Naiscoot River Fish Habitat Assessment

Executive Summary

The Eastern Georgian Bay Stewardship Council (EGBSC) received funding from Environment and Climate Change Canada to carry out a 32-month project to assess spawning, nursery, rearing, and foraging habitat in eight tributaries to eastern Georgian Bay, which included the Naiscoot River. Fish habitat assessments were focused on Walleye, Lake Sturgeon, and Sucker species, between the river mouths and the first major spawning area or barrier to fish passage.

During the 2017 spawning season, EGBSC visited the Naiscoot River spawning bed seventeen (17) times and the Harris Branch spawning bed nineteen (19) times between April 15 and June 20. Basic water chemistry measurements (water temperature, dissolved oxygen, pH, conductivity) were recorded on all site visits and were generally within the expected range for Canadian Shield waters.

Two stations were set up at the Naiscoot Dam spawning bed and four stations at the Harris Branch spawning bed to measure water velocity and water level fluctuations. All water velocity measurements were under 2.0 m/s at both spawning beds and would not likely limit fish movement throughout either spawning bed. At the Naiscoot Dam spawning bed, it is likely that fish are able to swim past the rapids, right up to the base of the dam. It is possible that velocities in the uppermost areas of the rapids at the Harris Branch spawning bed exceed 2.0 m/s, however, these are areas with predominantly bedrock and large boulder substrate, not ideal spawning habitat for Walleye, Lake Sturgeon, or Sucker. It is unknown whether fish are able to move beyond the rapids, further upstream.

Water levels at both sites fluctuated throughout the spawning and egg incubation periods with the Harris Branch spawning bed exhibiting a more consistent decreasing trend. Nevertheless, the spawning beds remained underwater and egg stranding was not observed at either site.

No Walleye were seen at the Naiscoot Dam spawning bed and only a very limited number of Sucker were seen during two night surveys. No eggs of any kind were deposited on the egg mats at this site. Very few Walleye and Sucker were observed at the Harris Branch spawning bed during the second of two night surveys (no fish seen on the first night survey). Sucker were observed in much larger numbers in the stretch of river around, and just upstream of, the Highway 69 bridge during two regular site visits. A relatively low number of Walleye and Sucker eggs were deposited on egg mats at the Harris Branch spawning bed. No signs of Lake Sturgeon were observed in the Naiscoot River.

Plankton samples were taken during the time when fry would likely be hatching. These composite samples were visually compared to samples collected from the other tributaries being assessed in 2017 – Key River and Pickerel River. The Naiscoot River downstream of the spawning beds is considered to have good plankton production.

In the fall of 2017, four transects were measured across the Naiscoot Dam spawning bed and forty-nine (49) were measured across the Harris Branch spawning bed with the intent of better understanding depth and substrate. At the Naiscoot Dam, all of the transects had at least some substrate considered ideal for Walleye, Lake Sturgeon, and/or Sucker spawning, at the appropriate depth. The same was true for forty-five (45) of the forty-nine (49) transects at the Harris Branch spawning bed.

To assess nursery, rearing, and foraging habitat available downstream of the spawning beds, thirteen (13) underwater surveys were conducted. Bathymetry, side scan sonar data, and aerial photography were also collected. Based on these surveys, there appeared to be a diversity of substrate in the nearshore area including bedrock, boulder, cobble, sand, gravel, clay, and silt. Clay was present in the greatest number of surveys. Density of aquatic vegetation ranged from sparse to abundant. Areas with no vegetation or sparse vegetation could potentially provide habitat for different life stages than areas with moderate to abundant vegetation. Sixty-two (62) percent of the surveys had an abundant amount of wood structure, which provides habitat and cover for fish. Overall, the predominantly natural shorelines of the Naiscoot River (97% natural, 3% altered) offer a good diversity and amount of habitat for many fish species.

Overall, EGBSC's observations were consistent with studies from the 1980s and early 1990s – a small number of Walleye, and a larger number of Sucker, spawn at the Harris Branch spawning bed. Moreover, Walleye spawning at the Naiscoot Dam spawning bed has not been confirmed. EGBSC recommends returning to Pickerel Pot and areas of suspected shoal spawning to compare present populations with those from the 80s and early 90s. EGBSC also recommends further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys. EGBSC does not recommend any habitat restoration at these sites.

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Project Overview and Methodologies

In 2015, the Eastern Georgian Bay Stewardship Council (EGBSC) received funding from Environment and Climate Change Canada to carry out a 32-month project to assess spawning, nursery, rearing, and foraging habitat in eight tributaries to eastern Georgian Bay, within the Parry Sound District. Lake Sturgeon, Walleye, and Sucker species have been experiencing varying levels of decline in parts of eastern Georgian Bay. Accordingly, fish habitat assessments were focused on these species with the goals of: (1) determining whether there is sufficient habitat available; and (2) identifying and prioritizing opportunities for restoration. Assessments were carried out between the river mouths and the first major spawning area or barrier to fish passage.

EGBSC formed a collaborative working group to aid in the development of a field protocol for data collection. This group consisted of:

- Arunas Liskauskas, Dave Gonder, Chris Davis, and Stephen James – Upper Great Lakes Management Unit, Ministry of Natural Resources and Forestry
- Scott Finucan – Ministry of Natural Resources and Forestry
- Greg Mayne – Environment and Climate Change Canada
- Karl Schiefer – Aquatic Biologist consultant and EGBSC member
- David Bywater – Environmental Scientist, Georgian Bay Biosphere Reserve
- David Sweetnam – Executive Director, Georgian Bay Forever

Two main protocols were considered for this project. The first was the Ontario Stream Assessment Protocol (OSAP), which is a standardized method of measuring and collecting field data in the province of Ontario. This protocol is applicable to wadeable streams. The rivers being considered in this project were non-wadeable. Nevertheless, components of the OSAP protocol were used when assessing spawning beds in late summer and fall.

The other protocol considered for tributary classification was the Rosgen Classification system. This protocol is often used in stream restoration projects. However, the Rosgen Classification system was designed based on U.S. rivers and may not be appropriate for central Ontario rivers. Consequently, the Rosgen Classification was not used.

EGBSC completed broad habitat surveys on each river – Shebeshekong, Seguin, Magnetawan, Shawanaga, Key, Pickerel, Naiscoot, Sucker Creek – to record the location and evaluate the amount and quality of habitat available. During assessments, EGBSC also considered whether there were habitat limitations from human or natural stressors and identified any potential restoration opportunities.

As part of the broad habitat assessments, the following information was collected on each river:

- Basic water quality parameters (pH, conductivity, dissolved oxygen)
- Water temperature
- Water velocity
- Water level fluctuations
- Aerial photographs
- Underwater photographs and videos

- Substrate type
- General size of habitat
- Accessibility of spawning areas during different flow regimes
- Potential limitations or indicators of stress
- Opportunity for restoration

For the assessments, EGBSC used a combination of methods to collect data and brought in standardized protocols where possible. The project advisory team helped guide the technical aspects of this project to ensure the data collected was not only valuable but useable for other work and reports.

To collect high quality imagery of the sites, EGBSC purchased and used a DJI Phantom 3 Advanced quadcopter.

Three software programs were used as part of this project. Pix4D was used to create orthomosaics from the drone photography. Reefmaster was used to map bathymetry and side scan sonar data that was collected using a Lowrance unit. Finally, QGIS 2.18 was used for mapping.

In addition to gathering field data, EGBSC also collected background information and local knowledge when possible. The information that can be shared is provided in the Background Information section.

Background Information

The Naiscoot River enters Georgian Bay via three channels just north of Bayfield Inlet, and receives water from the south branch of the Magnetawan River (Figure 1). The river and its watershed are situated in the ancestral and traditional territory of the Anishinabek people.

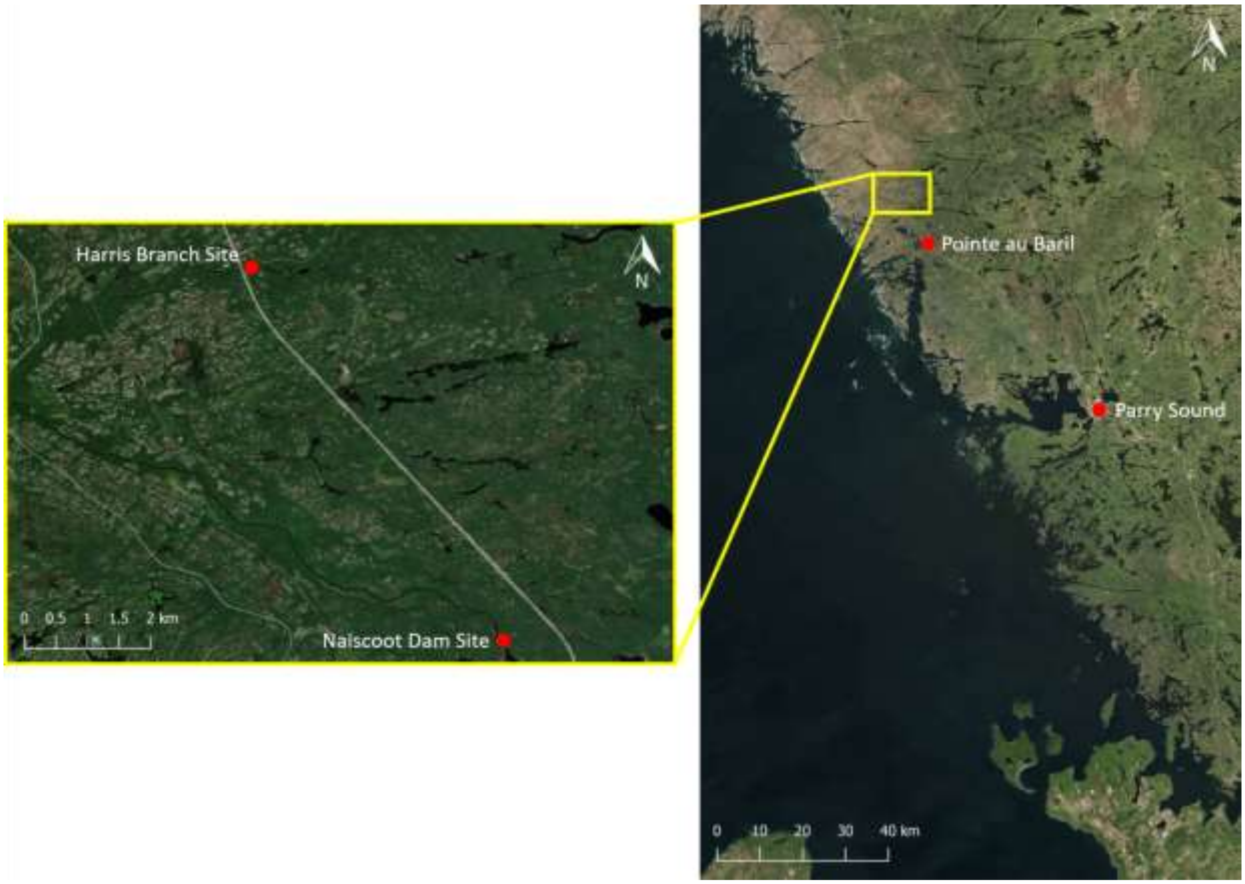

Figure 1. Location of the Naiscoot River spawning bed sites in relation to Parry Sound and Pointe au Baril

The Naiscoot River is captured in two quaternary watersheds. The Naiscoot branch falls within the Naiscoot Lake watershed (213 km^2) and the Harris branch falls within the Magnetawan-Naiscoot Rivers watershed (926 km^2) (Figure 2). Both watersheds are part of the larger Magnetawan River tertiary watershed. The Harris branch and the Naiscoot River join downstream of Highway 69, immediately upstream of the Highway 529 crossing.

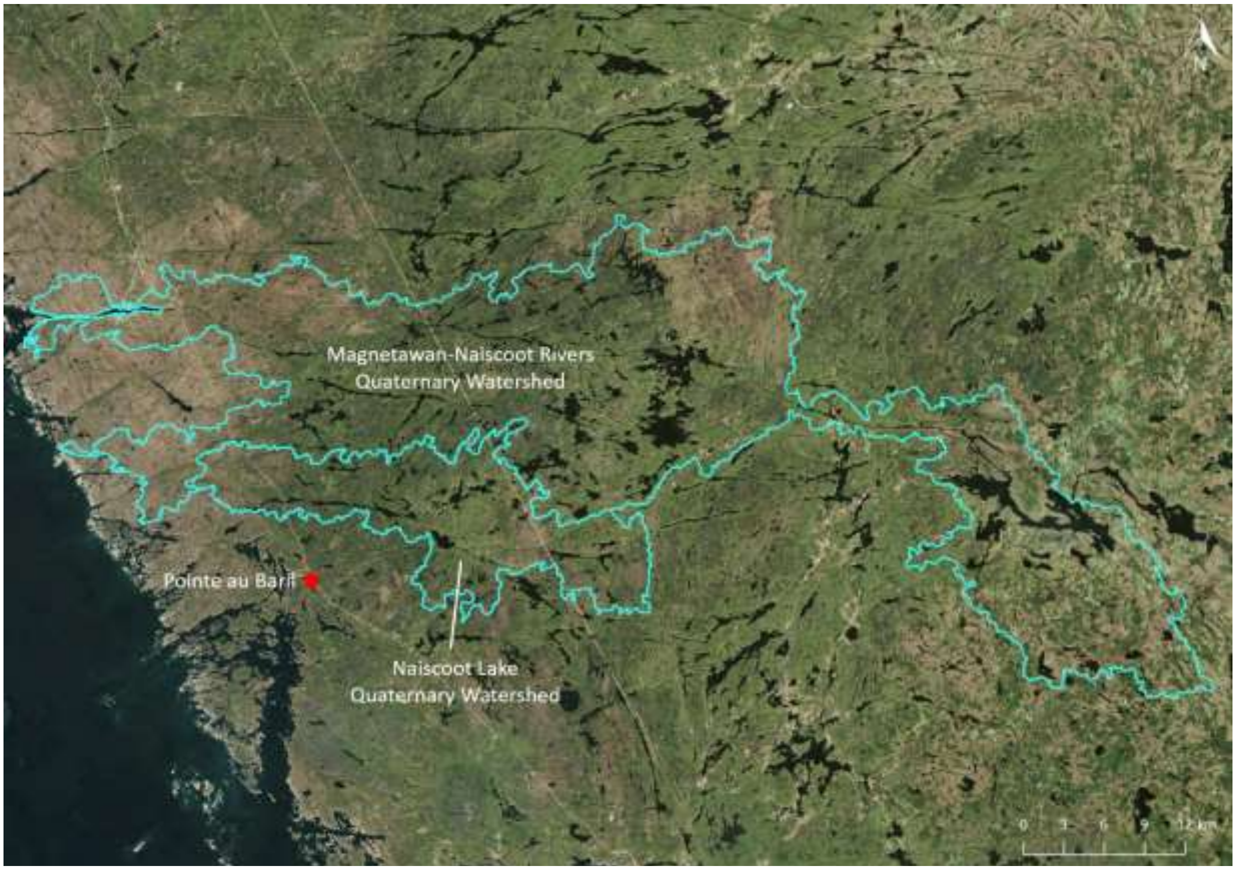

Figure 2. Magnetawan-Naiscoot Rivers quaternary watershed (Harris branch) and Naiscoot Lake quaternary watershed (Naiscoot branch)

The Naiscoot River Walleye population is believed to have two distinct spawning populations – Naiscoot River spawners and shoal spawners. A number of assessments and studies were conducted on the Naiscoot River between 1987 and 1990. Several of these studies are described here.

In the spring of 1987, an initial investigation of the Walleye population and spawning sites was undertaken. This involved night surveys at three locations on the Naiscoot River to determine whether spawning was taking place. No spawning was observed at the Naiscoot Dam. Only Common White Sucker (12) were seen at the confluence of Harris Creek and the Naiscoot River. Upstream of Highway 69 on Harris Creek, seven Walleye were observed (two on the south side, five throughout the rapids on the north side). As part of the investigation, Elm Tree Island was also checked and four Walleye and Common White Sucker were observed. Finally, trap netting was completed with one net set off of Big Burnt Island, close to the mouth of the Naiscoot River and Pickerel Pot (77 Walleye), and two sets in Pickerel Pot (25 Walleye).

The investigation of potential Walleye spawning sites continued in September 1987 with an assessment of rock rubble sites on the Naiscoot River by boat and by snorkelling. Several sites were identified as part of this effort.

The following spring, a total of ninety-six (96) Walleye were tagged – sixty (60) from Pickerel Pot, thirty (30) from Elm Tree Island, three from Alexander Passage, two from Naiscoot River between Rice Lake and Twin River Lodge, and one from Rice Lake. The netting effort also resulted in the capture of Common White Sucker and Northern Redhorse Sucker.

In the spring of 1989, nets were set at the North Channel, below Bull's Eye Narrows, Pickerel Pot (set late due to ice cover), Alexander Passage (set late due to ice cover), and another nine sites in the Bayfield Inlet-Naiscoot River area. The netting effort resulted in the capture of 579 Common White Sucker, 140 Northern Redhorse Sucker, and eighty-three (83) Walleye. Of the eighty-three (83) Walleye captured, fifty (50) were from Pickerel Pot, twenty-five (25) from Harris Creek, six from Alexander Passage, one from North Channel, and one from Bull's Eye Narrows. Eight were recaptures from 1988 and 1989 – six recaptures from Pickerel Pot, and two recaptures from Harris.

One year later in the spring of 1990, nets were set at Pickerel Pot and one at the Harris Creek site. The main spawning window was missed due to low water levels on Georgian Bay. Nevertheless, thirty (30) Walleye, 229 Common White Sucker, and twenty-seven (27) Northern Redhorse Sucker were caught. The majority of the Walleye were captured at Pickerel Pot; however, it was not known whether the fish were holding in that location or spawning nearby (e.g., mouth of the Naiscoot). Only eleven (11) Walleye were seen over spawning habitat – seven above the Harris Creek site (Highway 69) and four near Elm Tree Island.

Walleye were captured from Pickerel Pot and the Harris Creek site in 1989 for a radio tracking study that took place between April 1989 and August 1990. The study revealed that Harris Creek Walleye migrate from the spawning area to the islands in Bayfield Inlet via the North Channel of the Naiscoot River. The Pickerel Pot spawning population leaves the spawning grounds and travels into Alexander Passage. Both populations mix in late spring and remain in inner waters of the archipelago of islands throughout late spring and early summer. It is believed that the Walleye move into deeper and more open waters in July.

