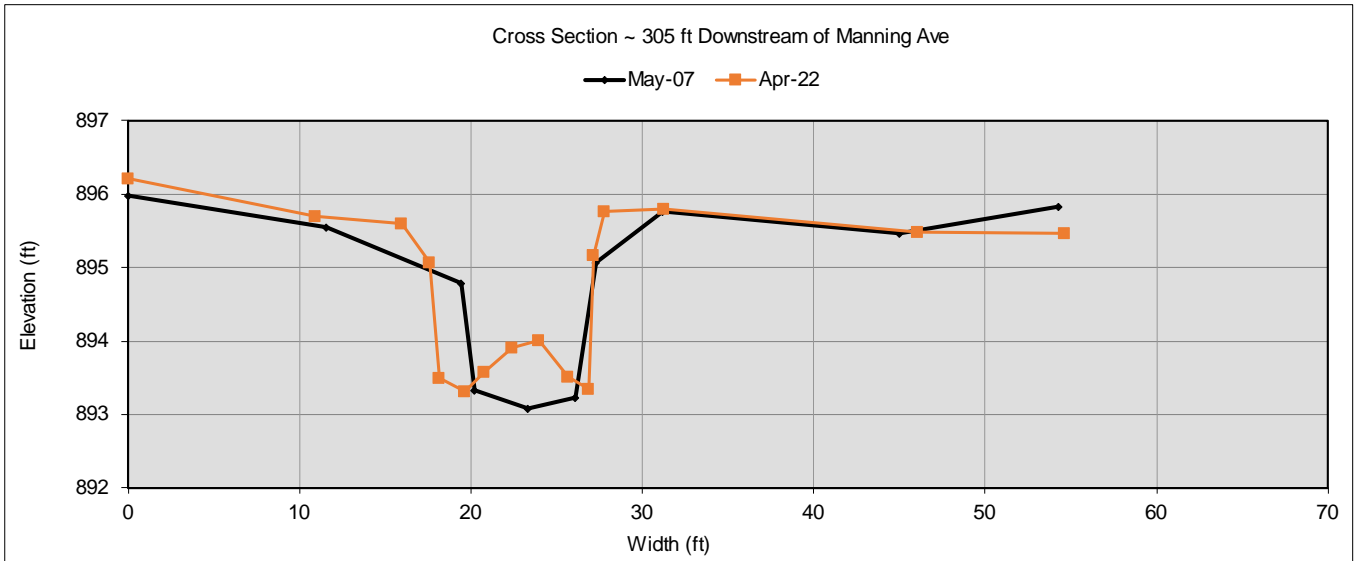
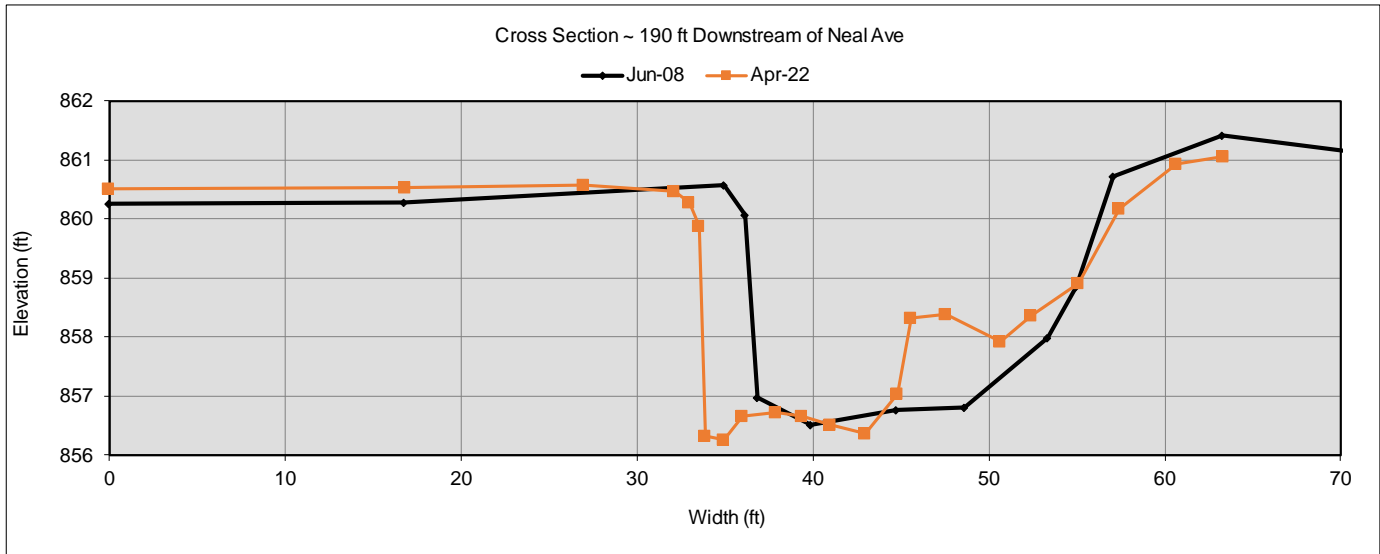
