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Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit

Atlantic Gold
A St Barbara Ltd Company

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Memo

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File:	121619250.2000.950.1503	Date:	December 11, 2020

Reference: Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit

BACKGROUND

This memo has been prepared in response to a October 9, 2020 request for additional information from Fisheries and Oceans Canada (DFO) regarding the potential reduction in flow from Moose River, that may have occurred as a result of the existing Touquoy Gold Mine open pit. A survey was conducted previously on July 30, 2020 on the section of Moose River beginning at surface water monitoring station SW-2 and extending downstream 650 m (Stantec 2020). This memo summarizes additional fish habitat surveys which were completed within Moose River in the vicinity of the existing open pit.

METHODS

For the purposes of the fish habitat surveys conducted in 2020, Moose River was divided into three reaches; the upper reach extending downstream of Mooseland Road to SW-2, the middle reach extending from SW-2 downstream 650 m, and the lower reach extending from 650 m downstream to the confluence with Otter Dam Flowage (Attachment A). Fish habitat surveys were conducted in the upper and lower section of Moose River on November 2 to 4, 2020.

Fish habitat information was collected on a habitat type scale and included: habitat type (riffle, run, pool), substrate composition, bank stability, riparian vegetation, overhead and instream cover, wetted and channel width, depth and gradient. Incidental observations of salmonid redds, preferred spawning habitat, groundwater seepage and potential “areas of interest” were noted. For the purposes of this report, the areas of interest defined as locations where a natural barrier to fish passage could occur as a result of low flows (i.e., bedrock intrusion or the channel geometry was shallow across its entire width). Data were collected using a proprietary Electronic Aquatic Utility (EAU) which included georeferenced data collection and photos of habitat via iPhone (accuracy less than <9.1 m).

The in situ water quality parameters measured included: water temperature, dissolved oxygen, and conductivity (all measured using a YSI ProPlus meter) and pH (measured using a Hanna Instruments 98127 pH meter or YSI ProDSS, which also included turbidity). Water quality meters were calibrated daily or as required. In situ water quality results were compared to the Canadian Water Quality Guidelines for Protection of Aquatic Life Freshwater (CWQG PAL) (CCME 2014).

Reference: **Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit**

RESULTS

Water levels were relatively high at the time of the survey due to recent heavy rain and snow fall, and limited the area that was safely wadable for obtaining fish habitat information (i.e., at or above bankfull depth). The water was clear, however stained with tannins which made visibility of substrate difficult in some places (e.g., limited visibility to less than 0.7m). Given the water flow, fish habitat assessment was typically conducted from the edge of shore or along the edge of the bank. Substrates were visually classified where visibility through the water was good and it was safe to wade. Where visibility was poor or water depths/velocities made wading unsafe the composition of substrate was classified based on feel using the bottom of a boot, by poking with a long stick, or a combination of both.

No redds were observed and no areas of preferable Atlantic salmon spawning habitat were observed in the upper and lower reach; however, these observations were limited by visibility.

The upper reach consisted of mainly riffle-run habitats. At the time of the fish habitat survey the average wetted width was 11.2 m (range 4 to 40 m) and average bankfull width was 12.5 m (4.8 to 40 m). Water depths in the main channel ranged from 0.10 to over 1.5 m. Banks were stable and riparian vegetation was dominated by trees (~60%) and grasses (~20%). Substrate was dominated by cobble and fines (~30% each respectively). Overhead and instream cover was generally low (<5% and ~20%, respectively). Instream cover was made up primarily of submergent aquatic vegetation (~15%). Representative photos are provided in Appendix B (Appendix B, Photos 1-32).

Within the upper reach, Moose River is typically one channel with braiding approximately 50 m downstream of Mooseland Road for approximately 90 m (Appendix B, Photos 3-10). One other small braid was observed approximately 100 m upstream of SW-2 (Appendix B, Photo 30). Three potential areas of interest (AOI)s in the upper reach (AOI-3, AOI-4, AOI-5; Appendix B, Photos 6, 24 and 29), in addition to two AOIs identified in July (AOI-1, and AOI-2; Stantec 2020) and three areas of potential groundwater seepage were observed (Appendix B, Photos 46 to 48).