Spring Spawning Assessments

In 2017, EGBSC studied two spawning bed sites on the Naiscoot River. The first site is located approximately 280 m downstream of the Naiscoot Dam (hereafter referred to as the Naiscoot Dam spawning bed) (Figure 3). The site is an old road crossing that washed out and was never repaired. Walleye spawning has always been suspected, but never confirmed at this site.

The second site is located just upstream of Highway 69 on the Harris Branch of the Naiscoot River (hereafter referred to as the Harris Branch spawning bed) (Figure 4). The site on the Harris branch is a well-known spawning area. EGBSC also investigated other potential sites downstream of Highway 69 prior to the field season. On the Harris Branch, there were three additional sets of small rapids between Highway 529 and Highway 69. The banks at each site were eroded and steep with no safe access, making it too dangerous in high flows to paddle upstream from Highway 529 and monitor the sites throughout the spawning period.

EGBSC began spring field work on the Naiscoot River on April 15 and ended on June 20. During this period, the Naiscoot Dam spawning bed was visited seventeen (17) times while the Harris Branch spawning bed was visited nineteen (19) times, approximately every three to four days whenever possible. Towards the end of the Walleye and Sucker spawning period (end of May, early June), site visits were less frequent.

Figure 3. Location of Naiscoot Dam spawning bed

Figure 4. Location of Harris Branch spawning bed upstream of Highway 69

Water Chemistry

A YSI PROPLUS metre was used to measure basic water quality parameters on each site visit – water temperature, dissolved oxygen, conductivity, and pH. These parameters were selected because of the influence they can have on fish and fish activity, and to see if the levels recorded indicated any potential issues.

Water temperature is extremely important to fish. Aside from water velocity, water temperature is the main stimulus for spawning. For Walleye, spawning males begin to move towards spawning areas when water temperatures reach 2 to 5˚C. Spawning takes place through a variety of temperatures, but peak spawning typically occurs at 7 to 8˚C (Kerr et al., 1997). Conversely, spawning activity typically ceases once water temperatures reach 10 to 11˚C (Kerr et al., 1997). For Sucker species, spawning takes place between 10 and 16˚C (Hasnain et al., 2010). For Lake Sturgeon, main spawning activity occurs between 13 and 18˚C (Scott & Crossman, 1998). Water temperature also influences the speed and success of egg incubation. Optimal water temperature for egg incubation is 12.2˚C for Walleye, 14.5 ˚C for Lake Sturgeon, 15˚C for White Sucker, and 12.5˚C for Longnose Sucker (Hasnain et al., 2010).

Fish require dissolved oxygen to breathe. Fast flowing, cold water has higher dissolved oxygen concentrations than slow moving, warm water. Cold water can hold more oxygen as it rolls through rapids, which incorporates air from the atmosphere into the water. Dissolved oxygen is typically highest in early spring and declines as water temperatures increase and velocity slows.

The pH of water refers to how alkaline or acidic the water is, and is ranked on a scale of 0 to 14. pH will influence how soluble and available nutrients and heavy metals are in a system. pH can also influence fish health and reproductive success. In general, Walleye do best in waterbodies with a pH ranging between 6.0 and 9.0. Reproductive success can be jeopardized at pH levels below 6.0.

Conductivity measures the ability of water to pass an electrical current and is influenced by geology. For example, a clay substrate will have a high conductivity because of a greater amount of ions in the water. Rivers within the Parry Sound District typically have low conductivity, but conductivity can be significantly affected by stormwater runoff, and a sudden increase or decrease can indicate issues in a waterbody.

For complete water chemistry data, refer to Appendix A.

Naiscoot Dam Spawning Bed

As illustrated in Figure 5, water temperature at the Naiscoot Dam spawning bed increased fairly consistently from 4.7°C on April 15 to 20.7°C on June 8. Small drops in temperature were observed between April 29 (10.4°C) and May 2 (8.4°C), May 18 (14.9°C) and May 22 (14.3°C), and May 30 (18.4°C) and June 2 (16.5°C). Common White Sucker were observed at the site during night surveys on April 25 and 26 when the water temperature was around 9°C.

Dissolved oxygen levels dropped consistently throughout the study period. The highest level was recorded on April 22 (13.33 mg/L) and reached a low of 9.10 mg/L on June 5.

Between April 15 and May 15, all pH levels recorded at the Naiscoot Dam spawning bed were slightly below 6.0 (ranging from 5.44 to 5.98). From May 18 to June 8, all pH levels recorded were above 6.0 (ranging from 6.08 to 6.74). The highest pH level was 6.74 recorded on June 5 and the lowest pH recorded was 5.44 on April 22. The pH readings are mildly acidic and typical for Canadian Shield watersheds.

Figure 5 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring.

Conductivity was also recorded between April 15 and June 8 (Figure 6). Conductivity was consistently low throughout the study period, ranging from 14.9 uS/cm on May 9 and May 15 to 16.8 uS/cm on May 2.

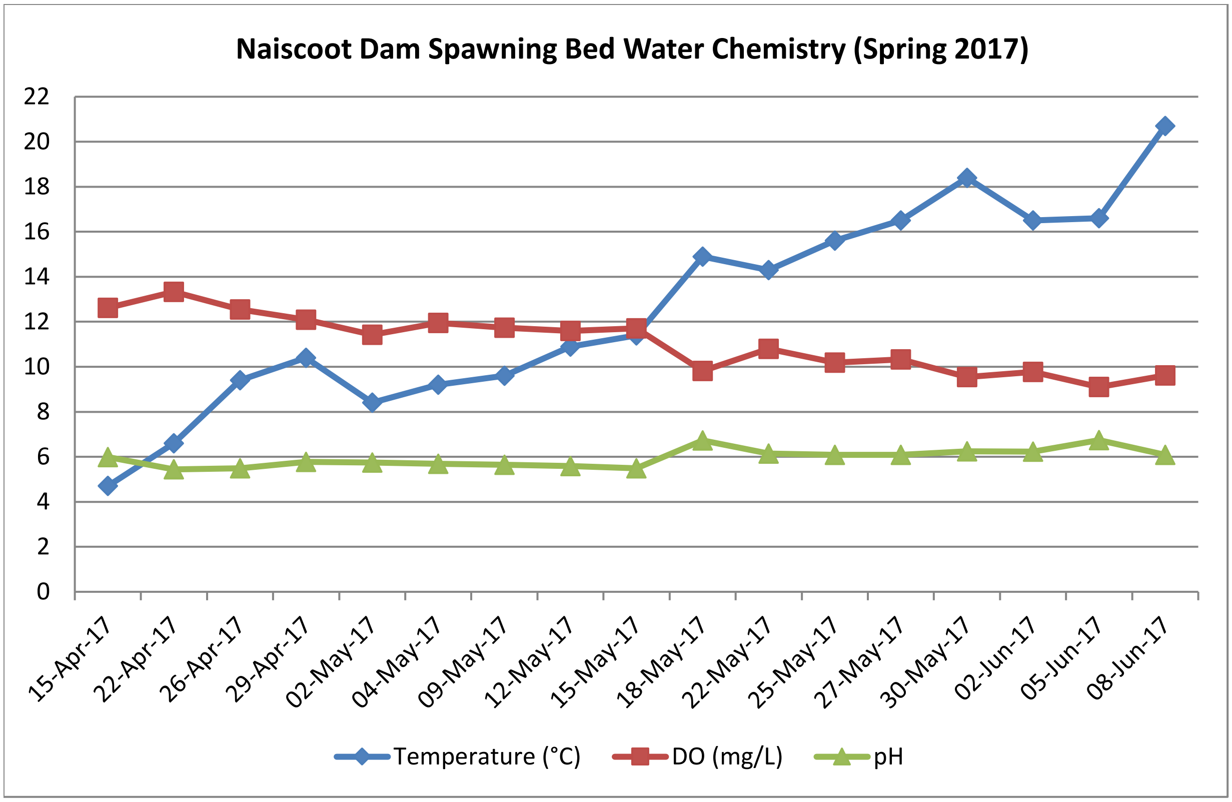

Figure 5. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at the Naiscoot Dam spawning bed in spring 2017

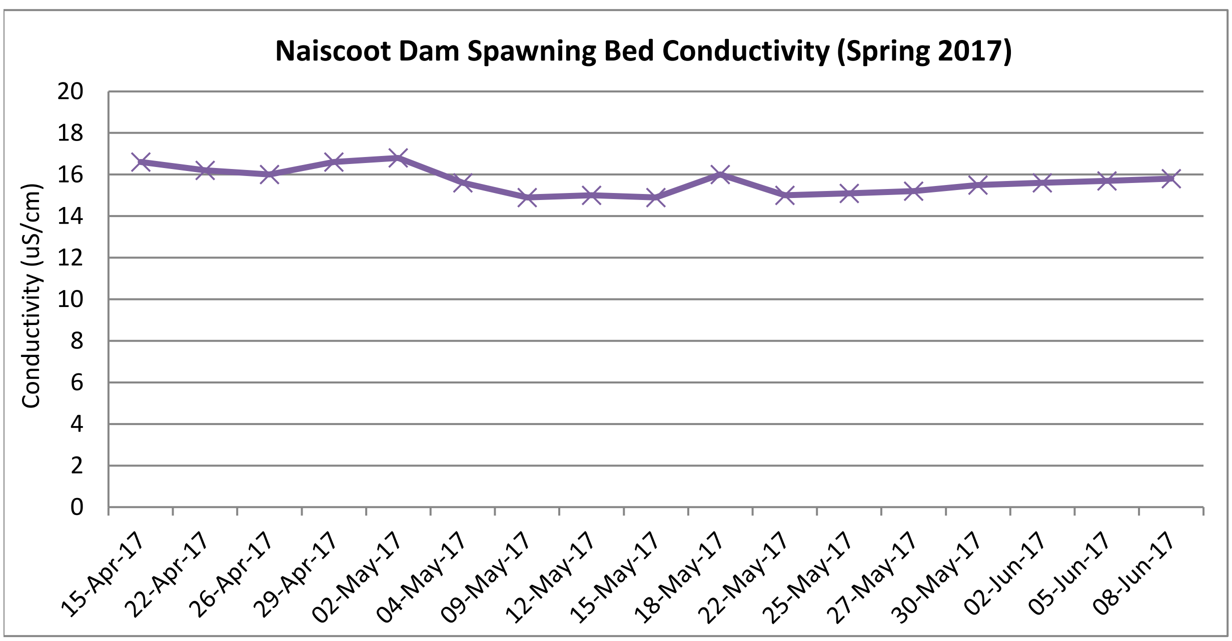

Figure 6. Conductivity measurements (uS/cm) at the Naiscoot Dam spawning bed in spring 2017

Harris Branch Spawning Bed

Water temperature at the Harris Branch spawning bed increased fairly consistently from 4.8°C on April 15 to 21.4°C on June 20 (Figure 7). Small drops in temperature were observed several times throughout the spawning period with the largest drop recorded between April 29 (10.9°C) and May 2 (8.8°C). Walleye and Sucker were observed at the site during night surveys on April 26 when the water temperature was around 9.8°C. Sucker were also seen at the site in much larger numbers during the day on May 22 (13.5°C) and May 25 (15.4°C).

Dissolved oxygen levels dropped consistently throughout the study period. The highest level was recorded on April 22 (13.07 mg/L) and the lowest level of 8.38 mg/L was recorded on June 20.

All pH levels recorded at the Harris Branch spawning bed were above 6.0. The highest pH level was 7.49 on May 2 and the lowest pH recorded was 6.11 on May 15. The pH readings are typical for Canadian Shield watersheds.

Figure 7 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring.

Conductivity was recorded between April 15 and June 20. Conductivity was much higher at the Harris Branch spawning bed than at the Naiscoot Dam spawning bed for the entirety of the study period. Measurements recorded at the Harris Branch spawning bed ranged from a high of 37.3 uS/cm on April 29 to a low of 32.9 uS/cm on May 22 (Figure 8).

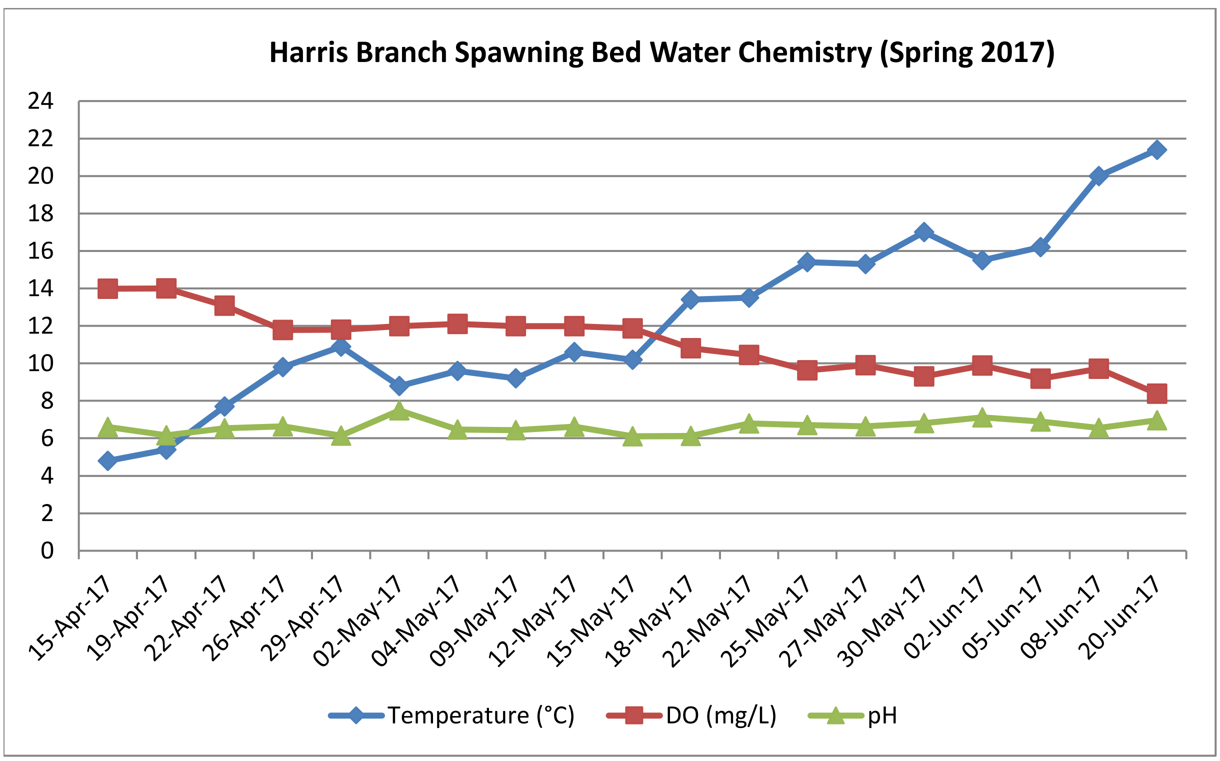

Figure 7. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at the Harris Branch spawning bed in spring 2017

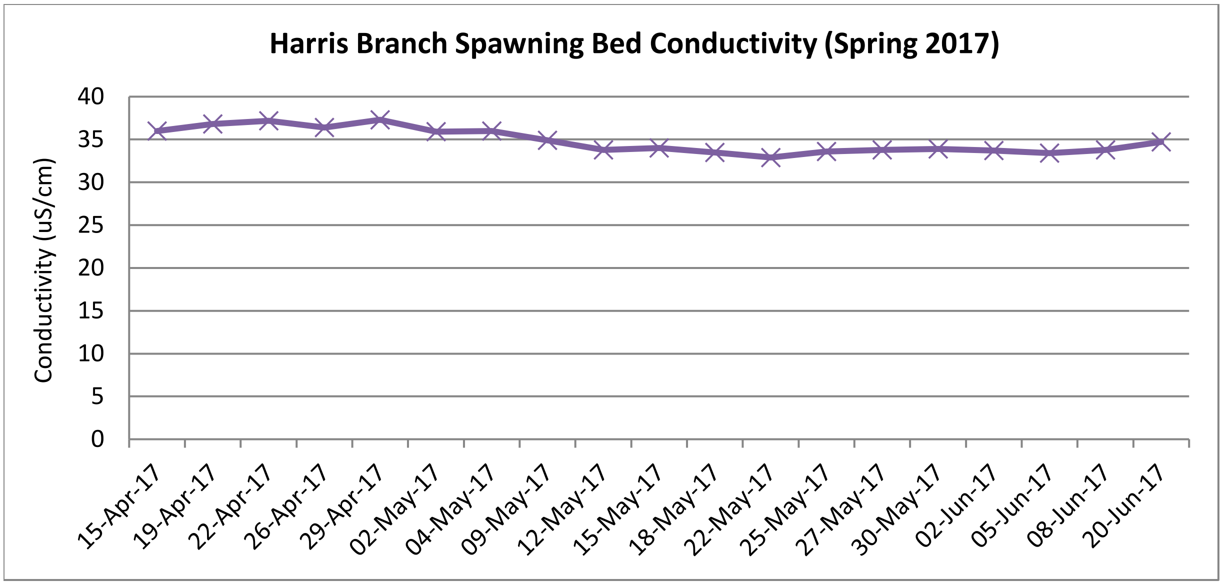

Figure 8. Conductivity measurements (uS/cm) at the Harris Branch spawning bed in spring 2017

Water Velocity

Water velocity has an influence on fish spawning. Species such as Walleye spawn in areas of fast-moving water, during the spring freshet. Walleye prefer velocities less than 2.0 m/s (Kerr et al., 1997). Lake Sturgeon generally spawn in conditions with a minimum velocity of 0.5 m/s to a maximum of 1.5 m/s (Golder Associates Ltd., 2011), and White Sucker typically spawn in velocities ranging from 0.14 m/s to 0.9 m/s (Twomey et al., 1984). Water velocity is typically high during the spawning period and declines over time.

Water velocity was measured with a Marsh McBirney Flo-mate 2000 flow meter to investigate whether there were areas where the flow would be too fast for fish to swim through. Mean velocity was measured at 60% of the water depth.

Naiscoot Dam Spawning Bed

Two stations were established at the Naiscoot Dam spawning bed to collect information on water velocity and water level fluctuations from April 15 to June 20 (Figure 9). Figure 10 displays velocity measurements recorded at station 1.