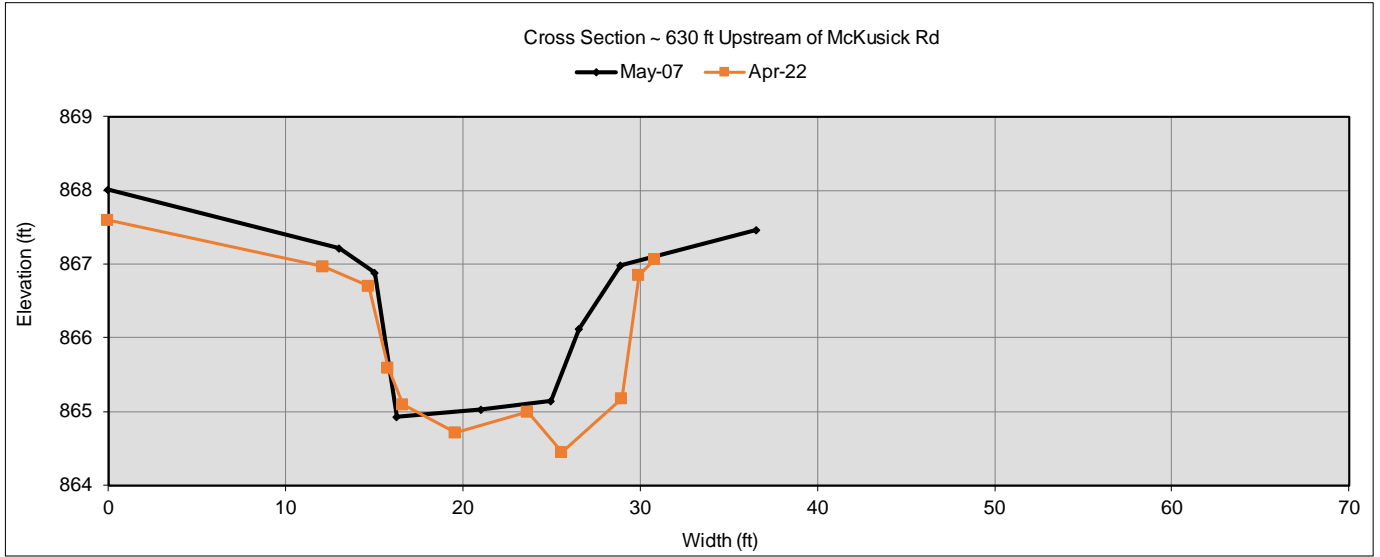
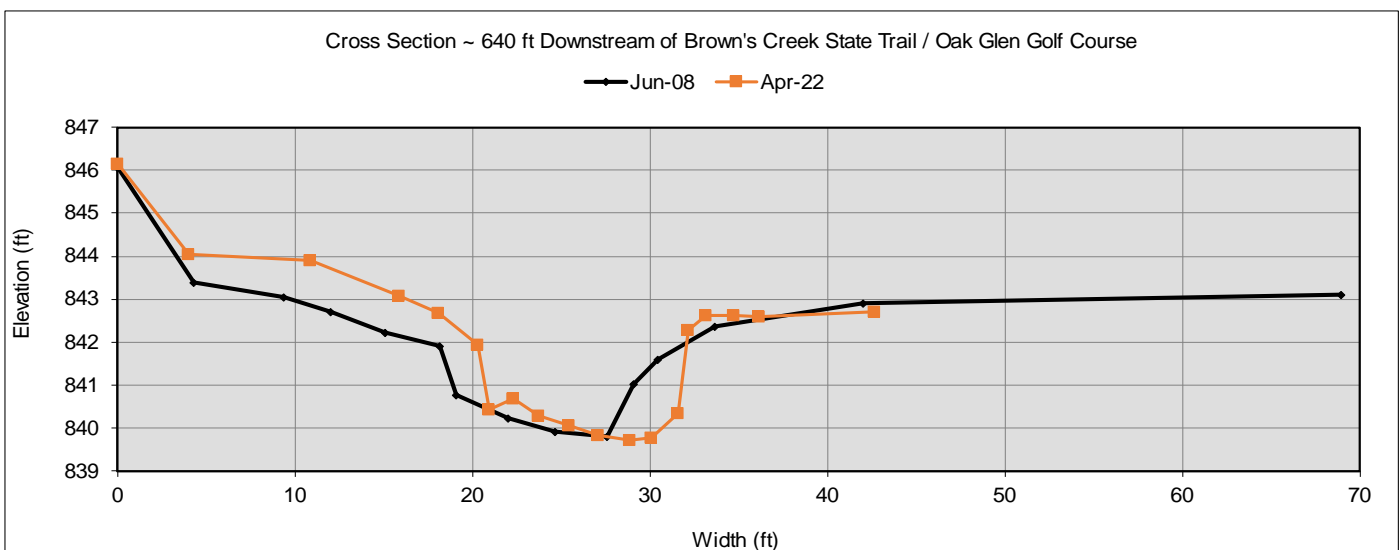
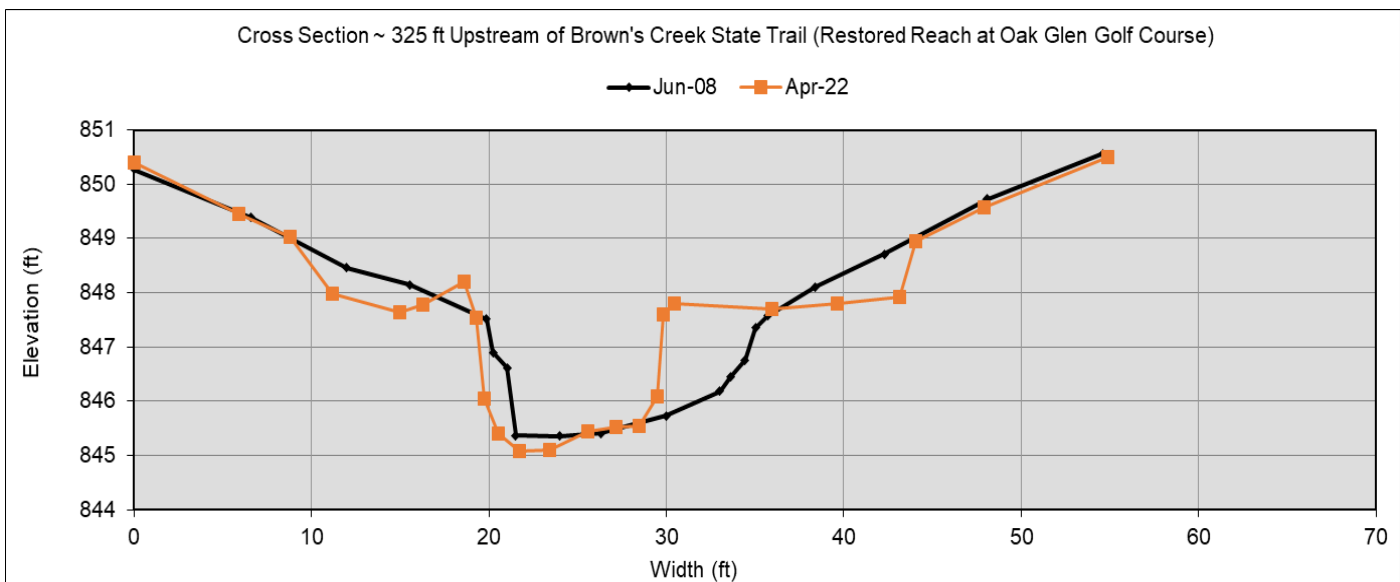