The lower reach consisted of mainly deep run and pool habitats. At the time of the fish habitat survey the average wetted width of the main channel was 18.4 m (range 9.25 to 35) and average bankfull width was 18.5 m (9.3 to 35 m). Water depths ranged from 0.3 to over 1.6 m. Banks were stable and riparian vegetation was dominated by trees (~50%) and shrubs (~35%). Substrate was dominated by a fines (~55%). Overhead and instream cover was generally low (<5% and ~20%, respectively). Instream cover was made up primarily of submergent aquatic vegetation (~15%). Representative photos are provided in Appendix B (Appendix B, Photos 33-45). No potential AOIs were observed and one area of potential groundwater seepage was observed (Appendix B, Photo 49).

Water temperature at the time of sampling in both the upper and lower reach ranged from 4.6 to 9.0ºC and conductivity ranged from 29.2 to 32.0 µS/cm (Attachment C, Table C.2). Dissolved oxygen concentrations ranged from 10.9 to 12.5 mg/L. They were above the CWQG PAL recommended minimum value of 9.5 mg/L for early life stages (CCME 2014). Turbidity ranged from 1.38 to 1.46 for the locations sampled and is considered low. The pH ranged from 3.9 to 4.9 and was below the CWQG PAL recommended range (6.5 – 9.0). The ranges of pH observed in Moose River during the fall survey are considered to be generally unsuitable for Atlantic salmon (*Salmo salar*) and brook trout (*Salvelinus fontinalis*) (Stanley and Trial 1995; Raleigh 1982). The pH values observed have the potential to result in decreased hatching success for Atlantic salmon and brook trout (Haines 1981; Menendez 1976).

Reference: **Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit**

SUMMARY

Moose River in the vicinity of the existing open pit generally consists of a single channel, however some braiding was observed during the fall surveys. Width ranges from 4.8 to 40.0 m and water depths range from 0.1 to over 1.6 m. The upper stretch is mainly riffle-run, while the lower stretch consists mainly of deeper runs and pools. Substrates appeared to consist of mainly cobble and boulder in swift-flowing habitats and fines or sand in slower moving habitats. No redds were observed and no areas of preferable Atlantic salmon spawning habitat were observed in the upper and lower reach; however, these observations were limited by visibility. Three AOIs were identified to survey during low flow conditions. Overall, the physical habitat characteristics are suitable for various life stages of salmonids, although water quality (specifically pH) may limit the overall suitability of the habitat for salmonids to carry out their life processes.

The upper reach of Moose River is the most similar to the middle reach, as it contains primarily riffle-run habitats, predominantly coarse substrates (i.e., cobble/boulder substrates) and similar riparian forest cover (Stantec 2020). Overall, water temperature and pH likely are the biggest determinants in the quality of habitat for all life stages of Atlantic salmon and brook trout.

REFERENCES

CCME (Canadian Council of Ministers of the Environment). 2014. Canadian Environmental Quality Guidelines. Available Online: http://ceqg-rcqe.ccme.ca/en/index.html#void. Accessed November 12, 2019.

Haines, T.A. 1981. Acidic precipitation and its consequences for aquatic ecosystems: A review. Transactions of the American Fisheries Society. 110:669-707.

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Raleigh, R.F. 1982. Habitat Suitability Index Models: Brook Trout. U.S. Department of the Interior. Fish and Wildlife Service. FWS/OBS-82/10.24. 42pp.

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Stantec (Stantec Consulting Ltd.). 2020. Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion. Prepared for Jim Millard, AMNS. August 31, 2020.

Reference: **Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit**

CLOSING

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Attachments: Attachment A – Moose River Fish Habitat Survey, November 2020, Touquoy Gold Mine, NS
Attachment B – Fish Habitat Photo Log
Attachment C – Field Data

Design with community in mind

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Sources: Stantec, Client

Service Layer Credits: Google Earth Image (July 27, 2019). Moose River Gold Mines, NS. CNES/Airbus [Obtained October 9, 2019]

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Moose River Fish Habitat Survey, November 2020
Touquoy Gold Mine, NS

Figure A.1 Attachment

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TOUQUOY GOLD PROJECT, NS

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 1 Representative Habitat in Moose River Upper Reach (HU 53452) Facing Upstream

Photo 2 Representative Habitat in Moose River Upper Reach (HU 53453) Facing Downstream

Photo 3 Representative Habitat in Moose River Upper Reach (HU 53437) Facing Downstream

Photo 4 Representative Habitat in Moose River Upper Reach (HU 53447) Side Channel Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 5 Representative Habitat in Moose River Upper Reach (HU 53451) Side Channel Facing Downstream