Figure 9. Water velocity (1) and depth stations (2) at the Naiscoot Dam spawning bed

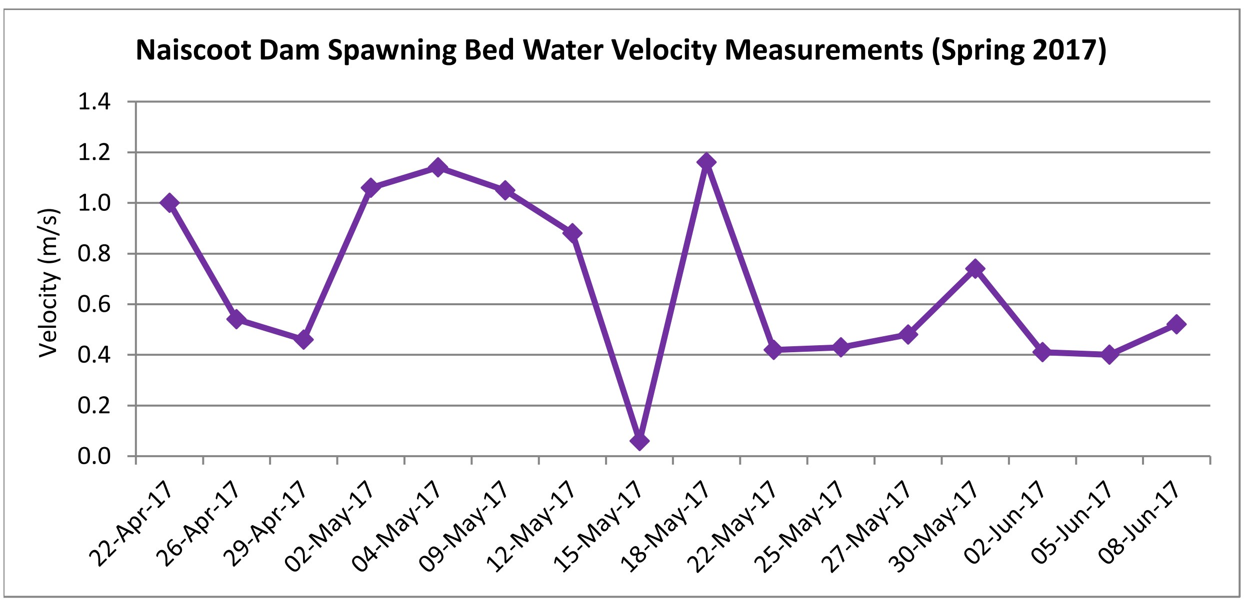

Figure 10. Water velocity measurements at the Naiscoot Dam spawning bed in spring 2017

The lowest velocity recorded was 0.06 m/s on May 15, and the highest velocity was 1.16 m/s, recorded on the very next site visit on May 18. None of the velocities recorded at station 1 would prevent fish from accessing or spawning at the site.

Harris Branch Spawning Bed

Four stations were established at the Harris Branch spawning bed to collect information on water velocity and water level fluctuations from April 19 to June 20 (Figure 11). Velocity measurements recorded at all stations are displayed in Figure 12.

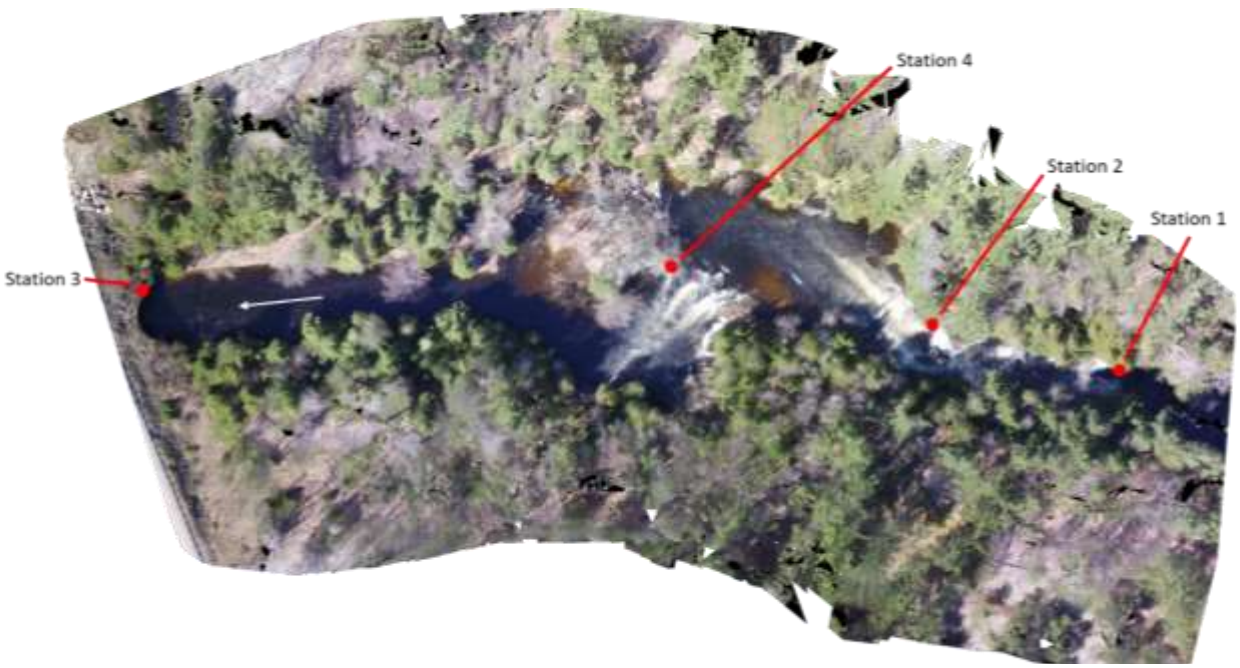

Figure 11. Water velocity (1-4) and depth stations (1-3) at the Harris Branch spawning bed

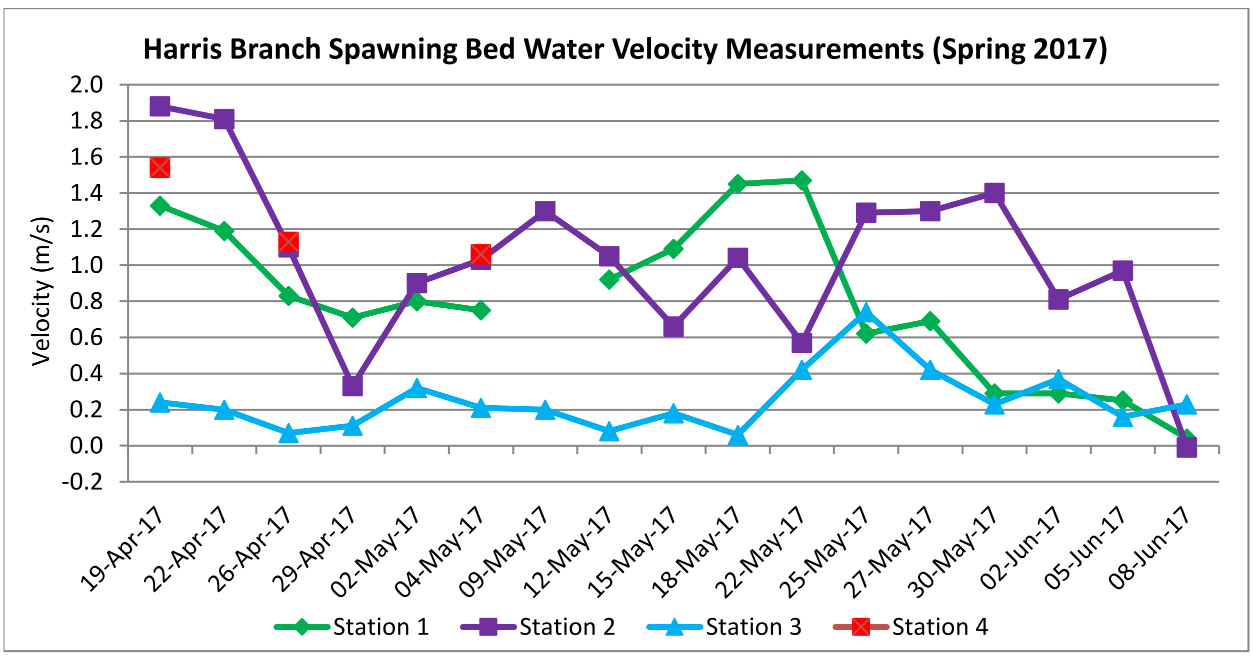

Figure 12. Water velocity measurements at the Harris Branch spawning bed in spring 2017

At station 1, the highest velocity recorded was 1.47 m/s on May 22 and the lowest velocity recorded was 0.04 m/s on June 8. The highest velocity recorded at station 2 was 1.88 m/s on April 19 (highest overall velocity of all stations), while the lowest velocity recorded was -0.01 m/s on June 8. The negative value indicates that the station had become a back eddy, and water was flowing in the opposite direction. The highest velocity recorded at station 3 was 0.74 m/s on May 25. The lowest velocity recorded at station 3 was 0.06 m/s on May 18. On April 19, the highest velocity at station 4 was recorded (1.54 m/s) and the lowest velocity recorded was 1.06 m/s on May 4. None of the velocities recorded would prevent fish from accessing or spawning at the site.

Water Level Fluctuations

Water levels were recorded at several stations (Figures 9 and 11) to understand how water levels change throughout spawning and egg incubation, and how they change along the spawning bed. Typically, when the spring freshet begins, water levels are high. Water levels subsequently decline over the following months. If water levels decline rapidly after the spawning period, deposited eggs may be left out of water and will not hatch.

Complete water level and velocity data can be found in Appendix B.

Naiscoot Dam Spawning Bed

At the Naiscoot Dam spawning bed, water levels fluctuated a considerable amount throughout the spawning and egg incubation periods. There was a large increase in water level between April 29 and May 2 and a smaller increase between May 2 and May 4. This increase was followed by a large decrease in water level from May 4 to May 25, at which point the water level increased again and continued to do so until June 8. The measurement on May 22 was mistakenly not recorded on the field sheet and, therefore, appears as missing data. Figure 13 illustrates the changes in water level from April 22 to June 8.

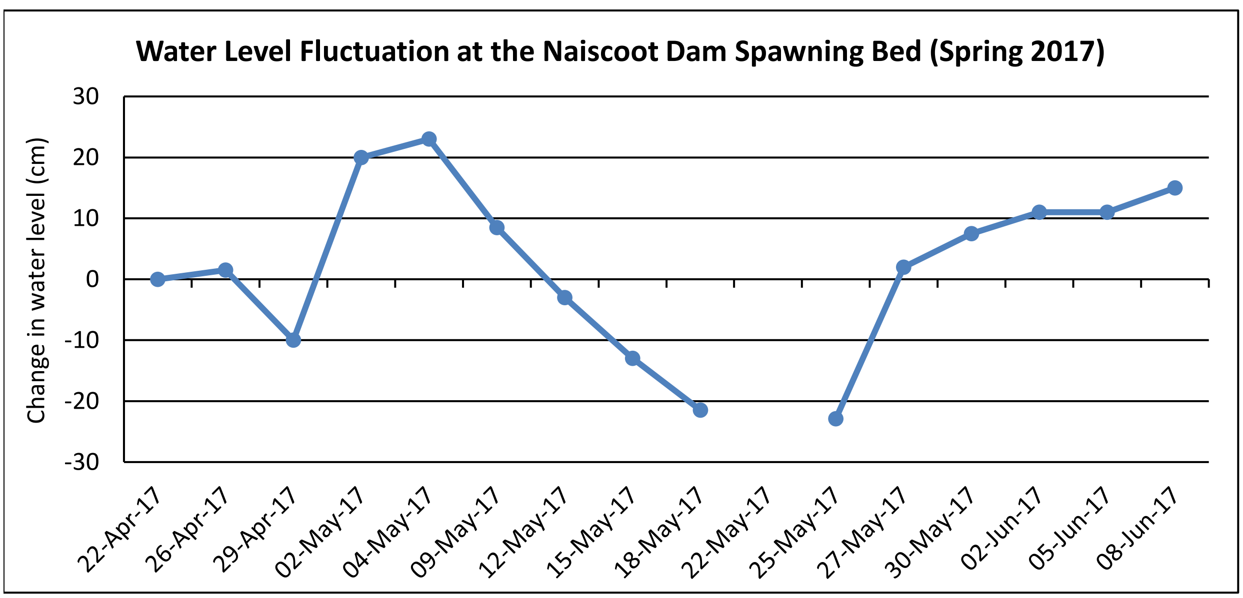

Figure 13. Water level fluctuations at the Naiscoot Dam spawning bed measured at station 2. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Harris Branch Spawning Bed

At the Harris Branch spawning bed, water levels decreased fairly consistently throughout the spawning and egg incubation periods. Stations 1 and 2 followed a similar pattern of decreasing water levels up to April 29, followed by a slight increase, and then a steady decline until June 20. Station 1 has a missing value on May 9 due to a recording error. Station 3a showed the greatest fluctuation in water level. The last data point recorded at this station was on May 18. On May 22, the location of station 3a was modified and the new location became station 3b. Station 3b showed a steady decline in water levels from May 22 to June 20. Figure 14 illustrates the changes in water level from April 19 to June 20.

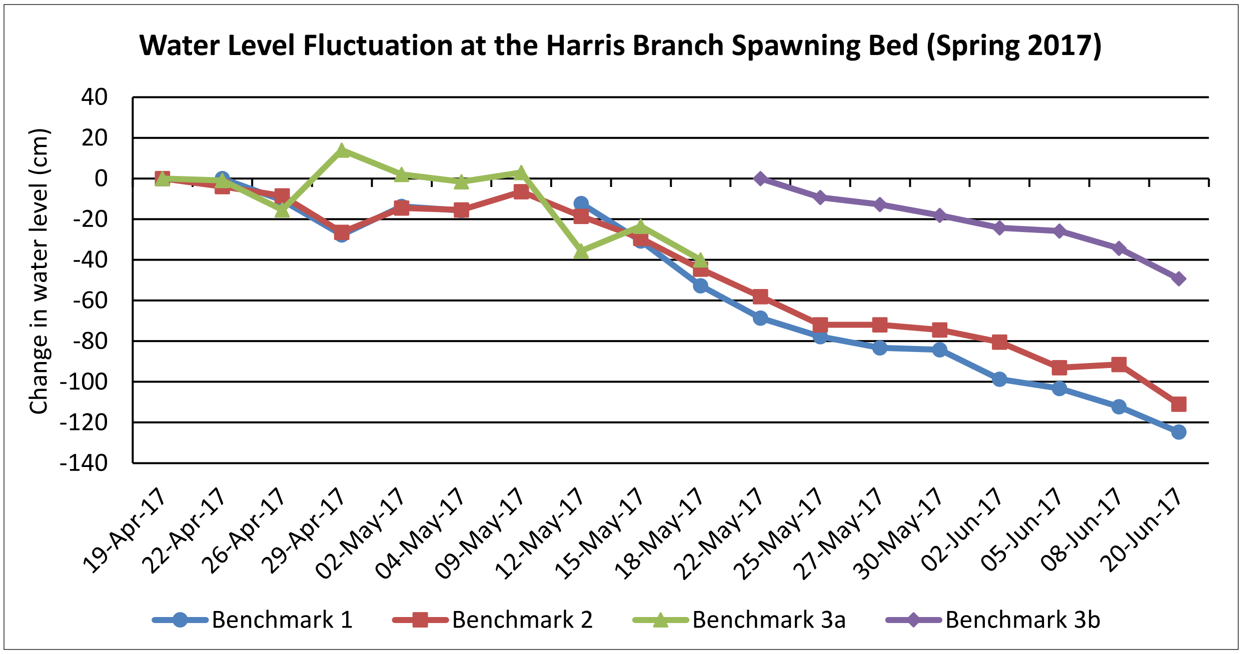

Figure 14. Water level fluctuations at the Harris Branch spawning bed measured at stations 1-3b. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Aerial Photographs

An important component of the spawning bed assessments was taking a series of drone photographs during the spawning and egg incubation period to help evaluate how the spawning area changed throughout the spring freshet. During each visit, weather permitting, EGBSC staff flew a drone to capture photos of the spawning bed. At the Harris Branch spawning bed, multiple photos were taken during each flight and then stitched together using Pix4D software to create an orthomosaic showing the entire spawning bed for each visit. At the Naiscoot Dam spawning bed, it was possible to capture the entire site in one photograph. The following photos and orthomosaics illustrate changes in water levels at both spawning beds from April 22 to June 8. The images show that the spawning beds remained underwater, which is crucial for successful egg incubation. There were no observations of eggs being stranded out of water.

Naiscoot Dam Spawning Bed

April 22, 2017

April 26, 2017 – unable to fly drone

May 2, 2017

May 9, 2017

May 12, 2017

May 15, 2017

May 18, 2017

May 27, 2017

May 30, 2017

June 2, 2017

June 5, 2017

June 8, 2017

Harris Branch Spawning Bed

April 19, 2017 – unable to fly drone

April 22, 2017

May 2, 2017

May 9, 2017

May 12, 2017

May 15, 2017

May 18, 2017

May 27, 2017

May 30, 2017

June 2, 2017

June 5, 2017

June 8, 2017

Fish Observations

Naiscoot Dam Spawning Bed

EGBSC observed fish at the Naiscoot Dam spawning bed via night surveys (refer to Appendix C for a complete list of fish and egg observations). Two White Sucker were seen on the night of April 25 and one was seen on the night of April 26. No other fish were observed during the day or night.

Harris Branch Spawning Bed

Visual day and night surveys were used to observe fish at the Harris Branch spawning bed. Walleye and Sucker were observed at the site during night surveys on April 26. In three passes of the spawning area, EGBSC observed: sixteen (16) Sucker; six Walleye and five Sucker; and two Walleye and four Sucker. Sucker were seen in the hundreds during regular daytime site visits on May 22 and May 25 (Figures 15 and 16). The Sucker had congregated near the Highway 69 bridge, both under the bridge and upstream until the point where the river splits around an island (Figure 17). By May 27, all of the Sucker were gone. Table 1 lists the species seen on each date.