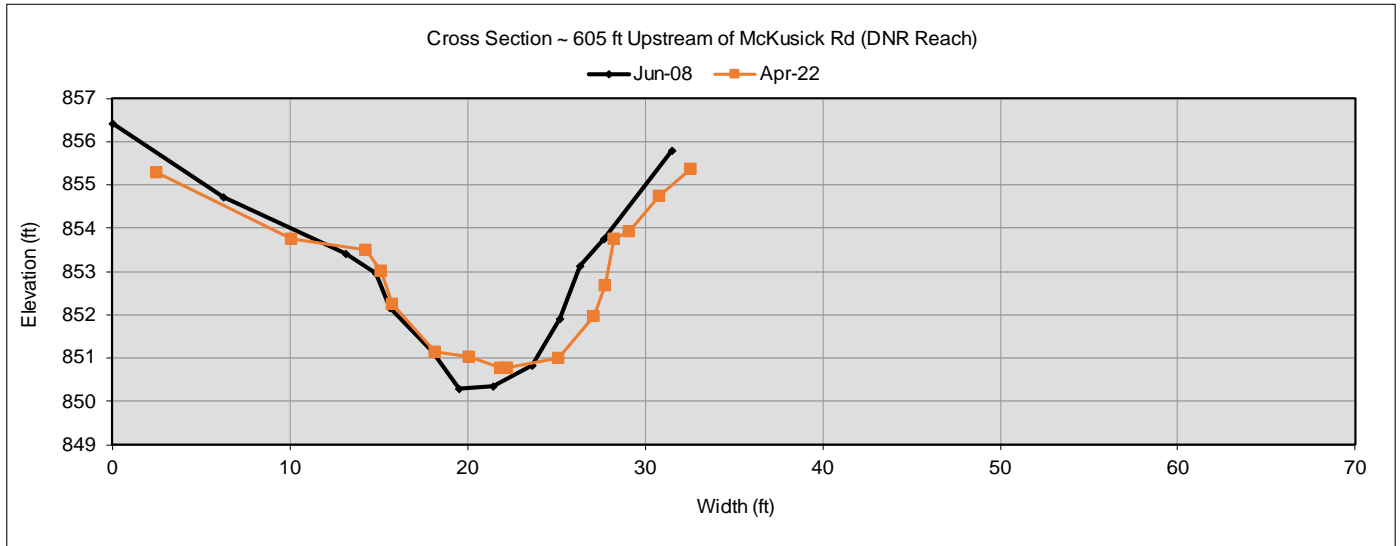
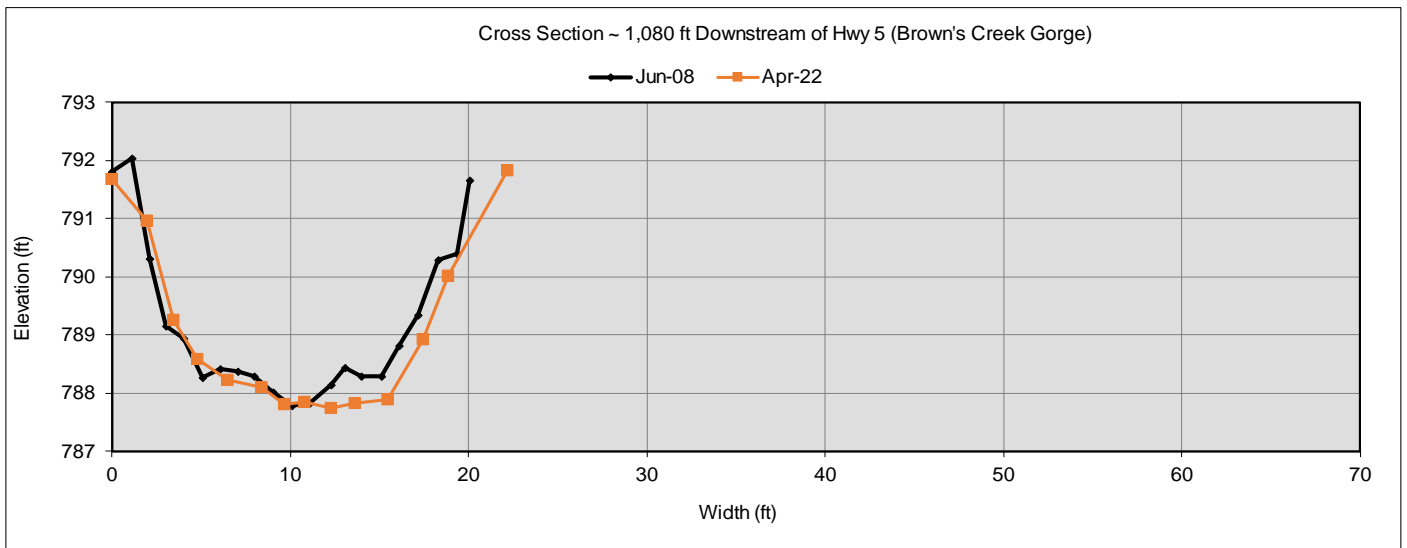