Photo 6 Representative Habitat in Moose River Upper Reach (HU 53446) Facing the Left Bank – Potential Area of Interest #3

Photo 7 Representative Habitat in Moose River HU Upper Reach (HU 53450) Side Channel Facing Downstream

Photo 8 Representative Habitat in Moose River HU Upper Reach (HU 53448) Side Channel Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 9 Representative Habitat in Moose River HU Upper Reach (HU 53449) Facing Upstream

Photo 10 Representative Habitat in Moose River HU Upper Reach (HU 53440) Side Channel Facing Upstream

Photo 11 Representative Habitat in Moose River Upper Reach (HU 53444) Facing Downstream

Photo 12 Representative Habitat in Moose River Upper Reach (HU 53439) Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 13 Representative Habitat in Moose River Upper Reach (HU 53438) Facing Downstream

Photo 14 Representative Habitat in Moose River Upper Reach (HU 53443) Facing Downstream

Photo 15 Representative Habitat in Moose River Upper Reach (HU 53442) Facing Upstream

Photo 16 Representative Habitat in Moose River Upper Reach (HU 53441) Facing Downstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 17 Representative Habitat in Moose River Upper Reach (HU 53885) Facing Downstream

Photo 18 Representative Habitat in Moose River Upper Reach (HU 53883) Facing Upstream

Photo 19 Representative Habitat in Moose River Upper Reach (HU 53884) Facing Downstream

Photo 20 Representative Habitat in Moose River Upper Reach (HU 53887) Facing Downstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 21 Representative Habitat in Moose River Upper Reach (HU 53889) Facing Downstream

Photo 22 Representative Habitat in Moose River Upper Reach (HU 53888) Facing Downstream

Photo 23 Representative Habitat in Moose River Upper Reach (HU 53882) Facing Downstream

Photo 24 Potential Area of Interest #4 in Moose River Upper Reach (HU 53882) Facing Downstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 25 Representative Habitat in Moose River Upper Reach (HU 53892) Facing Downstream

Photo 26 Representative Habitat in Moose River Upper Reach (HU 53893) Facing Downstream

Photo 27 Representative Habitat in Moose River Upper Reach (HU 53890) Facing Upstream

Photo 28 Representative Habitat in Moose River Upper Reach (HU 53891) Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 29 Potential Pinch Point #5 in Moose River Upper Reach (HU 53891) Facing Upstream

Photo 30 Representative Habitat in Moose River Upper Reach (HU 53886) Side Channel Facing Upstream

Photo 31 Representative Habitat in Moose River Upper Reach (HU 53881) Facing Upstream

Photo 32 Representative Habitat in Moose River Upper Reach (HU 53459) Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 33 Representative Habitat in Moose River Lower Reach (HU 53463) Facing Downstream

Photo 34 Representative Habitat in Moose River Lower Reach (HU 53464) Facing Upstream

Photo 35 Representative Habitat in Moose River Lower Reach (HU 53455) Facing Upstream

Photo 36 Representative Habitat in Moose River Lower Reach (HU 53457) Facing Downstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 37 Representative Habitat in Moose River Lower Reach (HU 53458) Facing Downstream

Photo 38 Representative Habitat in Moose River Lower Reach (HU 53461) Facing Upstream

Photo 39 Representative Habitat in Moose River Lower Reach (HU 53462) Facing Upstream

Photo 40 Representative Habitat in Moose River Lower Reach (HU 53465a) Facing Downstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 41 Representative Habitat in Moose River Lower Reach (HU 53465) Facing Downstream

Photo 42 Representative Habitat in Moose River Lower Reach (HU 53460) Facing Downstream

Photo 43 Representative Habitat in Moose River Lower Reach (HU 53454a) Facing Upstream

Photo 44 Representative Habitat in Moose River Lower Reach (HU 53454) Facing Upstream

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 45 Representative Habitat in Moose River Lower Reach (HU 53456) Facing Downstream

Photo 46 Potential Area of Groundwater Seepage #1 Along Bank

Photo 47 Potential Area of Groundwater Seepage #2 Along Bank

Photo 48 Potential Area of Groundwater Seepage #3 Along Bank

Attachment B - Photos Of Fish Habitat Survey Habitat Units (HU) In Moose River, NS, November 2 To 4, 2020