Figure 15. Sucker observed at the Harris Branch spawning bed

Figure 16. Sucker captured on a GoPro camera at the Harris Branch spawning bed

Figure 17. Yellow dashed line indicates the area just upstream of the Highway 69 bridge where Sucker were seen in the hundreds on May 22 and 25, 2017

Table 1. Fish observations at the Harris Branch spawning bed

Date	Observation Method	Fish Species
22-Apr-17	Visual (night)	None
26-Apr-17	Visual (night) – first pass	Sucker – 16
27-Apr-17	Visual (night) – second pass	Walleye – 6 Sucker – 5
29-Apr-17	Visual (night) – third pass	Walleye – 2 Sucker – 4
22-May-17	Visual	Sucker – hundreds
25-May-17	Visual	Sucker – hundreds

Egg Deposition

Naiscoot Dam Spawning Bed

EGBSC set four egg mats at the Naiscoot Dam spawning bed to help assess the amount, type, and location of egg deposition (Figure 18). Egg mats were only placed on a small, accessible portion of the spawning bed, and therefore, only represent a small portion of the entire spawning area. No eggs were counted on any of the egg mats at any time throughout the study period.

Figure 18. Location of egg mats installed at the Naiscoot Dam spawning bed in 2017

Harris Branch Spawning Bed

Nine egg mats were set at the Harris Branch spawning bed at different times throughout the study period to help assess the amount, type, and location of egg deposition (Figure 19). Egg mats were only placed on a small, accessible portion of the spawning bed, and therefore, only represent a small portion of the entire spawning area. Based on size, eggs could be differentiated between Walleye and Sucker species, but it was not possible to identify the Sucker eggs to species level. Had Lake Sturgeon eggs been deposited, they would have also been distinguishable by size and colour.

Figure 19. Location of egg mats installed at the Harris Branch spawning bed in 2017

Egg mats were installed at various times throughout the study period (see Appendix C for complete egg mat details). Egg deposition on the mats was very low. From April 19 to June 20, a total of 184 Sucker eggs and only eleven (11) Walleye eggs were counted. Egg mat 3 had the greatest total number of Sucker eggs (seventy-three (73)) and egg mats 1 and 3 had the greatest total number of Walleye eggs (five each). Based on the number of Sucker observed just upstream of Highway 69 on May 22 and 25, it is believed that the Sucker egg total from the egg mats is not representative of the actual degree of spawning that took place at the Harris Branch spawning bed.

In 2017, egg mats were set at a total of seven spawning areas on the three rivers being assessed – Naiscoot River (two spawning beds), Pickerel River (three spawning beds), and Key River (two spawning beds). Table 2 compares the total Walleye and Sucker egg counts for these sites.

Table 2. Comparison of egg mat totals at all spawning beds assessed in 2017

	Naiscoot River		Key River		Pickerel River		
Eggs	**Naiscoot Dam**	**Harris Branch**	**Ludgate**	**Portage Lake Outlet**	**Trestle Gully**	**Bailey Bridge**	**Squaw Rapids**
Walleye	0	11	1,840	7,017	86	9,374	667
Sucker	0	184	0	1	0	67	0

Plankton Sampling

Once eggs incubate and hatch, fish enter their larval stage. Larval Walleye have limited mobility and typically move by drifting with water flow and wave action. Shortly after hatching, Walleye need to feed on zooplankton to ensure survival, growth, and development. The availability of zooplankton is a major factor in surviving this life stage. To help evaluate the amount of zooplankton downstream of the Naiscoot River spawning beds, EGBSC conducted several plankton tows using a 12” diameter, 153 micron plankton net.

EGBSC did not identify and count the zooplankton in the samples. Only a visual observation of the samples could be made and compared with the two other rivers sampled in 2017.

Naiscoot Dam Spawning Bed

Three samples were taken downstream of the Naiscoot Dam spawning bed (Figure 20) on May 30 and combined to create one composite sample (Figure 21). Based on the composite sample, the waters downstream of the Naiscoot Dam spawning bed can be described as having good plankton production.

Figure 20. Approximate plankton sampling location at the Naiscoot Dam spawning bed

Figure 21. Naiscoot Dam spawning bed composite plankton sample (May 30, 2017)

Harris Branch Spawning Bed

Three samples were taken under the Highway 69 bridge, downstream of the Harris Branch spawning bed on May 27 and again on June 8. Each time, the three samples were combined to create one composite sample (Figures 22 and 23). The May 27 composite sample was noted as having lots of detritus/sediment as well as two Sucker eggs. Based on the composite samples, the waters downstream of the Harris Branch spawning bed can be described as having good plankton production.

Figure 22. Harris Branch spawning bed composite plankton sample (May 27, 2017)

Figure 23. Harris Branch spawning bed composite plankton sample (June 8, 2017)

Spawning Bed Measurements

Reproductive success for Walleye, Lake Sturgeon, and White Sucker is optimized when water depth, velocity, and appropriately sized substrate are present at the same location within a spawning area. The optimal substrate size for Walleye egg incubation ranges from gravel (0.2 to 6.4 cm) to cobble (6.4 to 25 cm) (Kerr et al., 1997). The optimal substrate size for Lake Sturgeon ranges from 10 to 60 cm in diameter (Golder Associates Ltd., 2011). White Sucker spawn on a clean bottom of coarse sand to gravel ranging from 2 to 16 mm in size (Twomey et al., 1984). Optimal depth for spawning Walleye ranges from 30 to 100 cm (Kerr et al., 1997) and 10 to 200 cm for Lake Sturgeon spawning (Golder Associates Ltd., 2011).

In the fall of 2017, transects were measured across the Naiscoot Dam and Harris Branch spawning beds with the intent of identifying areas “ideal” for spawning for Walleye, Lake Sturgeon, and Sucker species. EGBSC used some of the methods from the Ontario Stream Assessment Protocol (developed by MNRF) to complete the transects. Along each transect, six points were measured for depth and substrate type, based on the width (taken at bankfull) of each transect (with the exception of areas where water depth or velocity prohibited safe access). In addition to depth and substrate, any aquatic vegetation was noted at each point, and shoreline vegetation was recorded at each transect. Depth was recorded with a metre stick and substrate was estimated with the aid of a grid marked at 10 cm increments. Transects were completed later in the season, when it was safe to wade across most of the spawning bed; because of this, only depth and substrate information was collected. Any velocity data collected would not have been the same as during the spawning season. Therefore, the analysis of ideal spawning habitat is based on depth and substrate only.

Naiscoot Dam Spawning Bed

EGBSC completed four transects across the Naiscoot Dam spawning bed (Figures 24 and 25).

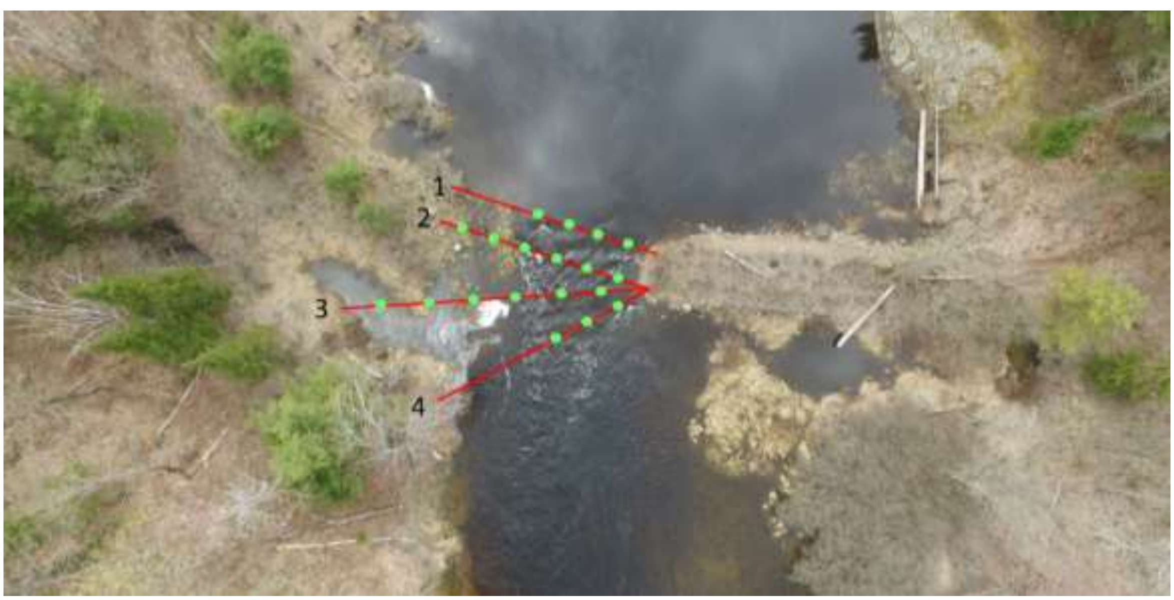

Figure 24. Spawning bed measurement transects at the Naiscoot Dam spawning bed. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning.

Figure 25. Measuring bankfull width and depths along transect 1

In total, across the four transects, twenty-two (22) points were measured for depth and substrate (two points on transect 4 could not be measured due to water depth). For Walleye, 82% of the points met the optimal depth and 86% of the points had at least some of the optimal substrate type. Overall, 68% of the points measured (15 of 22) had both the ideal depth and the ideal substrate size. Transects 2 and 3 had the highest amount of both ideal depth and substrate for Walleye.

For Lake Sturgeon, 100% of the points measured fell into the optimal depth range, and 86% of the points had at least some substrate in the optimal substrate range. Overall, 86% of the points measured met both depth and optimal substrate for Lake Sturgeon. Again, transects 2 and 3 had the highest amount of both ideal depth and substrate for Lake Sturgeon.

For White Sucker, EGBSC was unable to find the ideal depth for spawning in any of the literature searched. As a result, habitat for White Sucker was only based on ideal substrate type and size. Very few of the points measured at the Naiscoot Dam spawning bed were ideal for White Sucker. Only 18% of the points measured had the ideal substrate (four of the twenty-two (22) points). Appropriately sized substrate for White Sucker was found at two points on transects 1 and 3.

This evaluation was based on identifying ideal spawning habitat only. It does not indicate the actual amount of spawning, as fish will spawn in areas without ideal substrate. In addition, the ideal habitat has only been measured at certain points along the transects, and therefore does not represent the entire spawning bed. The measurements are a sample of the spawning bed and serve as an indicator of potential site limitations. Complete transect data is provided in Appendix D.

Harris Branch Spawning Bed

A total of forty-nine (49) transects were completed across the Harris Branch spawning bed (see Figures 26-29, transects 43-49 under the Highway 69 bridge are not shown). Data collected suggests that spawning habitat within the optimal range was present for all three species throughout parts of the Harris Branch spawning area.

In total, across the forty-nine (49) transects, 252 points were measured for depth and substrate (forty-two (42) points could not be measured due to water depth and/or velocity). For Walleye, 68% of the points met the optimal depth and 82% of the points had at least some of the optimal substrate type. Overall, 55% of the points measured (171 of 252) had both the ideal depth and the ideal substrate size. Transects 16-18, 20-23, and 25-31 represent the areas with the greatest concentrations of ideal depth and substrate for Walleye spawning.

For Lake Sturgeon, all but one of the points measured fell into the optimal depth range (99.6%), and 70% of the points had at least some substrate in the optimal substrate range. Overall, 70% of the points measured met both depth and optimal substrate for Lake Sturgeon. Transects 20-29 and 38-49 represent the areas with the greatest concentrations of ideal depth and substrate for Lake Sturgeon spawning.

For White Sucker, EGBSC was unable to find the ideal depth for spawning in any of the literature searched. As a result, habitat for White Sucker was only based on ideal substrate type and size. Overall, 60% of the points measured had the ideal substrate (152 of 252). Transects 28-49 represent the area with the greatest concentrations of ideal substrate for Sucker spawning.

Figure 26. Spawning bed measurement transects 1-12 at the Harris Branch spawning bed. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning. Measurements could not be obtained for transects 4-6 due to depth and flow.

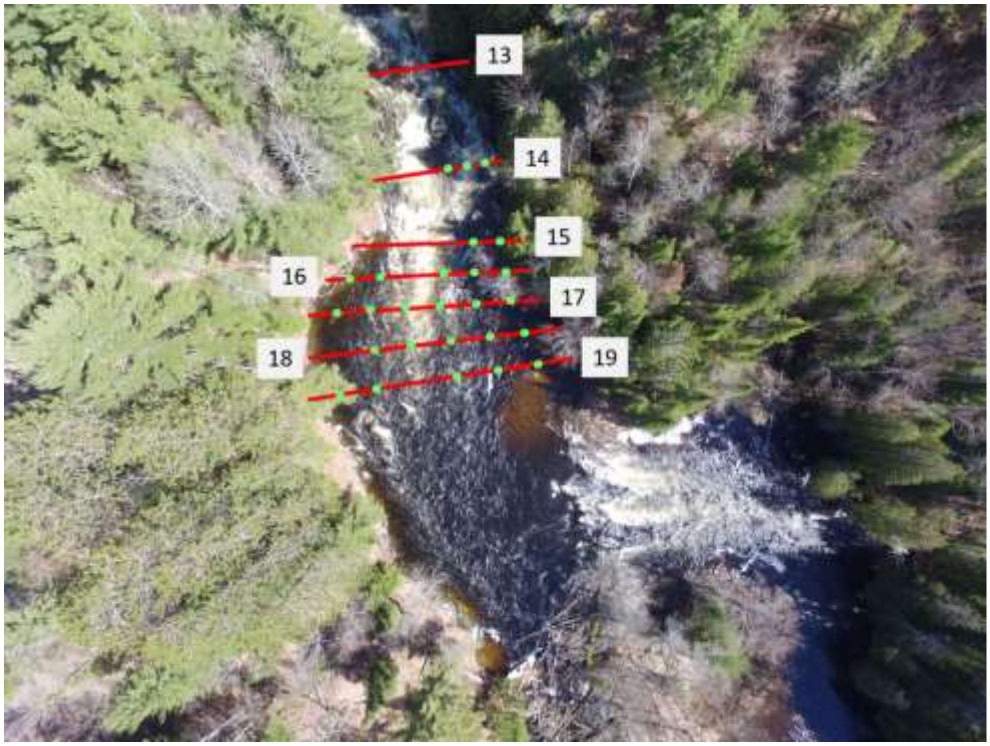

Figure 27. Spawning bed measurement transects 13-19 at the Harris Branch spawning bed. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning.

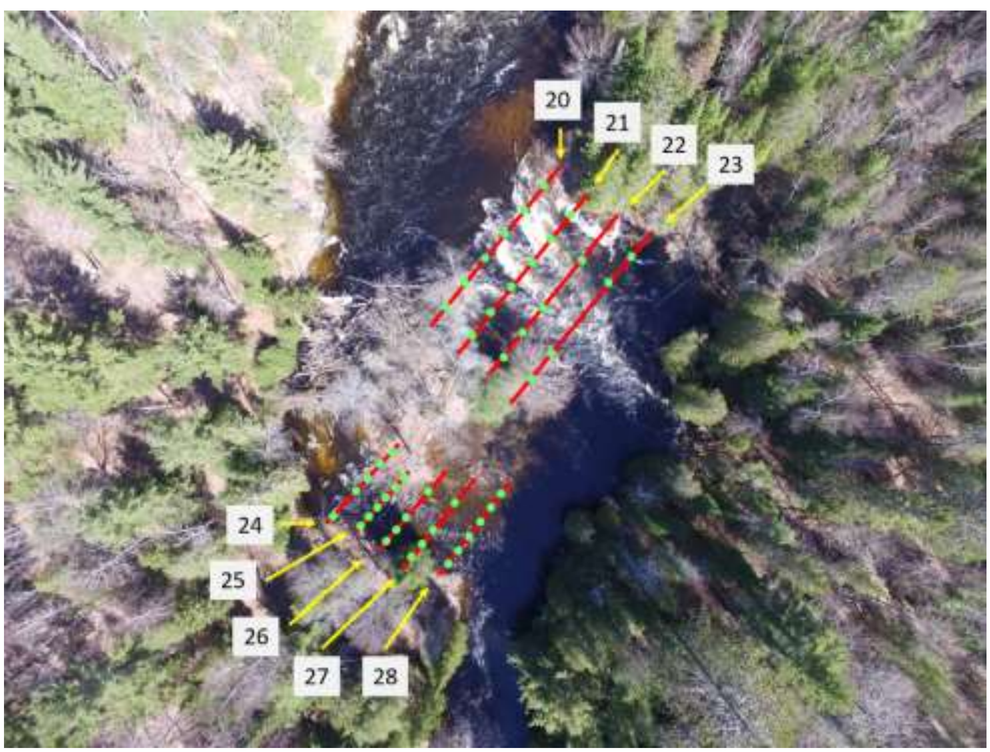

Figure 28. Spawning bed measurement transects 20-28 at the Harris Branch spawning bed. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning.