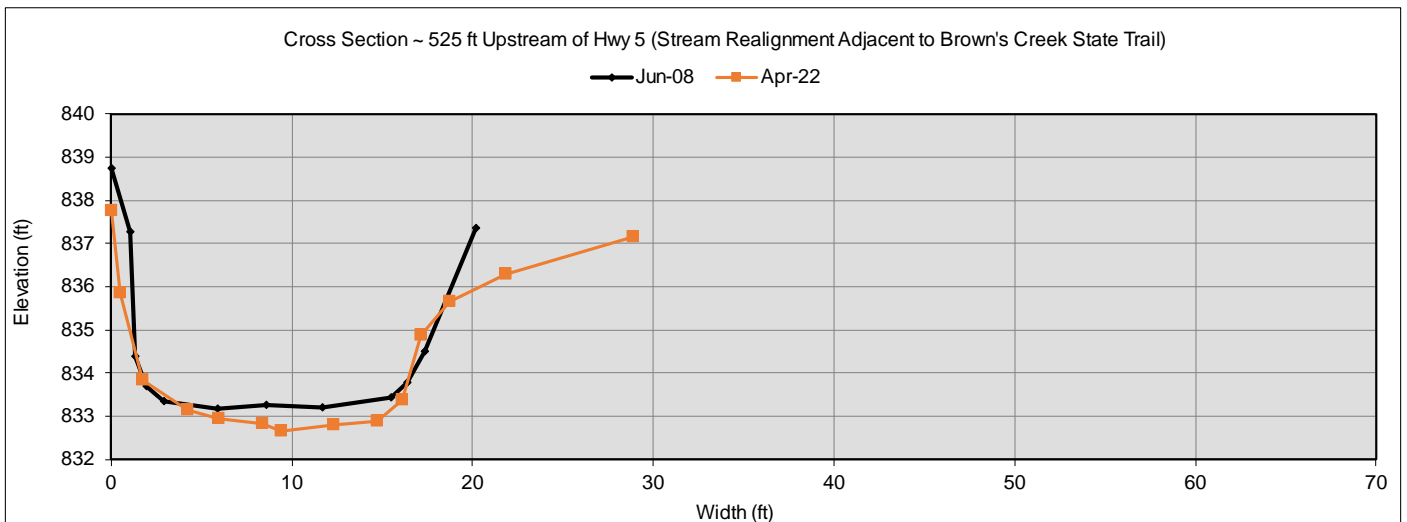
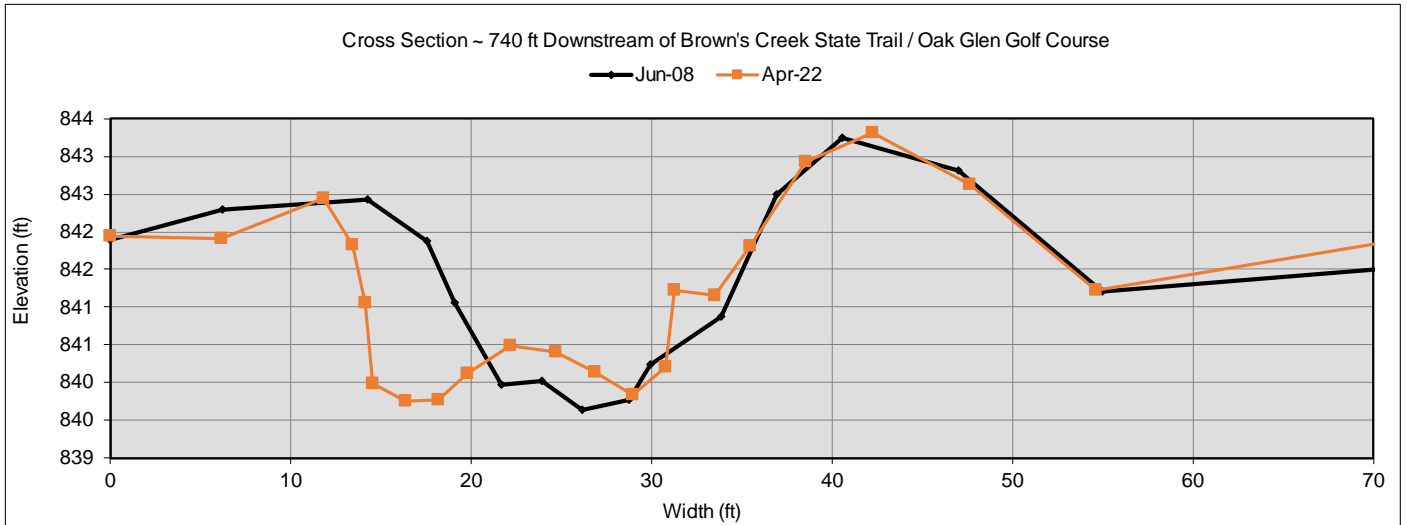