Photo 49 **Potential Area of Groundwater Seepage #4 Along Bank**

Table C.1 Raw Fish Habitat Data, Moose River, NS

Latitude	Longitude	Order	Reach	Habitat Unit Number	Dominant Habitat Unit Type	Unit Length (m)	Bank Stability (%)						Riparian Vegetation %					
Decimal Degrees							Left Bank Unstable	Left Bank Moderately Stable	Left Bank Stable	Right Bank Unstable	Right Bank Moderately Stable	Right Bank Stable	Bare	Grass	Shrub	Conifer	Deciduous	Wetland
44.98788	-62.94535	1	Upper	53452	Cascade/Rapid	23	0	0	50	0	0	50	30	15	5	25	25	0
44.98782	-62.94557	2	Upper	53453	Run (Unclassified)	12	0	0	50	0	0	50	15	35	25	15	10	0
44.98783	-62.9458	3	Upper	53437	Run (Unclassified)	76	0	0	50	0	0	50	0	20	20	30	30	0
44.98765	-62.94653	3b	Upper	53447	Run (Unclassified)	36	0	0	50	0	0	50	0	20	20	30	30	0
44.98772	-62.94617	3c	Upper	53451	Run (Unclassified)	41	0	0	50	0	0	50	0	40	0	30	30	0
44.98763	-62.94658	4	Upper	53446	Riffle	43	0	0	50	0	0	50	0	40	20	15	25	0
44.98746	-62.94656	4b	Upper	53450	Run (Unclassified)	15	0	0	50	0	0	50	0	40	25	15	20	0
44.98747	-62.94633	4c	Upper	53448	Riffle	19	0	0	50	0	0	50	0	40	0	30	30	0
44.98728	-62.94664	5	Upper	53449	Riffle	58	0	0	50	0	0	50	0	25	20	30	25	0
44.98731	-62.94645	5b	Upper	53440	Pool (unclassified)	15	0	0	50	0	0	50	0	40	0	30	30	0
44.98685	-62.94688	6	Upper	53444	Run (Unclassified)	35	0	0	50	0	0	50	0	25	20	30	25	0
44.98658	-62.94706	7	Upper	53439	Pool (unclassified)	10	0	0	50	0	0	50	0	25	20	30	25	0
44.98652	-62.94699	8	Upper	53438	Riffle	24	0	0	50	0	0	50	0	25	20	30	25	0
44.9863	-62.94682	9	Upper	53443	Run (Unclassified)	20	0	0	50	0	0	50	0	20	10	35	35	0
44.9861	-62.94675	10	Upper	53442	Riffle	15	0	0	50	0	0	50	0	15	5	40	40	0
44.98566	-62.94696	11	Upper	53445	Pool (unclassified)	56	0	0	50	0	0	50	0	15	10	40	35	0
44.98561	-62.94703	12	Upper	53441	Run (Unclassified)	120	0	0	50	0	0	50	0	15	5	40	40	0
44.98507	-62.94828	12	Upper	53885	Run (Unclassified)	57	0	0	50	0	0	50	0	20	20	30	30	0
44.9848	-62.94896	13	Upper	53883	Riffle	56	0	0	50	0	0	50	0	20	20	30	30	0
44.98434	-62.94895	14	Upper	53884	Riffle	110	0	0	50	0	0	50	0	20	20	30	30	0
44.98362	-62.94821	15	Upper	53887	Run (Unclassified)	151	0	0	50	0	0	50	0	15	15	70	0	0
44.98247	-62.9471	16	Upper	53889	Run	48	0	0	50	0	0	50	0	15	15	70	0	0
44.98219	-62.94686	17	Upper	53888	Riffle	113	0	0	50	0	0	50	0	25	25	40	10	0
44.98131	-62.94632	18	Upper	53882	Riffle	35	0	0	50	0	0	50	0	10	35	40	15	0
44.981	-62.94629	19	Upper	53892	Riffle	60	0	0	50	0	0	50	0	15	15	55	15	0
44.98062	-62.94577	20	Upper	53893	Pool (unclassified)	10	0	0	50	0	0	50	0	15	15	55	15	0
44.98056	-62.94574	21	Upper	53890	Riffle	30	0	0	50	0	0	50	0	15	15	55	15	0
44.98036	-62.94553	22	Upper	53891	Run (Unclassified)	75	0	0	50	0	0	50	0	15	15	55	15	0
44.98037	-62.94547	22b	Upper	53886	Run (Unclassified)	30	0	0	50	0	0	50	0	35	40	20	5	0
44.98022	-62.94478	23	Upper	53881	Run (Unclassified)	41	0	0	50	0	0	50	0	15	20	45	20	0
44.97483	-62.94509	24	Upper	53459	Pool (unclassified)	75	0	0	50	0	0	50	0	15	10	60	15	0
44.97424	-62.94534	25	Lower	53463	Run (Unclassified)	130	0	0	50	0	0	50	0	15	10	60	15	0
44.97329	-62.94587	26	Lower	53464	Riffle	125	0	0	50	0	0	50	0	15	15	55	15	0
44.97221	-62.94565	27	Lower	53455	Pool (unclassified)	130	0	0	50	0	0	50	0	15	15	55	15	0
44.97128	-62.94462	28	Lower	53457	Run (Unclassified)	30	0	0	50	0	0	50	0	15	15	55	15	0
44.97098	-62.94467	29	Lower	53458	Run (Unclassified)	60	0	0	50	0	0	50	0	25	25	50	0	0
44.9705	-62.94438	30	Lower	53461	Run (Unclassified)	42	0	0	50	0	0	50	0	25	25	50	0	0
44.97044	-62.94388	31	Lower	53462	Run (Unclassified)	26	0	0	50	0	0	50	0	25	25	50	0	0
44.97027	-62.94356	32	Lower	53465a	Run (Unclassified)	65	0	0	50	0	0	50	0	25	25	50	0	0
44.97027	-62.94356	33	Lower	53465	Run (Unclassified)	91	0	0	50	0	0	50	0	25	25	50	0	0
44.96904	-62.94269	34	Lower	53460	Riffle	115	0	0	50	0	0	50	0	10	10	80	0	0
44.9689	-62.94149	35	Lower	53454a	Run (Unclassified)	20	0	0	50	0	0	50	0	10	10	80	0	0
44.9689	-62.94149	36	Lower	53454	Run (Unclassified)	220	0	0	50	0	0	50	0	10	10	80	0	0
44.96728	-62.94009	37	Lower	53456	Run (Unclassified)	375	0	0	50	0	0	50	0	10	90	0	0	0