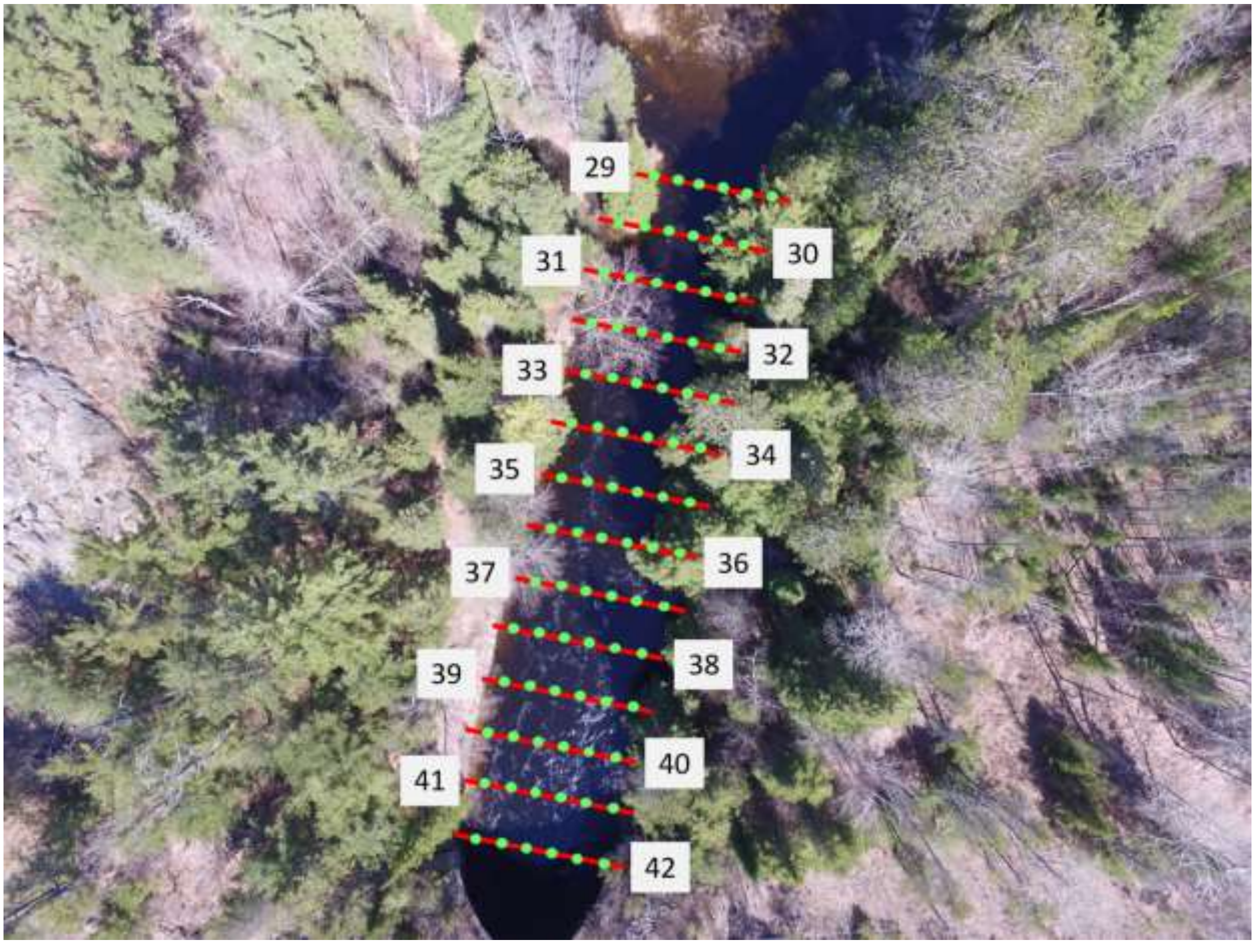

Figure 29. Spawning bed measurement transects 29-42 at the Harris Branch spawning bed. Transects 43-49 are not shown under the Highway 69 bridge. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning.

As previously mentioned, this evaluation was based on identifying ideal spawning habitat only. It does not indicate the actual amount of spawning, as fish will spawn in areas without ideal substrate. In addition, the ideal habitat has only been measured at certain points along the transect lines, and therefore does not represent the entire spawning bed. The measurements are a sample of the spawning bed and serve as an indicator of potential site limitations. Complete transect data is provided in Appendix E.

Nursery, Rearing, and Foraging Habitat

Until they become mobile, newly hatched fry of most riverine spawning species are dispersed largely according to water currents. In lake environments, wind-driven current can be a major factor in dispersing fry. Accordingly, the availability of nursery habitat in the downstream (or down-wind) vicinity of spawning sites is an important factor in reproductive success.

EGBSC completed surveys downstream of the Naiscoot Dam spawning bed and Harris Branch spawning bed to determine if there is habitat – nursery, rearing, and foraging – for Walleye, Lake Sturgeon, and Sucker fry. To assess nursery, rearing, and foraging habitat, EGBSC collected bathymetry and side scan sonar data, as well as, underwater survey data. The purpose of the underwater surveys was to help ground truth what was being displayed from the sonar data. In addition, EGBSC compared the length of natural shoreline (unaltered) downstream of each spawning bed to the length of altered shoreline. Natural shorelines are critical for maintaining water quality and fish habitat. Natural shorelines help to slow runoff from roads, houses, and other areas of development, improving water filtration and filtering nutrients before they reach the watercourse. Natural vegetation along watercourses helps to create shade and moderate temperature. Natural debris (branches, leaves, etc.) that fall into the water are a source of food for aquatic insects, which in turn, are a source of food for certain fish, such as White Sucker.

There were a number of challenges associated with gathering and interpreting the data collected. First, there is very little information on nursery, rearing, and foraging habitat for Sucker species. More information is available for Walleye and Lake Sturgeon, but it is quite vague. For example, adult Walleye are described as being found between 2 to 10 m depth, this wide range makes it challenging to focus in on specific habitat. EGBSC focused survey efforts in the nearshore area at depths of approximately 1.5 m. Second, once eggs hatch, the larvae drift downstream, according to currents and wind. It is not possible to say how far the larvae drift, and this distance would vary river by river. Third, side scan sonar data was collected to help identify the type of substrate present in the river and identify areas with vegetation and boulders (.sl2 files are available upon request). However, in some areas, interpretation of the side scan data was very difficult making it challenging to discern between different types of substrate. In the areas where the substrate was not clear, that information was not used in determining fish habitat due to a lack of confidence in interpretation. Finally, the fourth challenge was integrating all of the data collected.

Underwater Surveys

Underwater videos were taken while snorkelling for 100 m approximately every 1 km, using a GoPro camera. In total, EGBSC carried out thirteen (13) underwater surveys – three on the main stem, three on the Harris branch, and seven on the Naiscoot branch. Survey locations are identified in Figures 30 and 31. Bathymetry maps are presented in Appendix F.

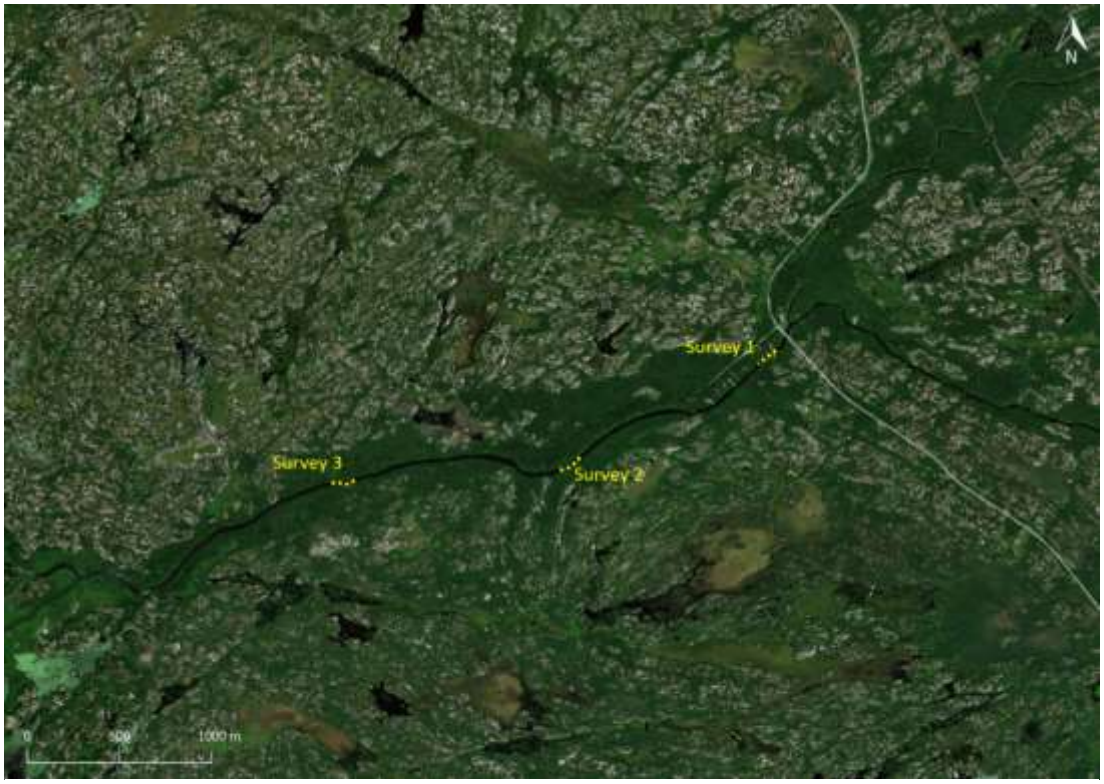

Figure 30. Underwater survey locations on the main stem of the Naiscoot River

Figure 31. Underwater survey locations on the Harris branch (red) and Naiscoot branch (yellow)

For each underwater survey, types of substrate and aquatic vegetation, as well as, abundance of aquatic vegetation and woody debris (sticks, branches, logs) were recorded. Aquatic vegetation and woody debris offer cover for fish at various life stages and provide cover for predatory fish to ambush their prey. Classifications and definitions of abundance are detailed in Table 3. Each of the underwater surveys is summarized in Table 4.

Table 3. Definitions of aquatic vegetation and wood structure abundances

Abundance	Sparse	Moderate	Abundant
Aquatic vegetation	Observed in small, inconsistent patches	Observed consistently along the substrate, camera moves easily through the area	Consistent and thick, difficult to move camera through the area
Wood structure	1-2 branches or sticks	2 logs and/or several branches or sticks (<10)	>3 logs and/or >10 branches

Table 4. Summary of findings from underwater surveys (MS = main stem, HB = Harris branch, NB = Naiscoot branch)

Survey	Substrate	Wood Structure	Aquatic Vegetation	Notes
MS - 1	Bedrock, sand, clay	Moderate	Sparse with patches of moderate	
MS - 2	Clay, muck, sand	Moderate	Moderate with a few patches of abundant	Lots of overhanging trees; small tributary at the end of the survey
MS - 3	Sand, clay, muck; one bedrock outcrop	Sparse	Moderate for 1/2, sparse for 1/2	
HB - 1	Sand, cobble, boulder, gravel; one bedrock outcrop	Abundant	Sparse	Abundant fish habitat - good variety of substrate and high amount of structure
HB - 2	Sand changing to clay	Abundant	Sparse with patches of moderate	
HB - 3	Clay - steep and undercut banks	Abundant	Moderate	
NB - 1	Bedrock, cobble, boulder, large gravel for 2/3, coarse sand, gravel and silt for 1/3	Sparse	Sparse for 3/4, moderate to abundant for 1/4	Lots of hiding places for fish with unembedded, fairly clean cobble and small boulders; Cyprinid spp., Centrarchid spp.
NB - 2	Clay, muck, detritus	Abundant	Abundant for 3/4, moderate for 1/4	Centrarchid spp., Cyprinid spp.
NB - 3	Clay, detritus	Moderate	Abundant for 3/4, sparse for 1/4	Beaver lodge partway through
NB - 4	Clay, detritus	Abundant	Abundant	Cyprinid spp.
NB - 5	Clay	Abundant	Abundant	A few small fish
NB - 6	Clay with some sand and detritus, changing to bedrock outcrop with cobble, boulder, and gravel	Abundant	Abundant for 3/4, sparse for 1/4	Centrarchid spp., animal slides coming down into the water, some erosion, several fallen trees
NB - 7	Clay, detritus; some boulder and cobble near the end	Abundant	Sparse with patches of moderate	Over 20 logs and many branches; undercut banks

Survey	Substrate	Wood Structure	Aquatic Vegetation	Notes
				with branches and roots - good fish habitat

The following list of aquatic vegetation (submergent, emergent, and floating) was recorded from the thirteen (13) surveys: Sedge spp., Pickerelweed, White Water Lily, algae, Freshwater Sponge, Tapegrass, Water Bulrush, Potamogeton spp., Wild Rice, Coontail, and Narrow-leaved Pondweed. Algae (12 of 13 surveys) and Tapegrass (10 of 13 surveys) were the most dominant species observed.

Shoreline Characteristics

Along each of the underwater surveys, shoreline characteristics were also recorded and photographed. The Naiscoot River and Harris branch, downstream of the spawning areas to the outlet, have almost entirely natural shorelines (97% natural, 3% altered) (Figures 32-34). Observed alterations included train and highway bridges, mown grass close to the shoreline, and docks. The natural shoreline along the surveys consisted of forest, meadow, and wetland. Photos of the shoreline from each survey can be found in Appendix G. It is important to note that surveys did not cover the entire length of the shoreline, therefore, they do not represent all possible alterations or types of natural shoreline.

Figure 32. Natural and altered shoreline downstream of the Naiscoot Dam and Harris Branch spawning beds

Figure 33. Natural and altered shoreline downstream of the Naiscoot Dam and Harris Branch spawning beds

Figure 34. Natural and altered shoreline downstream of the Naiscoot Dam and Harris Branch spawning beds

Shoreline substrate was also recorded and photographed for each of the surveys. Only the shoreline substrate that was visible was recorded. Table 5 lists the shoreline characteristics for each survey.

Table 5. Shoreline characteristics along the underwater surveys (MS = main stem, HB = Harris branch, NB = Naiscoot branch)

Survey	Shoreline Characteristics
MS - 1	Steeply sloped bedrock for 1/3 of survey, changing to moderately sloped with forest and open areas
MS - 2	Forested with fringe of Alder spp., including an area of flooded Alders
MS - 3	Low sloping shoreline, mainly forested with Alder spp. at the fringe
HB - 1	Moderately to steeply forested slope; sandy clay banks with undercutting
HB - 2	Steeply sloped, partially open meadow and partially forested; clay banks
HB - 3	Low sloping shoreline with upland meadow species with a fringe of wetland species
NB - 1	Steep rock cliff shoreline for 1/2 of survey, changed to a more vegetated shoreline with pockets of shoreline vegetation
NB - 2	Wetland
NB - 3	Low sloping shoreline with wetland species and trees approximately 15 m from the shoreline
NB - 4	Low sloping shoreline with wetland species
NB - 5	Low sloping forested shoreline with a fringe of wetland species
NB - 6	Moderately to steeply sloped forested shoreline with a fringe of wetland species, changing to bedrock shoreline halfway through

NB - 7	Steeper, forested bank with some open wet meadow along immediate shore; ended at an open upland meadow

In addition to substrate, shoreline vegetation that could be identified was recorded for each survey (Table 6). No terrestrial or aquatic invasive species were observed in the survey locations.

Table 6. Shoreline vegetation observed along the underwater surveys (MS = main stem, HB = Harris branch, NB = Naiscoot branch)

Survey	Shoreline Vegetation
MS - 1	Grass spp., Meadowsweet, White Spruce, Goldenrod spp., Moss, Trembling Aspen, Black Spruce, Spotted Joe-pye Weed, Viburnum spp., Sensitive Fern, Maple spp., White Birch, Prunus spp., Common Cattail
MS - 2	Grass spp., Sedge spp., Viburnum spp., Sensitive Fern, Blue Flag Iris, Spotted Joe-pye Weed, Blue Vervain, Wild Clematis, Tall Meadowrue, Goldenrod spp., Marsh St. John's Wort, Ostrich Fern
MS - 3	White Birch, Ash spp., Sensitive Fern, Alder spp., Wild Clematis, Spotted Joe-pye Weed, Grass spp., Blue Vervain, Common Elderberry, Flat-topped Aster, Meadowsweet, Viburnum spp.
HB - 1	White Spruce, Black Spruce, White Pine, Eastern Hemlock, Balsam Fir, Wild Sarsaparilla, Alder spp., Northern Beech Fern, Canada Mayflower, Grass spp., Sensitive Fern, Violet spp., Bugleweed, Moss, Flat-topped Aster, Meadowsweet, Goldenrod spp., Tall Meadowrue, Sweet Gale, Spotted Joe-pye Weed, Wild Clematis, Blue Bead Lily, Fringed Sedge
HB - 2	White Birch, Black Spruce, Red Pine, White Spruce, Ash spp., Alder spp., Goldenrod spp., Aster spp., Bracken Fern, Buttercup, Grass spp., Beaked Hazel, Ribes spp., Common Mullein, Wild Clematis, Spotted Joe-pye Weed, Cardinal Flower, Bugleweed
HB - 3	Common Cattail, Sensitive Fern, Spotted Joe-pye Weed, Canada Yew, Black Spruce, White Spruce, Prunus spp., False Solomon's Seal, Cardinal Flower, Goldenrod spp., Grass spp.
NB - 1	Maple spp., White Pine, Meadowsweet, St. John's Wort, Cardinal Flower, Winterberry, Bugleweed, Royal Fern, Sweet Gale, Sumac, Swamp Candles, Steeplebush, Sedge spp.
NB - 2	Speckled Alder, Spotted Joe-Pye Weed, Swamp Rose, Sensitive Fern, Sweet Gale, Sedge spp., Bulrushes, Grass spp.
NB - 3	Alder spp., Meadowsweet, Sweet Gale, Sensitive Fern, Spotted Joe-Pye Weed, Common Elderberry, Ash spp., White Birch, White Pine
NB - 4	Alder spp., Grass spp., Sensitive Fern, Marsh St. John's Wort, Fringed Sedge, Skullcap spp., Bugleweed, Ash spp.
NB - 5	Ash spp., Trembling Aspen, White Pine, Black Cherry, Winterberry, Bracken Fern, Wild Clematis, Spotted Joe-pye Weed, Grass spp., Tall Meadowrue, Marsh St. John's Wort, Sensitive Fern
NB - 6	White Birch, White Pine, Spruce, Red Osier Dogwood, Bracken Fern, Spotted Joe-Pye Weed, Grass spp., Tall Meadowrue, Sensitive Fern, Poison Ivy, Fringed Sedge, Arrowhead
NB - 7	Alder spp., Black Spruce, Ash spp., White Spruce, Blue Vervain, Spotted Joe-Pye Weed, Grass spp., Bulrushes, Tall Meadowrue, Wild Clematis, Ostrich Fern, Blue Flag Iris, Goldenrod spp., Red Osier Dogwood, Bush Honeysuckle, Viburnum spp., Highbush Cranberry, White Birch, Common Milkweed, Bracken Fern, Sumac

Discussion and Recommendations

Water chemistry measurements that were monitored (water temperature, dissolved oxygen, pH, and conductivity) were generally normal and typical of what one would expect from a Canadian Shield watershed. However, at the Naiscoot Dam spawning bed, nine pH measurements recorded were below 6.0 with the lowest measurement being 5.44. At pH levels below 6.0, Walleye reproduction can be jeopardized. From May 18 onwards, all pH measurements at the Naiscoot Dam spawning bed were above 6.0. There were no other indications of water quality having any adverse effects on fish spawning or egg incubation.

Approximately 280 m upstream of the Naiscoot Dam spawning bed is the Naiscoot Lake Dam, a V-notch style dam or weir. The dam was erected to hold water back on Naiscoot Lake to connect it with Wilson Lake and Little Wilson Lake for the purpose of floating logs to the railroad siding on Naiscoot Lake. The dam is not manipulated during the spawning and egg incubation period. Therefore, water levels in 2017 were likely typical of most springs. In 2017, there was a considerable degree of fluctuation in water level at the Naiscoot Dam spawning bed. As time went on, the edge of the left bank dried up but there were no eggs observed stranded. Water velocities did not exceed 1.16 m/s for any of the readings. There is no reason to believe that water velocity would impede movement of fish throughout the spawning bed or past it.