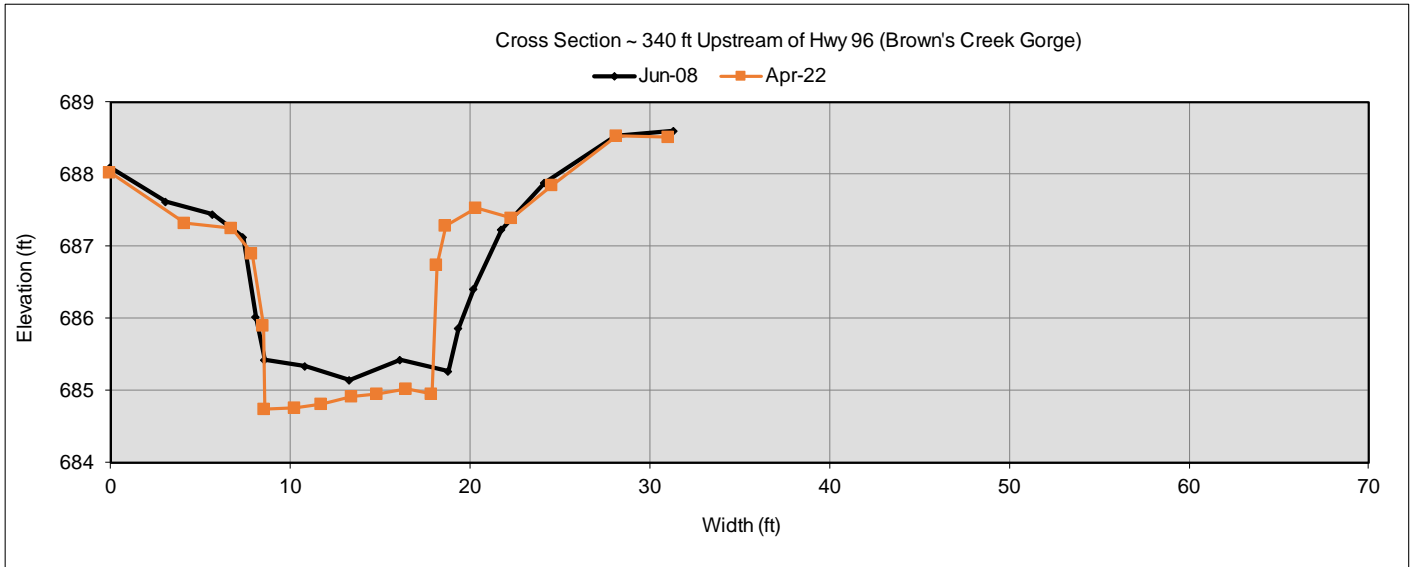
Figure 1. SVAP2 reaches assessed from Manning Avenue to the St. Croix River. Refer to Appendix B for individual reach scores