ND = No data; Habitat units are listed sequentially from upstream to downstream

Table C.1 Raw Fish Habitat Data, Moose River, NS

Latitude	Longitude	Order	Reach	Habitat Unit Number	Dominant Habitat Unit Type	Unit Length (m)	Substrate Composition (%)									Embeddedness		Overhead Cover (% of Survey Area)			
Decimal Degrees							Organics	Fines	Sand	Small Gravel	Large Gravel	Cobble	Small Boulder	Large Boulder	Bedrock		Total Cover (%/survey area)	Undercut Bank	Grass	Tree / Shrub	Large Woody Debris
44.98788	-62.94535	1	Upper	53452	Cascade/Rapid	23	0	0	0	0	0	5	10	10	75	Low embeddedness : <25% embedded	15	0	0	0	5
44.98782	-62.94557	2	Upper	53453	Run (Unclassified)	12	0	0	0	0	20	15	20	5	40	Low embeddedness : <25% embedded	10	0	5	0	0
44.98783	-62.9458	3	Upper	53437	Run (Unclassified)	76	5	30	0	5	5	15	40	0	0	Medium embeddedness : 25-50% embedded	50	0	0	0	0
44.98765	-62.94653	3b	Upper	53447	Run (Unclassified)	36	0	0	0	5	15	40	35	5	0	Medium embeddedness : 25-50% embedded	10	0	0	0	0
44.98772	-62.94617	3c	Upper	53451	Run (Unclassified)	41	0	30	0	0	5	20	30	15	0	Low embeddedness : <25% embedded	10	0	0	0	0
44.98763	-62.94658	4	Upper	53446	Riffle	43	0	0	5	5	10	15	50	15	0	Low embeddedness : <25% embedded	10	0	0	0	0
44.98746	-62.94656	4b	Upper	53450	Run (Unclassified)	15	0	0	0	0	10	45	35	10	0	Low embeddedness : <25% embedded	10	0	0	0	0
44.98747	-62.94633	4c	Upper	53448	Riffle	19	0	0	0	0	0	20	60	20	0	Low embeddedness : <25% embedded	15	0	0	0	5
44.98728	-62.94664	5	Upper	53449	Riffle	58	0	5	0	10	10	45	30	0	0	Low embeddedness : <25% embedded	15	0	0	0	0
44.98731	-62.94645	5b	Upper	53440	Pool (unclassified)	15	20	0	0	0	0	20	50	10	0	Medium embeddedness : 25-50% embedded	15	0	0	0	5
44.98685	-62.94688	6	Upper	53444	Run (Unclassified)	35	0	35	0	5	5	35	20	0	0	Low embeddedness : <25% embedded	25	0	0	0	0
44.98658	-62.94706	7	Upper	53439	Pool (unclassified)	10	0	30	0	0	30	30	10	0	0	Low embeddedness : <25% embedded	20	0	0	0	5
44.98652	-62.94699	8	Upper	53438	Riffle	24	0	0	0	0	50	40	10	0	0	Non-embedded - All rock substrates	20	0	0	0	5
44.9863	-62.94682	9	Upper	53443	Run (Unclassified)	20	0	0	0	5	10	40	40	5	0	Low embeddedness : <25% embedded	20	0	0	0	0
44.9861	-62.94675	10	Upper	53442	Riffle	15	0	40	0	15	5	0	35	5	0	Medium embeddedness : 25-50% embedded	40	0	0	0	0
44.98566	-62.94696	11	Upper	53445	Pool (unclassified)	56	0	90	0	0	0	0	10	0	0	High embeddedness : 50-75% embedded	30	0	0	0	0
44.98561	-62.94703	12	Upper	53441	Run (Unclassified)	120	0	40	0	0	20	30	10	0	0	Medium embeddedness : 25-50% embedded	20	0	0	0	0
44.98507	-62.94828	12	Upper	53885	Run (Unclassified)	57	0	70	0	10	10	5	5	0	0	Medium embeddedness : 25-50% embedded	70	0	0	5	0
44.9848	-62.94896	13	Upper	53883	Riffle	56	0	40	0	5	5	30	20	0	0	Medium embeddedness : 25-50% embedded	30	0	0	5	0
44.98434	-62.94895	14	Upper	53884	Riffle	110	0	15	0	5	25	40	15	0	0	Low embeddedness : <25% embedded	20	0	0	5	0