At the Harris Branch spawning bed, a fairly consistent decrease in water level was observed throughout the spring with no indication of egg stranding or dramatic loss of spawning habitat. Water velocities did not exceed 1.88 m/s at the stations where it was measured. It is possible that velocities in the uppermost areas of the rapids exceed 2.0 m/s, however, these are areas with predominantly bedrock and large boulder substrate, not ideal spawning habitat for Walleye, Lake Sturgeon, or Sucker species. It is unknown whether fish are able to move beyond the rapids, further upstream.

Visual day and night surveys revealed an extremely low number of Sucker at the Naiscoot Dam spawning bed and no Walleye or Lake Sturgeon. None of the egg mats set at this spawning bed had any eggs of any kind. Walleye spawning has been suspected in this area, but never confirmed. While there is substrate of a suitable size, the overall area of the spawning bed is quite small. Furthermore, it is possible that fish are swimming past this site up to the area immediately below the dam. Unfortunately, due to site characteristics below the dam, EGBSC was unable to set egg mats (water depth) and conduct night surveys (poor visibility due to turbulent water) in this area.

Based on visual observations and egg deposition on egg mats, the number of spawning Walleye appeared to be very low at the Harris Branch spawning bed. However, the placement of egg mats was restricted to a small portion of the total potential spawning area and some of the best spawning substrate could not be safely accessed during the spawning period to install egg mats at. Moreover, observations were only made from the left bank during night surveys leaving the entire right bank unchecked. Very few individuals were seen harvesting at the site and no successful attempts were observed. Although very few Sucker eggs were deposited on egg mats, hundreds of Sucker were seen during two regular site visits. Prior to these observations, egg mat placement was focused upstream of the area in which the Sucker were seen. Once Sucker were observed at, and upstream of, the Highway 69 bridge, two egg mats were installed in this area where it was safe to do so. By this time, some spawning activity may have already been missed.

Downstream of the spawning beds to the Naiscoot River's outlet into Georgian Bay, the shoreline is primarily natural with limited altered shoreline. Underwater surveys revealed a variety of substrate, a considerable amount of structure, and varying abundance of vegetation. Furthermore, plankton samples indicated good plankton production downstream of the spawning beds. No obvious stressors or limiting factors were identified with regard to nursery, rearing, or foraging habitat.

Overall, EGBSC's observations are consistent with studies from the 1980s and early 1990s which found low numbers of Walleye, and slightly higher numbers of Sucker at the Harris Branch spawning bed. EGBSC could not confirm Walleye spawning at the Naiscoot Dam spawning bed.

EGBSC recommends returning to Pickerel Pot and areas of suspected shoal spawning to compare present populations with those from the 80s and early 90s. EGBSC also recommends further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys and provide more in-depth insights into nursery, rearing, and foraging habitat (.sl2 files available upon request). EGBSC is not recommending any habitat restoration work at either of these sites.

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- Scott Finucan – Ministry of Natural Resources and Forestry
- Greg Mayne – Environment and Climate Change Canada
- Karl Schiefer – Aquatic Biologist consultant and EGBSC member
- David Bywater – Environmental Scientist, Georgian Bay Biosphere Reserve
- David Sweetnam – Executive Director, Georgian Bay Forever

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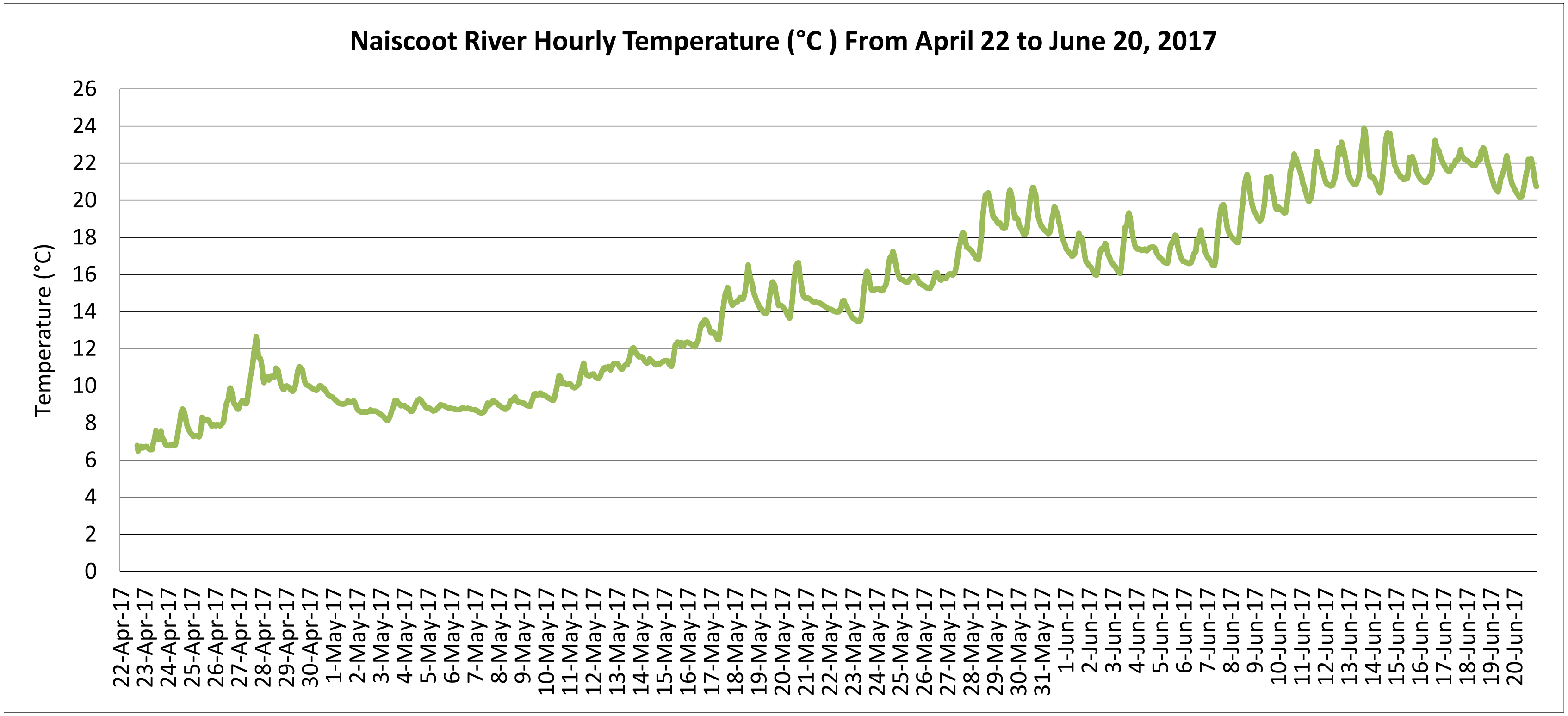
Appendix A – Water Chemistry

Water Chemistry – Naiscoot Dam, 2017

Date	Time	Temperature (°C)	DO (mg/L)	DO (%)	pH	Conductivity
15-Apr-17	12:30	4.7	12.62	98	5.98	16.6
22-Apr-17	4:07	6.6	13.33	108.7	5.44	16.2
26-Apr-17	5:42	9.4	12.55	109.4	5.49	16
29-Apr-17	4:43	10.4	12.09	108.3	5.78	16.6
02-May-17	9:16	8.4	11.42	97.3	5.74	16.8
04-May-17	5:20	9.2	11.95	104	5.69	15.6
09-May-17	2:10	9.6	11.74	102.4	5.64	14.9
12-May-17	12:05	10.9	11.59	104.9	5.59	15
15-May-17	10:40	11.4	11.71	107.6	5.49	14.9
18-May-17	10:11	14.9	9.82	97.1	6.73	16
22-May-17	1:40	14.3	10.79	105.2	6.15	15
25-May-17	10:20	15.6	10.18	102.2	6.08	15.1
27-May-17	10:40	16.5	10.32	105.9	6.08	15.2
30-May-17	10:10	18.4	9.55	101.9	6.24	15.5
02-Jun-17	10:15	16.5	9.77	99	6.23	15.6
05-Jun-17	9:00	16.6	9.1	94.2	6.74	15.7
08-Jun-17	4:30	20.7	9.61	107.2	6.09	15.8

Water Chemistry – Harris Branch, 2017

Date	Time	Temperature (°C)	DO (mg/L)	DO (%)	pH	Conductivity
15-Apr-17	1:30	4.8	13.98	108.6	6.61	36.0
19-Apr-17	11:39	5.4	14.00	110.7	6.16	36.8
22-Apr-17	3:14	7.7	13.07	109.5	6.53	37.2
26-Apr-17	8:40	9.8	11.78	104.0	6.64	36.4
29-Apr-17	4:17	10.9	11.80	107.7	6.15	37.3
02-May-17	2:54	8.8	11.99	103.0	7.49	35.9
04-May-17	4:45	9.6	12.11	106.2	6.47	36.0
09-May-17	1:00	9.2	11.98	103.1	6.43	34.9
12-May-17	11:08	10.6	11.98	107.5	6.62	33.8
15-May-17	9:40	10.2	11.86	105.6	6.11	34.0
18-May-17	9:30	13.4	10.81	102.7	6.12	33.5
22-May-17	12:45	13.5	10.44	100.4	6.79	32.9
25-May-17	9:33	15.4	9.63	97.0	6.71	33.6
27-May-17	10:00	15.3	9.91	99.2	6.64	33.8
30-May-17	9:30	17.0	9.31	96.2	6.81	33.9
02-Jun-17	9:20	15.5	9.89	99.0	7.11	33.7
05-Jun-17	10:05	16.2	9.19	93.3	6.89	33.4
08-Jun-17	4:00	20.0	9.71	105.3	6.55	33.8
20-Jun-17	4:30	21.4	8.38	95.0	6.97	34.7



Naiscoot River Hourly Temperature (°C) From April 22 to June 20, 2017
Temperature (°C)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
22-Apr-17
23-Apr-17
24-Apr-17
25-Apr-17
26-Apr-17
27-Apr-17
28-Apr-17
29-Apr-17
30-Apr-17
1-May-17
2-May-17
3-May-17
4-May-17
5-May-17
6-May-17
7-May-17
8-May-17
9-May-17
10-May-17
11-May-17
12-May-17
13-May-17
14-May-17
15-May-17
16-May-17
17-May-17
18-May-17
19-May-17
20-May-17
21-May-17
22-May-17
23-May-17
24-May-17
25-May-17
26-May-17
27-May-17
28-May-17
29-May-17
30-May-17
31-May-17
1-Jun-17
2-Jun-17
3-Jun-17
4-Jun-17
5-Jun-17
6-Jun-17
7-Jun-17
8-Jun-17
9-Jun-17
10-Jun-17
11-Jun-17
12-Jun-17
13-Jun-17
14-Jun-17
15-Jun-17
16-Jun-17
17-Jun-17
18-Jun-17
19-Jun-17
20-Jun-17

Appendix B – Water Level and Velocity

Water Level Data – Naiscoot Dam, 2017

Benchmark	Date	Depth (cm)
2	22-Apr-17	9
2	26-Apr-17	5
2	29-Apr-17	-1
2	02-May-17	29
2	04-May-17	32
2	09-May-17	17.5
2	12-May-17	6
2	15-May-17	-4
2	18-May-17	-12.5
2	22-May-17	
2	25-May-17	-13.9
2	27-May-17	11
2	30-May-17	16.5
2	02-Jun-17	20
2	05-Jun-17	20
2	08-Jun-17	24

Water Level Data – Harris Branch, 2017

Benchmark	Date	Depth (cm)
1	22-Apr-17	91.3
1	26-Apr-17	102
1	29-Apr-17	119
1	02-May-17	105
1	04-May-17	107
1	09-May-17	
1	12-May-17	103.5
1	15-May-17	122
1	18-May-17	144
1	22-May-17	160
1	25-May-17	169
1	27-May-17	174.5
1	30-May-17	175.5
1	02-Jun-17	190
1	05-Jun-17	194.5
1	08-Jun-17	203.5
1	20-Jun-17	216
2	19-Apr-17	32.5
2	22-Apr-17	36.5
2	26-Apr-17	41
2	29-Apr-17	59
2	02-May-17	47
2	04-May-17	48
2	09-May-17	39
2	12-May-17	51
2	15-May-17	62

2	18-May-17	77
2	22-May-17	90.5
2	25-May-17	104.5
2	27-May-17	104.5
2	30-May-17	107
2	02-Jun-17	113
2	05-Jun-17	125.5
2	08-Jun-17	124
2	20-Jun-17	143.5
3a	19-Apr-17	52
3a	22-Apr-17	51
3a	26-Apr-17	36.5
3a	29-Apr-17	66
3a	02-May-17	54
3a	04-May-17	50.5
3a	09-May-17	55
3a	12-May-17	16.5
3a	15-May-17	28.5
3a	18-May-17	12
3b	22-May-17	60.7
3b	25-May-17	70
3b	27-May-17	73.5
3b	30-May-17	78.8
3b	02-Jun-17	85
3b	05-Jun-17	86.5
3b	08-Jun-17	95
3b	20-Jun-17	110

Velocity Data (m/s) – Naiscoot Dam, 2017

Date	Station 1
22-Apr-17	1.19
26-Apr-17	0.83
29-Apr-17	0.71
02-May-17	0.8
04-May-17	0.75
09-May-17	
12-May-17	0.92
15-May-17	1.09
18-May-17	1.45
22-May-17	1.47
25-May-17	0.62
27-May-17	0.69
30-May-17	0.29
02-Jun-17	0.29
05-Jun-17	0.25
08-Jun-17	0.04

Velocity Data (m/s) – Harris Branch, 2017

Date	Station 1	Station 2	Station 3	Station 4
19-Apr-17	1.33	1.88	0.24	1.54
22-Apr-17	1.19	1.81	0.2	
26-Apr-17	0.83	1.1	0.07	1.13
29-Apr-17	0.71	0.33	0.11	
02-May-17	0.8	0.9	0.32	
04-May-17	0.75	1.03	0.21	1.06
09-May-17		1.3	0.2	
12-May-17	0.92	1.05	0.08	
15-May-17	1.09	0.66	0.18	
18-May-17	1.45	1.04	0.06	
22-May-17	1.47	0.57	0.42	
25-May-17	0.62	1.29	0.74	
27-May-17	0.69	1.3	0.42	
30-May-17	0.29	1.4	0.23	
02-Jun-17	0.29	0.81	0.37	
05-Jun-17	0.25	0.97	0.16	
08-Jun-17	0.04	-0.01	0.23	

Appendix C – Visual Observations

Visual Observations – Naiscoot Dam, 2017

Date	Observation Method	Fish Species
25-Apr-17	Visual (night)	Sucker – 2
26-Apr-17	Visual (night)	Sucker – 1

Visual Observations – Harris Branch, 2017

Date	Observation Method	Fish Species
22-Apr-17	Visual (night)	None
26-Apr-17	Visual (night) – first pass	Sucker – 16
	Visual (night) – second pass	Walleye – 6 Sucker – 5
	Visual (night) – third pass	Walleye – 2 Sucker – 4
22-May-17	Visual	Sucker – hundreds
25-May-17	Visual	Sucker – hundreds

Egg Mat Counts – Naiscoot Dam, 2017

Egg Mat	Date Set	Date Counted	Sucker Eggs	Walleye Eggs	Notes
1	22-Apr-17	26-Apr-17	0	0	no eggs and no flow left in location
2	22-Apr-17	26-Apr-17	0	0	couldn't find
4	04-May-17	09-May-17	0	0	
2	22-Apr-17	12-May-17	0	0	needed cleaning
3	26-Apr-17	12-May-17	0	0	
4	09-May-17	12-May-17	0	0	needed cleaning
3	12-May-17	15-May-17	0	0	
3	18-May-17	22-May-17	0	0	
3	22-May-17	25-May-17	0	0	
3	25-May-17	27-May-17	0	0	
3	27-May-17	30-May-17	0	0	
3	30-May-17	02-Jun-17	0	0	
3	02-Jun-17	05-Jun-17	0	0	
3	05-Jun-17	08-Jun-17	0	0	

Egg Mat Counts – Harris Branch, 2017

Egg Mat	Date Set	Date Counted	Sucker Eggs	Walleye Eggs	Notes
1	19-Apr-17	22-Apr-17	0	0	large number of caddisflies, set in same vicinity on US end of island
2	19-Apr-17	22-Apr-17	0	0	set in same vicinity on US end of island
3	21-Apr-17	22-Apr-17	0	3	removed to be set at Naiscoot Dam
4	21-Apr-17	22-Apr-17	0	0	
5	21-Apr-17	22-Apr-17	0	0	removed
1	22-Apr-17	26-Apr-17	0	5	couple of eggs on back of mat, moved ~2 m instream for water levels
2	22-Apr-17	26-Apr-17	0	0	missing, couldn't find

4	22-Apr-17	26-Apr-17	0	0	DS side of island across from sandy pool (DS of #3)
1	26-Apr-17	09-May-17	14	0	
3	26-Apr-17	09-May-17	68	1	
4	26-Apr-17	09-May-17	30	0	
6	26-Apr-17	09-May-17	n/a	n/a	couldn't find
5	26-Apr-17	09-May-17	n/a	n/a	too deep to lift
1	09-May-17	12-May-17	1	0	
3	09-May-17	12-May-17	2	1	
4	09-May-17	12-May-17	1	0	
6	26-Apr-17	12-May-17	1	0	
3	12-May-17	15-May-17	0	0	
4	12-May-17	15-May-17	0	0	
5	26-Apr-17	15-May-17	19	1	
3	15-May-17	18-May-17	2	0	changed location a bit
5	15-May-17	18-May-17	0	0	
7	15-May-17	18-May-17	0	0	543099, 5059502
3	18-May-17	22-May-17	1	0	pulling mat to use DS where suckers seen spawning
4	18-May-17	22-May-17	0	0	pulling mat to use DS where suckers were seen spawning
5	18-May-17	22-May-17	1	0	
5	22-May-17	25-May-17	1	0	
8	22-May-17	25-May-17	0	0	
9	22-May-17	25-May-17	0	0	
5	25-May-17	27-May-17	5	0	
8	25-May-17	27-May-17	7	0	
9	25-May-17	27-May-17	3	0	
5	28-May-17	30-May-17	8	0	
8	28-May-17	30-May-17	15	0	
9	28-May-17	30-May-17	7	0	
5	30-May-17	02-Jun-17	0	0	
8	30-May-17	02-Jun-17	3	0	
9	30-May-17	02-Jun-17	3	0	
5	02-Jun-17	05-Jun-17	0	0	
8	02-Jun-17	05-Jun-17	0	0	
9	02-Jun-17	05-Jun-17	0	0	
5	05-Jun-17	08-Jun-17	0	0	
8	05-Jun-17	08-Jun-17	0	0	
9	05-Jun-17	08-Jun-17	0	0	
5	08-Jun-17	20-Jun-17	0	0	
8	08-Jun-17	20-Jun-17	0	0	
9	08-Jun-17	20-Jun-17	0	0	
		TOTAL	**184**	**11**	