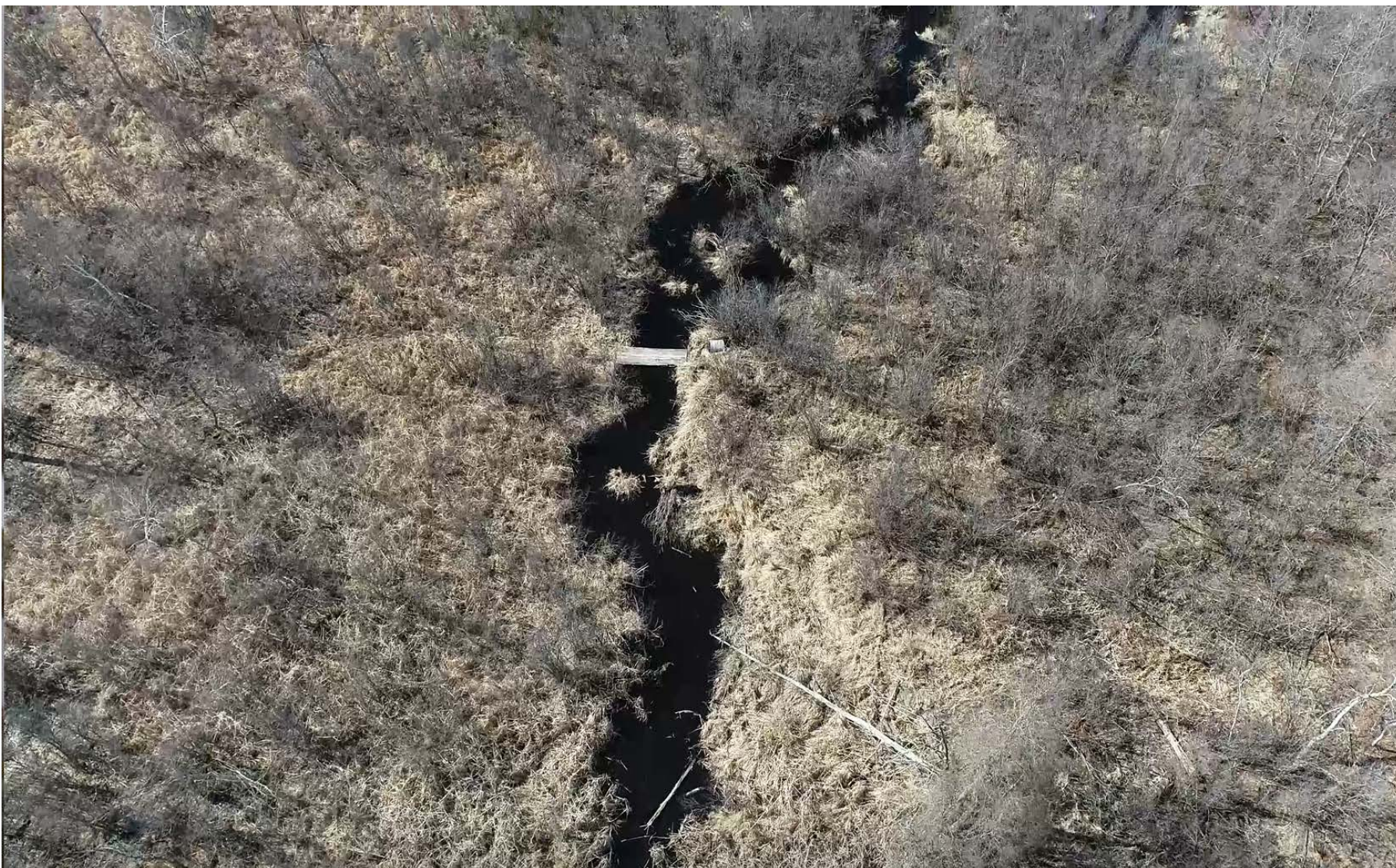


Appendix A

Select Images from the Drone Flight Upstream of Manning Avenue



Image of the headwaters of Brown's Creek and the beginning of perennial flow



Small wood bridge over Brown's Creek in the headwaters reach north of 110th St



Driveway crossing and small foot bridge over Brown's Creek just upstream of 110th St