44.98362	-62.94821	15	Upper	53887	Run (Unclassified)	151	0	20	10	0	10	40	20	0	0	Medium embeddedness : 25-50% embedded	5	0	0	5	0
44.98247	-62.9471	16	Upper	53889	Run	48	0	40	0	0	0	20	40	0	0	Medium embeddedness : 25-50% embedded	30	0	0	5	0
44.98219	-62.94686	17	Upper	53888	Riffle	113	0	40	0	0	20	30	10	0	0	Low embeddedness : <25% embedded	30	0	0	5	0
44.98131	-62.94632	18	Upper	53882	Riffle	35	0	0	0	0	0	30	30	40	0	Low embeddedness : <25% embedded	30	0	0	5	0
44.981	-62.94629	19	Upper	53892	Riffle	60	0	25	0	0	10	30	30	5	0	Low embeddedness : <25% embedded	30	0	0	5	0
44.98062	-62.94577	20	Upper	53893	Pool (unclassified)	10	0	25	0	0	5	30	30	10	0	Low embeddedness : <25% embedded	10	0	0	5	0
44.98056	-62.94574	21	Upper	53890	Riffle	30	0	25	0	0	5	30	30	10	0	Low embeddedness : <25% embedded	10	0	0	5	0
44.98036	-62.94553	22	Upper	53891	Run (Unclassified)	75	0	25	0	0	5	30	30	10	0	Low embeddedness : <25% embedded	10	0	0	5	0
44.98037	-62.94547	22b	Upper	53886	Run (Unclassified)	30	0	20	0	5	35	35	5	0	0	Low embeddedness : <25% embedded	20	0	0	5	0
44.98022	-62.94478	23	Upper	53881	Run (Unclassified)	41	0	25	0	0	5	30	30	10	0	Low embeddedness : <25% embedded	15	0	0	5	0
44.97483	-62.94509	24	Upper	53459	Pool (unclassified)	75	100	0	0	0	0	0	0	0	0	Very high embeddedness : >75% embedded	10	0	0	5	0
44.97424	-62.94534	25	Lower	53463	Run (Unclassified)	130	50	45	5	0	0	0	0	0	0	Very high embeddedness : >75% embedded	10	0	0	5	0
44.97329	-62.94587	26	Lower	53464	Riffle	125	0	0	30	0	5	15	35	15	0	Low embeddedness : <25% embedded	35	0	0	5	0
44.97221	-62.94565	27	Lower	53455	Pool (unclassified)	130	50	20	5	0	0	0	20	5	0	Very high embeddedness : >75% embedded	10	0	0	5	0
44.97128	-62.94462	28	Lower	53457	Run (Unclassified)	30	25	30	10	10	10	10	0	5	0	Medium embeddedness : 25-50% embedded	50	0	0	5	0
44.97098	-62.94467	29	Lower	53458	Run (Unclassified)	60	0	0	50	5	35	5	5	0	0	Medium embeddedness : 25-50% embedded	50	0	0	5	0
44.9705	-62.94438	30	Lower	53461	Run (Unclassified)	42	0	0	20	20	0	20	40	0	0	Medium embeddedness : 25-50% embedded	20	0	0	5	0
44.97044	-62.94388	31	Lower	53462	Run (Unclassified)	26	5	0	10	10	10	20	45	0	0	Medium embeddedness : 25-50% embedded	10	0	0	5	0
44.97027	-62.94356	32	Lower	53465a	Run (Unclassified)	65	5	35	5	5	0	20	30	0	0	Medium embeddedness : 25-50% embedded	40	0	0	5	0
44.97027	-62.94356	33	Lower	53465	Run (Unclassified)	91	5	35	5	5	0	20	30	0	0	Medium embeddedness : 25-50% embedded	40	0	0	5	0
44.96904	-62.94269	34	Lower	53460	Riffle	115	5	55	0	0	0	0	30	10	0	Medium embeddedness : 25-50% embedded	70	0	0	5	0
44.9689	-62.94149	35	Lower	53454a	Run (Unclassified)	20	0	100	0	0	0	0	0	0	0	Very high embeddedness : >75% embedded	5	0	5	0	0
44.9689	-62.94149	36	Lower	53454	Run (Unclassified)	220	0	100	0	0	0	0	0	0	0	Very high embeddedness : >75% embedded	5	0	5	0	0
44.96728	-62.94009	37	Lower	53456	Run (Unclassified)	375	0	100	0	0	0	0	0	0	0	Very high embeddedness : >75% embedded	5	0	5	0	0