Appendix D – Naiscoot Dam Spawning Bed Transect Data

Transect 1

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.45		10% lg bld, 90% muck	lily
(2) 4.5	0.35		30% lg bld, 70% muck	terrestrial veg
(3) 7.5	1.05		60% sm bld, 40% cobble	none
(4) 10.5	0.9		50% lg bld, 30% sm b, 20% cobble	none
(5) 13.5	0.8		20% sm bld, 60% cobble, 20% gravel	none
(6) 16.5	0.85		10% lg bld, 30% sm bld, 60% cobble/gravel	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25			*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*		*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6					*	*

*mixed substrate, some optimal

Transect 2

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.25		20% lg bld, 20% sm bld, 50% cobble, 10% soil	none
(2) 4.5	0.55		30% cobble, 70% soil/muck	none
(3) 7.5	0.95		30% sm bld, 60% cobble, 10% soil/grass	none
(4) 10.5	0.65		30% sm bld, 70% cobble	none
(5) 13.5	0.6		100% cobble	none
(6) 16.5	1.05		10% lg bld, 10% grass/soil, 80% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*		*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*		*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 3

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.2	0.88		100% cobble/gravel/muck	none
(2) 3.5	1.15		50% sm bld, 50% cobble/gravel/sand	none
(3) 5.8	0.7		10% lg bld, 50% sm bld, 40% cobble	none
(4) 8.1	0.65		20% sm bld, 80% cobble	none
(5) 10.4	0.95		40% sm bld, 60% cobble	none
(6) 16.5	1.05		10% lg bld, 10% grass/soil, 80% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*			
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*				

*mixed substrate, some optimal

Transect 4

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.90	0.25		100% muck	
(2) 5.70	too deep		too deep	
(3) 9.50	too deep		too deep	
(4) 13.30	1.15		100% sm bld/cobble	
(5) 17.10	0.85		40% lg bld, 30% sm bld, 30% cobble	
(6) 20.90	0.45		40% lg bld, 20% sm bld, 40% cobble	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25				*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60					*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Appendix E – Harris Branch Spawning Bed Transect Data

Transect 1

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.7	0.58		100% cobble	none
(2) 5	0.65		90% cobble, 10% sm b	none
(3) 8.3	0.70		100% cobble	none
(4) 11.6	0.77		60% cobble, 30% sand, 10% bedrock	none
(5) 14.9	0.78		100% cobble	none
(6) 18.2	0.52		80% cobble, 10% lg b, 10% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*		*		*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*		*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6				*		

*mixed substrate, some optimal

Transect 2

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.38		70% cobble, 30% lg b	none
(2) 4.1	0.40		70% cobble, 30% lg b	none
(3) 6.8	0.82		100% cobble	none
(4) 9.5	0.77		100% cobble	none
(5) 12.7	0.80		100% cobble	none
(6) 15.4	0.30		70% bedrock, 20% lg b, 10% sm b	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*				
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*				*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 3

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1	1.00		100% bedrock	none
(2) 3	1.11		60% bedrock, 20% sm b, 20% cobble	none
(3) 5	0.68		100% bedrock	none
(4) 7	0.68		100% bedrock	none
(5) 9	0.58		100% bedrock	none
(6) 11	1.15		50% lg b, 30% cobble, 20% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*				*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*				*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 4
Too dangerous to take measurements due to deep, fast flowing water.

Transect 5
Too dangerous to take measurements due to deep, fast flowing water.
- Bankfull width – 7.4 m
- 100% bedrock

Transect 6

Too dangerous to take measurements due to deep, fast flowing water.

- Bankfull width – 15 m
- Bedrock on left bank half, right bank half unclear

Transect 7

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.2	0.95		100% bedrock	
(2) 3.5	0.75		100% bedrock	
(3) 5.8	unsafe			
(4) 8.1	unsafe			
(5) 10.4	0.88		50% lg b, 50% cobble	
(6) 12.7	0.57		50% lg b, 20% sm b, 20% bedrock, 10% cobble	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25					*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60					*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 8

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.1	0.85		100% bedrock	
(2) 3.3	unsafe			
(3) 5.5	unsafe			
(4) 7.7	unsafe			
(5) 9.9	0.50		80% bedrock, 20% lg b	
(6) 12.1	0.53		60% cobble, 30% sm b, 10% lg b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transcect 9

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.84		100% bedrock	
(2) 3.8	unsafe			
(3) 6.3	unsafe			
(4) 8.8	0.85		100% bedrock	
(5) 11.3	0.98		unknown	
(6) 13.8	0.63		60% cobble, 20% bedrock, 20% lg b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 10

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.90		100% bedrock	
(2) 4.1	unsafe			
(3) 6.8	unsafe			
(4) 9.5	0.60		100% bedrock	
(5) 12.2	1.00		100% bedrock	
(6) 14.9	0.55		70% lg b, 30% cobble	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 11

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.2	0.51		100% bedrock covered in soil	
(2) 3.5	0.92		Cannot see	
(3) 5.8	unsafe			
(4) 8.1	unsafe			
(5) 10.4	unsafe			
(6) 12.7	0.35		80% lg b, 20% sm b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 12

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.2	0.26		100% bedrock covered in soil	
(2) 3.5	0.62		100% bedrock	
(3) 5.8	unsafe			
(4) 8.1	unsafe			
(5) 10.4	0.70		Cannot see	
(6) 12.7	0.58		30% bedrock, 30% lg b, 30% cobble, 10% sm b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 13

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.32		100% bedrock	
(2) 3.8	unsafe			
(3) 6.3	unsafe			
(4) 8.8	0.65		60% lg b, 40% bedrock	
(5) 11.3	0.90		60% lg b, 40% bedrock	
(6) 13.8	0.26		100% bedrock	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25						
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

Transect 14

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.70		100% bedrock	
(2) 4.1	unsafe			
(3) 6.8	unsafe			
(4) 9.5	1.15		50% lg b, 30% sm b, 20% cobble	
(5) 12.2	0.33		70% lg b, 30% sm b	
(6) 14.9	0.28		60% bedrock, 30% lg b, 10% gravel/cobble	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25				*		*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						*

*mixed substrate, some optimal

Transect 15

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	1.0+		100% bedrock	
(2) 3.8	unsafe			
(3) 6.3	unsafe			
(4) 8.8	0.07		70% lg b, 30% sm b	
(5) 11.3	0.50		50% lg b, 30% cobble, 20% sm b	
(6) 13.8	0.45		30% lg b, 30% cobble, 20% bedrock, 20% sm b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25					*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 16

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.6	0.30		50% bedrock, 50% sm b	
(2) 4.8	0.94		50% cobble, 50% sand/gravel	
(3) 8.0	unsafe			
(4) 11.2	0.97		40% lg b, 40% sm b, 20% cobble	
(5) 14.4	0.90		80% cobble, 10% lg b, 10% sm b	
(6) 17.6	0.66		40% lg b, 30% sm b, 20% sand/soil, 10% cobble	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*		*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*		*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*				*

*mixed substrate, some optimal

Transect 17

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 2.4	0.58		30% cobble, 30% gravel, 20% lg b, 10% bedrock, 10% sand	
(2) 7.1	0.62		60% gravel, 20% cobble, 20% lg b	
(3)11.8	0.66		40% cobble, 40% lg b, 20% sm b	
(4) 16.5	0.95		40% lg b, 40% sm b, 20% cobble	
(5) 21.2	0.45		60% lg b, 20% sm b, 20% cobble	
(6) 25.9	0.40		80% sand, 10% lg b, 10% sm b	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*				*

*mixed substrate, some optimal

Transect 18

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 2.9	0.70		100% muck	
(2) 8.6	0.95		80% sand, 20% rock	
(3) 14.3	0.75		80% cobble, 10% lg b, 10% sm b	
(4) 20	0.50		60% cobble, 40% lg b	
(5) 25.7	0.85		60% cobble, 40% sm b	
(6) 31.4	0.88		60% cobble, 30% sm b, 10% gravel	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*				*

*mixed substrate, some optimal

Transect 19

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 2.7	0.40		100% muck/sand	
(2) 8.1	1.27		100% sand	
(3) 13.5	unsafe		too deep	
(4) 18.9	0.63		40% cobble, 30% lg b, 30% sm b	
(5) 24.3	1.15		40% lg b, 40% sm b, 20% cobble	
(6) 29.7	0.50		40% cobble, 30% lg b, 20% gravel, 10% sm b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25				*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*				*

*mixed substrate, some optimal

Transect 20

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.9	0.15	0	50% lg b, 30% sm b, 20% cobble	
(2) 5.7	0.25	0	40% cobble, 40% lg b, 20% sm b	
(3) 9.5	0.60	0	50% lg b, 30% cobble, 20% sm b	none
(4) 13.3	0.48	0	60% cobble, 40% sm b	none
(5) 17.1	0.67	0	50% lg b, 40% cobble, 10% sm b	none
(6) 20.9	0.65	0	40% lg b, 30% sm b, 30% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 21

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.9	0.35	0	100% cobble	none
(2) 5.7	0.35	0	70% cobble, 30% lg b	none
(3) 9.5	0.45	0	30% lg b, 30% cobble, 20% sm b, 20% bedrock	none
(4) 13.3	0.35	0	50% lg b, 30% sm b, 20% cobble	none
(5) 17.1	0.55	0	50% lg b, 30% cobble, 20% sm b	none
(6) 20.9	0.75	0	70% lg b, 20% gravel, 10% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						*

*mixed substrate, some optimal

Transect 22

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.9	0.35	0	90% cobble, 10% sand/gravel	
(2) 5.6	0.37	0	40% lg b, 30% sm b, 30% cobble	
(3) 9.3	0.55	0	50% lg b, 30% sm b, 20% cobble	
(4) 13	0.65	0	100% lg b	
(5) 16.7	0.65	0	40% cobble, 20% lg b, 20% sm b, 20% sand/gravel	
(6) 20.4	0.55	0	100% muck	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*		*	
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*		*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*				*	

*mixed substrate, some optimal

Transect 23

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 2	0.65	0	50% cobble, 40% gravel, 10% sand	
(2) 6	1.05	0	100% cobble	
(3) 10	unsafe	0	too deep	
(4) 14	unsafe	0	too deep	
(5) 18	0.85	0	60% cobble, 40% lg b	
(6) 22	0.55	0	90% sand/muck, 10% cobble	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*				*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*				*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*					*

*mixed substrate, some optimal

Transect 24

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.1	0.90	0	90% lg b, 10% cobble/sm b	
(2) 3.3	0.60	0	100% lg b	
(3) 5.5	0.60	0	80% lg b, 20% sm b	none
(4) 7.7	0.62	0	50% sm b, 40% lg b, 10% cobble	none
(5) 9.9	0.55	0	50% sm b, 40% lg b, 10% cobble	none
(6) 12.1	0.25	0	90% soil, 10% sm b	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*			*	*	
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*		*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6						

*mixed substrate, some optimal

Transect 25

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 0.9	0.45	0	50% soil, 50% cobble/gravel/sand	none
(2) 2.6	0.65	0	100% cobble/gravel/sand	none
(3) 4.3	0.60	0	80% cobble, 10% sm b, 10% gravel	none
(4) 6.0	0.55	0	60% cobble, 30% sm b, 10% lg b	none
(5) 7.7	0.60	0	50% cobble, 40% sm b, 10% lg b	none
(6) 9.4	0.15	0	90% soil, 10% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*			

*mixed substrate, some optimal

Transect 26

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.0	0.70	0	10% lg b, something hard can't see	none
(2) 2.9	0.55	0	70% lg b, 30% cobble/gravel/sand	none
(3) 4.8	0.35	0	60% sm b, 40% cobble	terrestrial veg
(4) 6.7	0.45	0	60% cobble/gravel/sand, 40% sm b	terrestrial veg
(5) 8.6	0.35	0	60% lg b, 20% soil/clay, 10% cobble, 10% sm b	terrestrial veg
(6) 10.5	0.30	0	100% cobble/gravel	terrestrial veg

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*		*		*

*mixed substrate, some optimal

Transect 27

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.1	0.65	0	80% gravel/cobble, 20% lg b	none
(2) 3.3	0.65	0	100% cobble/gravel/sand	none
(3) 5.5	0.75	0	90% cobble/gravel/sand, 10% lg b	none
(4) 7.7	0.50	0	70% cobble, 20% lg b, 10% sand	terrestrial veg
(5) 9.9	0.35	0	100% soil/sand/muck	terrestrial veg
(6) 11.1	0.20	0	100% soil/sand/muck	terrestrial veg

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*		
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*		
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*	*	*	*	*

*mixed substrate, some optimal

Transect 28

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.2	0.50	0	70% cobble/gravel, 20% sand, 10% lg b	none
(2) 3.5	0.60	0	100% cobble/gravel/sand	none
(3) 5.8	0.60	0	50% gravel/sand, 30% cobble, 10% lg b, 10% sm b	none
(4) 8.1	0.60	0	50% soil/muck, 20% cobble, 20% gravel, 10% sm b	terrestrial veg
(5) 10.4	0.35	0	100% soil/muck	terrestrial veg
(6) 12.7	0.25	0	100% soil/muck	terrestrial veg

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*		
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*		
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 29

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.75		100% gravel/sand	
(2) 3.9	0.75		80% cobble/gravel/sand, 20% lg b	
(3) 6.5	0.80		100% cobble/gravel/sand	
(4) 9.1	0.70		100% cobble/gravel/sand	
(5) 11.7	0.70		90% gravel/sand, 10% cobble	
(6) 14.3	0.60		80% cobble/gravel/sand, 20% lg b	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*	*	*	*	*

*mixed substrate, some optimal

Transect 30

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.78		70% cobble/gravel/muck, 20% sm b, 10% lg b	
(2) 3.8	1.38		100% gravel/sand	
(3) 6.3	0.75		100% gravel/sand	
(4) 8.8	0.97		80% cobble/gravel/sand, 20% lg b	
(5) 11.3	0.95		60% cobble/gravel/sand, 40% lg b	
(6) 13.8	0.95		100% gravel/sand	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*			*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*			*	*	

*mixed substrate, some optimal

Transect 31

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.7	0.80		100% cobble/gravel/sand	
(2) 4.0	0.95		100% cobble/gravel/sand	
(3) 7.3	1.10		100% cobble/gravel/sand	
(4) 10.6	0.90		100% cobble/gravel/sand	
(5) 13.9	1.17		100% cobble/gravel/sand	
(6) 17.2	0.80		100% gravel/sand	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60						
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	

*mixed substrate, some optimal

Transect 32

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.7	1.05		90% cobble/gravel/sand, 10% lg b	
(2) 4.0	1.30		80% cobble/gravel/sand, 20% sm b	
(3) 7.3	1.15		100% gravel/sand	
(4) 10.6	1.05		100% cobble/gravel/sand	
(5) 13.9	1.00		100% cobble/gravel/sand	
(6) 17.2	1.05		100% gravel/sand	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*		*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*		*	*	

*mixed substrate, some optimal

Transect 33

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.7	0.95		100% gravel/sand	
(2) 4.0	1.30		70% cobble/gravel/sand, 20% lg b, 10% sm b	
(3) 7.3	0.98		100% gravel/sand	
(4) 10.6	1.00		100% gravel/sand	
(5) 13.9	1.05		100% gravel/sand	
(6) 17.2	1.05		100% gravel/sand	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*				
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6		*				

*mixed substrate, some optimal

Transcect 34

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.95		100% cobble/gravel/sand	
(2) 4.2	0.75		70% gravel/sand, 30% lg b	
(3) 7.0	0.72		100% gravel/sand	
(4) 9.8	1.10		100% cobble/gravel/sand	
(5) 12.6	1.23		100% gravel/sand	
(6) 15.4	1.43		100% gravel/sand	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*			*		
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*		*		

*mixed substrate, some optimal

Transect 35

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.70		60% gravel/sand, 40% lg b	
(2) 4.2	0.65		90% cobble/gravel/sand, 10% sm b	
(3) 7.0	1.27		100% cobble/gravel/sand	
(4) 9.8	1.08		100% cobble/gravel/sand	
(5) 12.6	1.08		100% cobble/gravel/sand	
(6) 15.4	1.20		100% cobble/gravel/sand	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60		*	*	*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	

*mixed substrate, some optimal

Transect 36

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.87		100% sand/muck	
(2) 3.8	1.50		60% gravel/sand, 40% lg b	
(3) 6.3	1.30		100% gravel/sand	
(4) 8.8	0.78		100% cobble/gravel/sand	
(5) 11.3	1.07		100% gravel/sand	
(6) 13.8	0.90		100% gravel/sand	

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25		*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60				*		
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*		*		

*mixed substrate, some optimal

Transect 37

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.7	0.90		80% cobble/gravel/sand, 20% lg b	
(2) 5.0	1.05		70% cobble/gravel/sand, 30% lg b	
(3) 8.3	1.08		70% cobble/gravel/sand, 30% lg b	
(4) 11.6	0.90		100% gravel/sand	
(5) 14.9	0.82		100% gravel/sand	
(6) 18.2	0.75		100% gravel/sand	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*			
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*			

*mixed substrate, some optimal

Transect 38

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.9	0.80		40% cobble, 40% muck, 20% sand/gravel	freshwater sponge throughout
(2) 5.6	1.18		70% cobble/gravel/sand, 30% lg b	
(3) 9.3	1.15		60% gravel/sand, 40% lg b	
(4) 13.0	1.20		80% gravel/sand, 20% cobble	
(5) 16.7	1.00		70% cobble/gravel/sand, 20% lg b, 10% sm b	
(6) 20.4	0.65		100% gravel/sand/muck	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*		*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 39