Twin culverts under a trail crossing downstream of 110th St



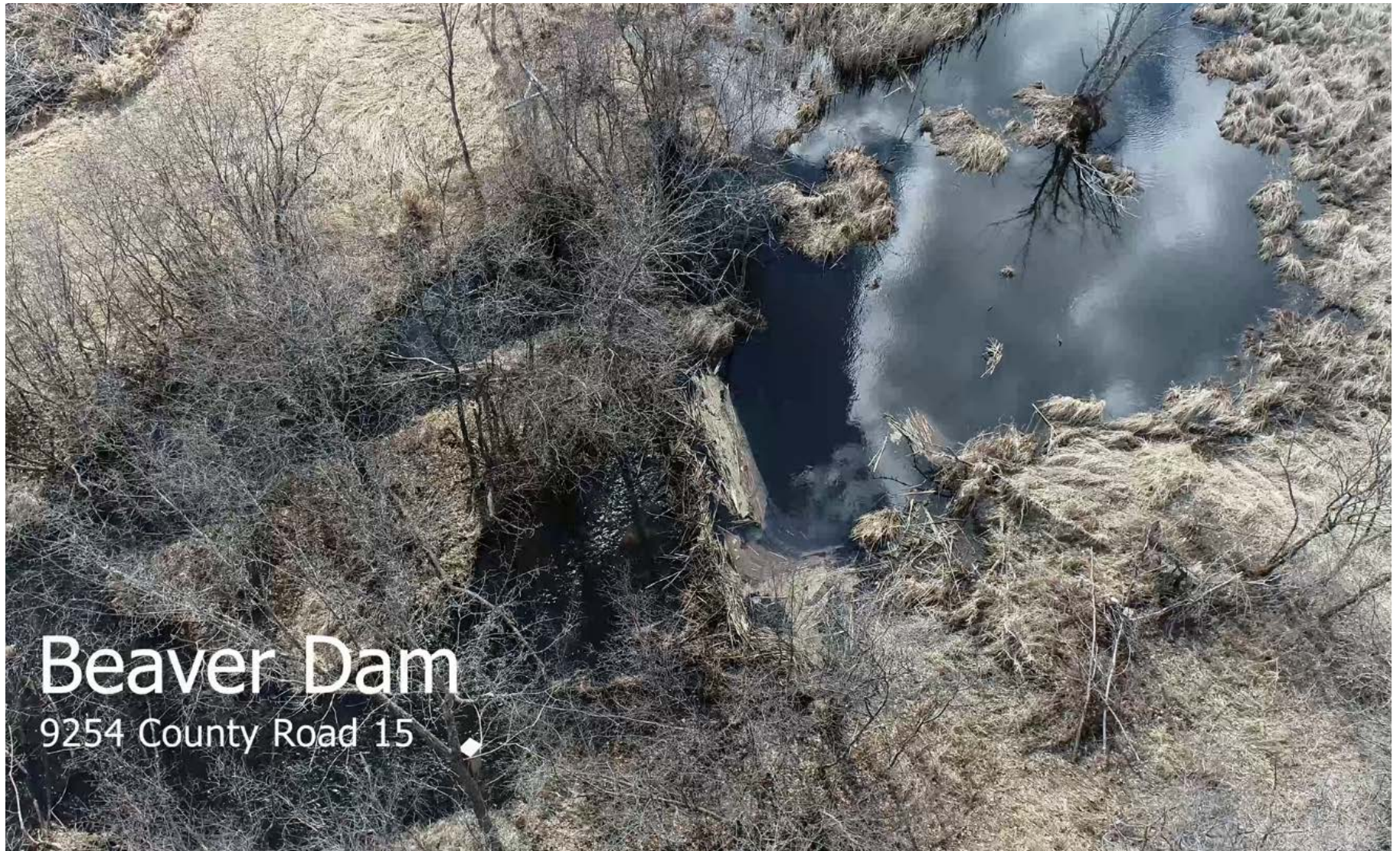
Location of previous large beaver dam (yellow line) that spanned the entire floodplain downstream of the Gateway Trail



Wood bridge and small beaver dam (yellow oval) near private parcel west of 97th St. N / downstream of the Gateway Trail



New bridge crossing (yellow circle) over a small tributary southwest of 97th Street N



Beaver Dam

9254 County Road 15

Beaver dam located upstream of Manning Avenue

Appendix B

SVAP2 Element Descriptions and Individual Reach Scores from Brown's Creek

Channel Condition

Channel condition is a description of the geomorphic stage of the channel as it adjusts its shape relative to its floodplain. Channel adjustments that result in a dramatic drop in streambed elevation (incision) or excessive deposition of sediment that raises the bed elevation (aggradation) affect the degree of bank shear and often decrease stream channel stability.

Hydrologic alteration

Hydrologic alteration is the degree to which hydrology and streamflow conditions differ from natural, unregulated flow patterns. Streamflow regime affects the distribution and abundance of stream species and influences the health of streams through physical and chemical processes.

Bank Condition

Stable streambanks are essential components of functional physical habitat and biological communities. Accelerated bank erosion can cause excess fine sediment to build up in a stream which can impact certain aquatic species and often results in water quality impacts within the system and downstream resources.

Riparian Quantity

The riparian area is the vegetated zone adjacent to a stream that functions as a transitional area between the stream and the adjacent upland. Riparian vegetation thrives on the moisture provided by streamflow and ground water associated with the stream corridor. Riparian areas may or may not include floodplains and associated wetlands, depending on the valley form of the stream corridor.

Riparian Quality

The composition of vegetation within the riparian corridor includes both the herbaceous layer and the canopy layer, and the degree of invasive species present can impact the composition and distribution of native species present along the stream. Riparian corridors with significant massings of invasives species typically result in low diversity of the herbaceous layer and may result in exposed soils due to dense shade.

Canopy Cover

In forested riparian areas, shading of the stream is important because it helps maintain cool water temperatures and limits algal growth. Cool water can hold more dissolved oxygen than warm water. When streamside vegetation is removed, the stream is exposed to the warming effects of the sun, causing the water temperature to increase and dissolved oxygen to decrease for longer periods during the daylight hours and for more days during the year.

Water Appearance

The water appearance assessment element compares turbidity, color, and other visual characteristics of water with those from a reference reach. The assessment of turbidity is the depth to which an object can be clearly seen, typically measured with a turbidity-tube or water quality sonde.

Barriers to Aquatic Species Movement

Passage barriers may prevent the movement or migration of fish, limit access to spawning or foraging habitats, and isolate populations of fish and other aquatic animals. Natural physical barriers include waterfalls, cascades, large rapids, and beaver dams. Fabricated physical barriers include dams, sills, culverts, weirs, and other structures.

Riffle Embeddedness

Riffles are critical for maintaining high species diversity and abundance of macroinvertebrates and provide spawning and foraging opportunities for fish. Embeddedness measures the degree in which gravel and cobble substrates are covered (or embedded) by fine sediment. Embeddedness relates directly to the availability and suitability of stream substrates as habitat for macroinvertebrates, fish, and other aquatic organisms.

Fish Habitat Complexity

The dynamic features of stream corridors create diverse habitat types and conditions for fish and invertebrates. Quality fish habitat contains a variety of different habitat types created by various combinations of water quality and quantity, water depth, velocity, channel substrates (sand, gravel, cobble, wood), and aquatic & riparian vegetation. The greater the variety of habitat features, the more likely a stream can support a diversity of aquatic species.

Pools

Streams with a mix of shallow and deep pools offer diverse habitats for a variety of aquatic species. In general, a deep pool has a water depth that is 2 times the maximum depth of its upstream riffle while a shallow pool has a water depth that is less than 2 times the maximum depth of its upstream riffle.

Reach ID	Total Element Score	Reach Score	Channel Condition	Hydro Alteration	Bank Condition		Riparian Quantity		Riparian Quality		Canopy Cover	Water Appearance	Fish Barriers	Riffle Embeddedness	Fish Habitat Complexity	Pools
					Righ bank	Left Bank	Righ bank	Left Bank	Righ bank	Left Bank						
14	109	8.3	10	10	10	10	10	10	6	6	1	9	10	5	5	7
15	104	7.4	9	10	7	7	9	9	5	5	10	9	10	5	5	4
16	68	4.9	8	10	1	1	2	2	1	1	7	9	10	5	4	7
17	118	9.0	9	10	10	10	10	10	8	8	1	9	10	7	6	10
18	118	9.0	9	10	10	10	10	10	8	8	1	9	10	7	6	10
19	111	8.5	8	10	9	9	10	10	8	8	1	9	10	6	5	8
20	105	7.9	7	10	8	8	10	10	7	7	2	9	10	5	6	6
21	102	7.3	7	10	6	6	10	10	5	5	9	9	10	2	6	7
22	101	7.2	7	10	6	6	10	10	5	5	8	9	10	2	6	7
23	97	6.9	6	10	5	5	10	10	5	5	7	9	10	2	6	7
24	118	8.4	9	10	8	8	9	9	6	6	10	9	10	8	6	10
25A	120	8.6	10	10	9	9	10	10	6	6	10	9	10	8	6	7
25B	94	6.7	5	8	5	5	10	10	4	4	10	9	10	2	6	6
26	90	6.4	4	6	6	6	10	10	5	5	6	9	10	2	6	5
27	92	6.6	5	5	6	8	9	9	3	3	9	9	10	5	6	5
28	90	6.4	5	5	6	7	8	8	3	3	10	9	10	5	6	5
29	124	8.9	9	10	9	9	8	8	8	8	10	9	10	8	8	10
30	124	8.9	9	10	9	9	8	8	8	8	10	9	10	8	8	10
31	112	8.4	9	10	9	9	7	7	7	7	3	9	10	7	8	10
32	116	8.3	9	10	9	9	7	7	7	7	7	9	10	7	8	10
33	127	9.1	9	10	9	9	10	10	7	7	10	9	10	9	8	10
34	127	9.1	9	10	8	8	10	10	8	8	10	9	10	9	8	10
35	127	9.1	9	10	8	8	10	10	8	8	10	9	10	9	8	10
36	127	9.1	9	10	8	8	10	10	8	8	10	9	10	9	8	10
37	123	8.8	9	10	6	6	10	10	8	8	10	9	10	9	8	10
38	113	8.1	6	10	6	6	10	10	8	8	9	9	10	6	7	8
39	118	8.4	9	10	9	9	10	10	6	6	6	9	10	6	8	10
40	115	8.2	9	10	9	9	10	10	6	6	5	9	10	5	7	10

Reach Score Grading System
1 - 2.9 Severely Degraded
3 - 4.9 Poor
5 - 6.9 Fair
7 - 8.9 Good
9 - 10 Excellent

SVAP2 scores of 28 reaches along Brown's Creek from Manning Avenue and the St. Croix River, listed upstream to downstream. Refer to Figure 1 for a map of the reaches