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.96		90% cobble/gravel/sand, 10% lg b	
(2) 4.5	1.05		90% gravel/sand, 10% sm b	
(3) 7.5	1.00		70% gravel/sand, 30% cobble	
(4) 10.5	1.10		70% gravel/sand, 30% lg b	
(5) 13.5	1.28		60% gravel/sand, 20% cobble, 20% sm b	
(6) 16.5	0.95		60% cobble/gravel/sand, 40% lg b	

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*		*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 40

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	1.05	0	60% sand/muck, 40% cobble	none
(2) 4.1	0.78	0	50% gravel/sand, 30% cobble, 20% sm b	none
(3) 6.8	0.90	0	50% gravel/sand, 30% lg b, 20% sm b	none
(4) 9.4	0.78	0	50% cobble, 40% gravel/sand, 10% sm b	none
(5) 12.1	0.85	0	80% gravel/sand, 20% cobble	none
(6) 13.8	0.80	0	60% gravel/sand, 30% cobble, 10% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 41

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.3	0.60	0	60% gravel/cobble, 30% sm b, 10% lg b	none
(2) 3.9	1.05	0	70% gravel/sand, 20% cobble, 10% sm b	none
(3) 6.5	1.02	0	70% cobble/gravel, 20% sm b, 10% lg b	none
(4) 9.1	1.08	0	70% cobble/sand, 20% sm b, 10% lg b	none
(5) 11.7	0.95	0	40% lg b, 40% cobble, 20% sand/gravel	none
(6) 14.3	1.05	0	50% cobble/gravel, 40% lg b, 10% sm b	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 42

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.4	0.70	0	40% sand/muck, 30% lg b, 20% cobble, 10% sm b	none
(2) 4.1	0.82	0	30% lg b, 30% cobble, 20% sm b, 20% gravel	none
(3) 6.8	0.97	0	100% cobble	none
(4) 9.5	0.88	0	80% cobble, 20% sm b	none
(5) 12.2	0.65	0	60% cobble, 20% lg b, 20% sm b	none
(6) 14.9	1.05	0	80% cobble/gravel/sand, 20% lg b	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*		*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*		*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*				*

*mixed substrate, some optimal

Transect 43

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	1.05	0	60% cobble/gravel, 40% sm b	none
(2) 4.4	1.25	0	80% cobble/gravel, 20% lg b	none
(3) 7.3	1.20	0	70% gravel/sand, 20% cobble, 10% sm b	none
(4) 10.2	1.40	0	40% cobble, 30% gravel/sand, 30% sm b	none
(5) 13.1	1.25	0	100% cobble/gravel/sand	none
(6) 16.0	0.75	0	90% gravel/sand, 10% lg b	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 44

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.95	0	40% cobble, 30% gravel, 20% sm b, 10% lg b	none
(2) 4.4	1.50	0	80% cobble/gravel/sand, 20% sm b	none
(3) 7.3	1.25	0	60% cobble/gravel/sand, 30% lg b, 10% sm b	none
(4) 10.2	1.35	0	70% cobble/gravel, 30% sm b	none
(5) 13.1	1.00	0	90% gravel/sand, 10% sm b	none
(6) 16.0	0.75	0	80% gravel/sand, 20% cobble	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 45

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	1.10	0	80% gravel, 20% cobble	none
(2) 4.4	1.60	0	100% cobble	none
(3) 7.3	1.45	0	80% cobble/gravel/sand, 20% sm b	none
(4) 10.2	1.08	0	90% cobble/gravel/sand, 10% sm b	none
(5) 13.1	1.05	0	100% gravel/sand	none
(6) 16.0	0.65	0	90% cobble/gravel/sand, 10% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25			*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*		*	*		*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*		*	*		*

*mixed substrate, some optimal

Transect 46

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.80	0	50% cobble/gravel, 40% lg b, 10% sm b	none
(2) 4.4	1.20	0	100% cobble/gravel/sand	none
(3) 7.3	1.50	0	70% cobble/gravel/sand, 30% lg b	none
(4) 10.2	1.20	0	100% cobble/gravel/sand	none
(5) 13.1	1.00	0	100% gravel/sand	none
(6) 16.0	0.75	0	80% cobble/gravel/sand, 20% lg b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*		*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*		*

*mixed substrate, some optimal

Transect 47

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	1.00	0	80% cobble/gravel, 20% sm b	none
(2) 4.4	1.35	0	80% cobble/gravel/sand, 20% sm b	none
(3) 7.3	1.50	0	80% cobble/gravel/sand, 20% sm b	none
(4) 10.2	1.15	0	60% gravel/sand, 20% cobble, 20% sm b	none
(5) 13.1	1.10	0	90% gravel/sand, 10% cobble	none
(6) 16.0	0.75	0	70% cobble/gravel, 30% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 48

Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	1.08	0	60% cobble/gravel, 30% lg b, 10% sm b	none
(2) 4.4	1.30	0	90% cobble/gravel/sand, 10% sm b	none
(3) 7.3	1.40	0	90% cobble/gravel/sand, 10% sm b	none
(4) 10.2	1.40	0	70% cobble/gravel/sand, 30% lg b	none
(5) 13.1	1.05	0	90% gravel/sand, 10% sm b	none
(6) 16.0	0.90	0	70% gravel/sand, 20% cobble, 10% sm b	none

Walleye		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	*
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	*

*mixed substrate, some optimal

Transect 49

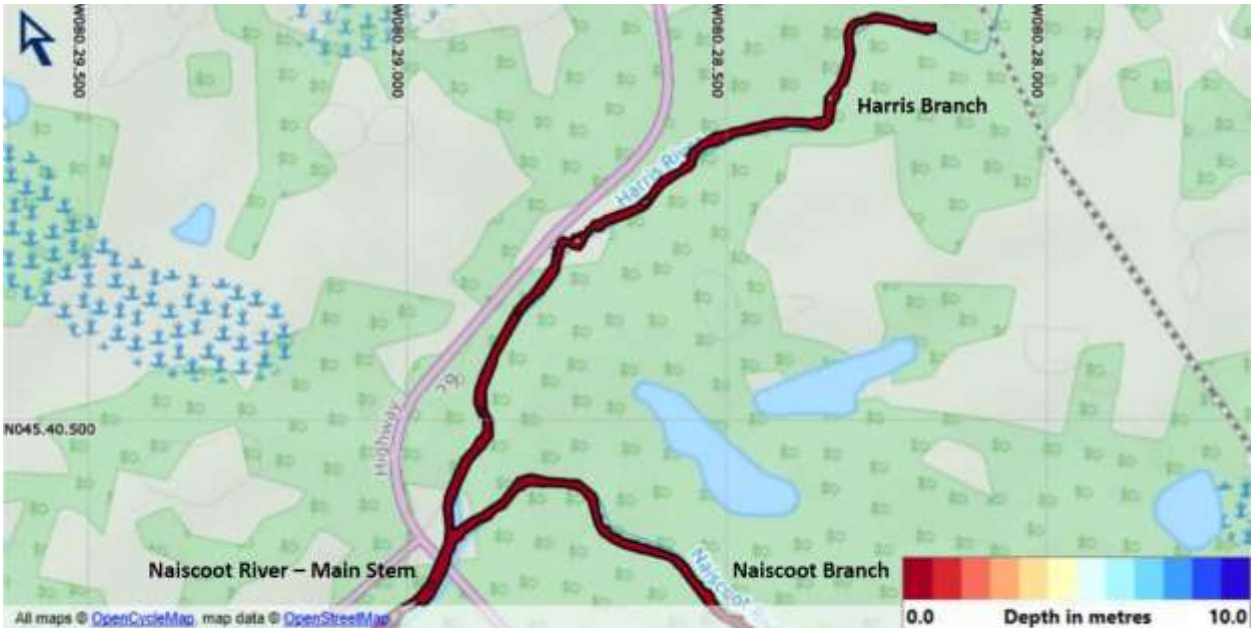
Point	Depth (m)		Particle sizes	Aquatic vegetation present
	Bankfull	Present		
(1) 1.5	0.80	0	60% cobble/gravel/sand, 30% lg b, 10% sm b	none
(2) 4.4	1.30	0	60% gravel/sand, 20% cobble, 20% sm b	none
(3) 7.3	1.30	0	70% cobble/gravel/sand, 30% lg b	none
(4) 10.2	1.25	0	80% cobble/gravel/sand, 20% lg b	none
(5) 13.1	1.10	0	90% gravel/sand, 10% sm b	none
(6) 16.0	1.15	0	100% gravel/sand	none

Walleye		**Point 1**	**Point 2**	**Point 3**	**Point 4**	**Point 5**	**Point 6**
Optimal depth (m)	0.3 - 1.0						
Optimal substrate (cm)	0.2 - 25	*	*	*	*	*	*
Lake Sturgeon							
Optimal depth (m)	0.1 - 2.0						
Optimal substrate (cm)	10 - 60	*	*	*	*	*	
Sucker species							
Optimal depth (m)							
Optimal substrate (cm)	0.2 - 1.6	*	*	*	*	*	

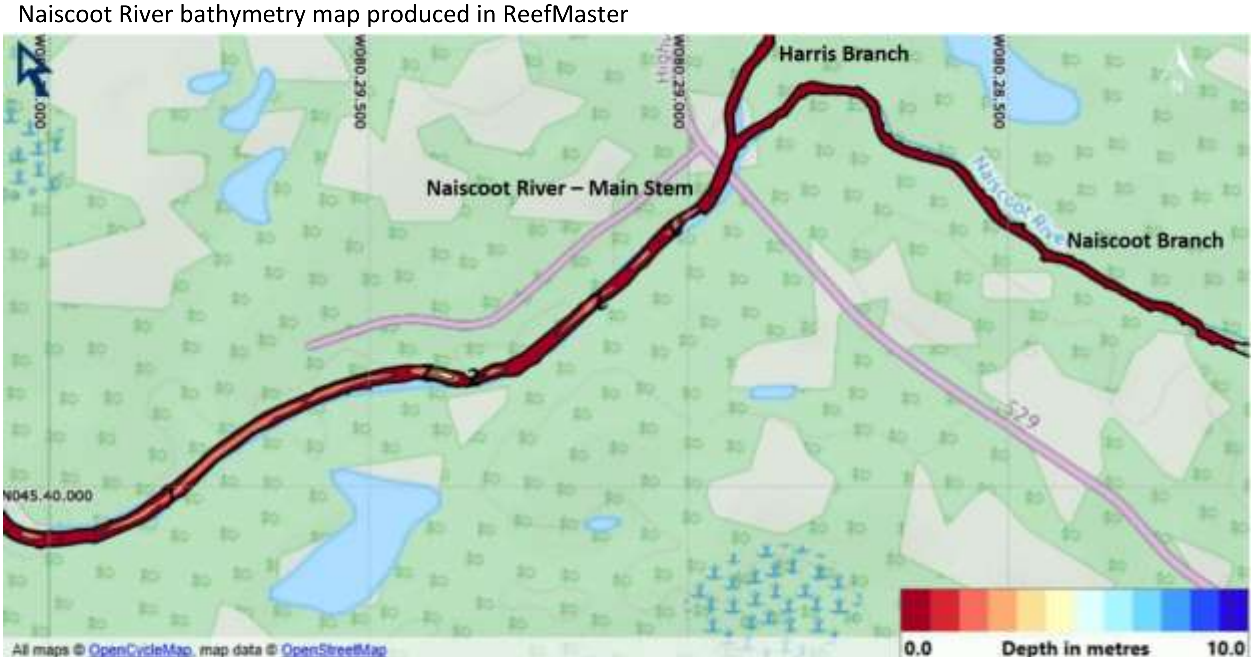
*mixed substrate, some optimal

Appendix F – Bathymetry Maps

Naiscoot River bathymetry map produced in ReefMaster

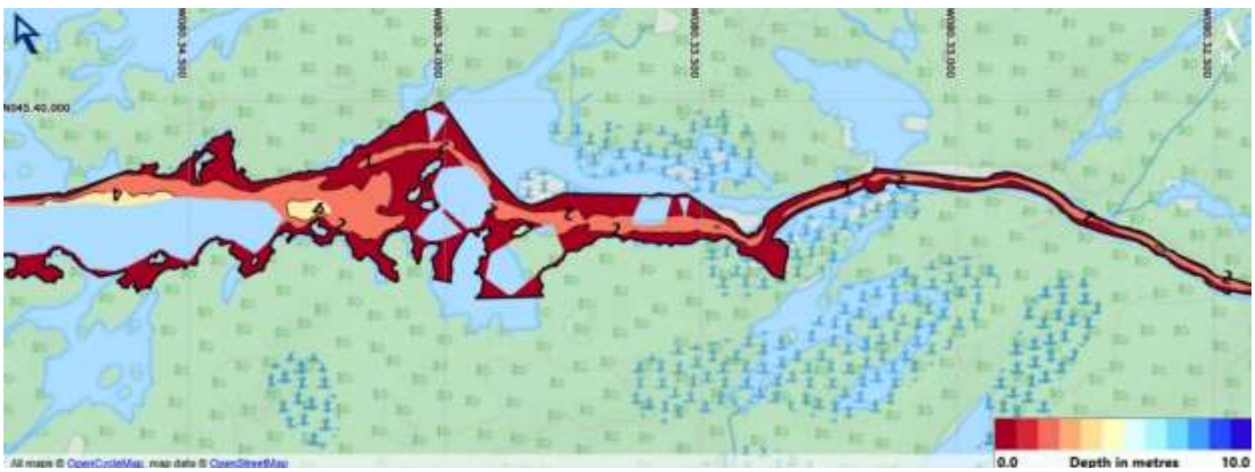


Naiscoot River bathymetry map produced in ReefMaster

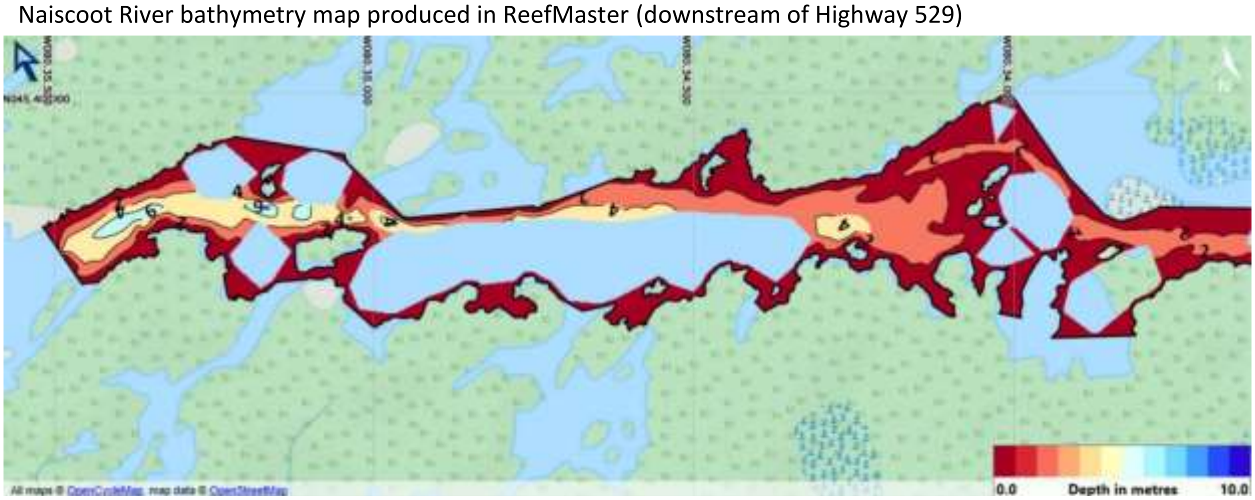


Naiscoot River bathymetry map produced in ReefMaster (downstream of Highway 529)

Naiscoot River bathymetry map produced in ReefMaster (downstream of Highway 529)



Naiscoot River bathymetry map produced in ReefMaster (downstream of Highway 529)



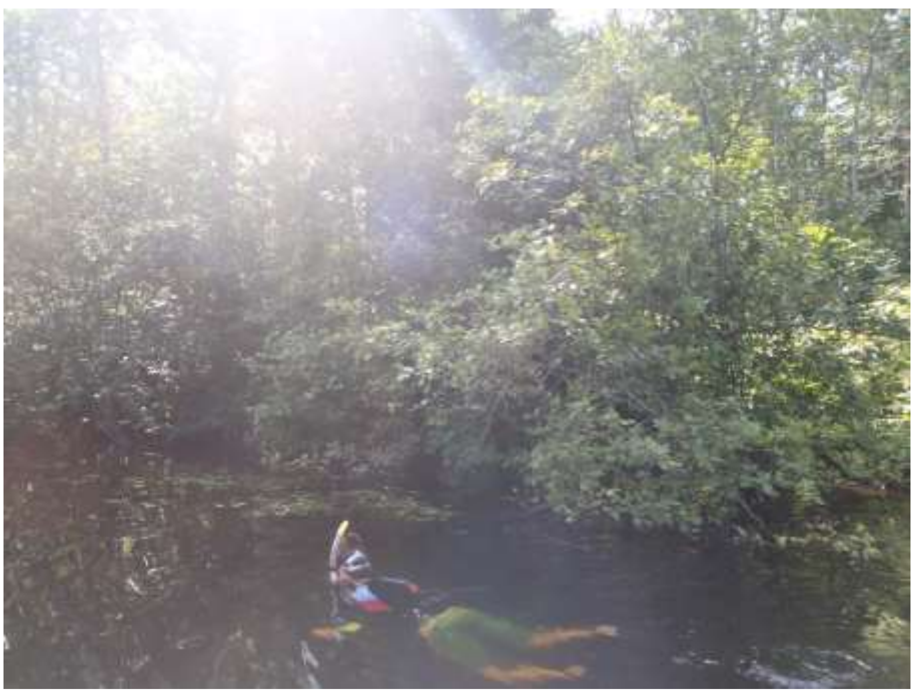
Appendix G – Shoreline Photos

Underwater Surveys – shoreline photos

Main Stem Survey 1

Main Stem Survey 2

Main Stem Survey 3



Harris Branch Survey 1

Harris Branch Survey 2

Harris Branch Survey 3

Naiscoot Branch Survey 1

Naiscoot Branch Survey 2

Naiscoot Branch Survey 3

Naiscoot Branch Survey 4

Naiscoot Branch Survey 5

Naiscoot Branch Survey 6

Naiscoot Branch Survey 7