ND = No data; Habitat units are listed sequentially from upstream to downstream

Table C.1 Raw Fish Habitat Data, Moose River, NS

Latitude	Longitude	Order	Reach	Habitat Unit Number	Dominant Habitat Unit Type	Unit Length (m)	Instream Cover (% Survey Area)					Aquatic Vegetation Composition					
Decimal Degrees							Large Woody Debris	Small Woody Debris	Boulders	Water Visability	Vegetation	Emergent	Floating Leafed	Free Floating	Submerged	Filamentous Algae	Macrophytic Algae
44.98788	-62.94535	1	Upper	53452	Cascade/Rapid	23	0	0	5	10	0	0	0	0	0	0	0
44.98782	-62.94557	2	Upper	53453	Run (Unclassified)	12	0	0	5	0	0	0	0	0	0	0	0
44.98783	-62.9458	3	Upper	53437	Run (Unclassified)	76	0	0	25	0	30	0	0	0	100	0	0
44.98765	-62.94653	3b	Upper	53447	Run (Unclassified)	36	0	0	10	5	5	0	0	0	100	0	0
44.98772	-62.94617	3c	Upper	53451	Run (Unclassified)	41	0	0	10	0	0	0	0	0	0	0	0
44.98763	-62.94658	4	Upper	53446	Riffle	43	0	0	10	0	0	0	0	0	0	0	0
44.98746	-62.94656	4b	Upper	53450	Run (Unclassified)	15	0	0	10	0	0	0	0	0	0	0	0
44.98747	-62.94633	4c	Upper	53448	Riffle	19	0	0	10	5	0	0	0	0	0	0	0
44.98728	-62.94664	5	Upper	53449	Riffle	58	0	0	5	5	10	0	0	0	100	0	0
44.98731	-62.94645	5b	Upper	53440	Pool (unclassified)	15	0	0	10	0	0	0	0	0	0	0	0
44.98685	-62.94688	6	Upper	53444	Run (Unclassified)	35	0	0	5	5	25	0	0	0	100	0	0
44.98658	-62.94706	7	Upper	53439	Pool (unclassified)	10	0	0	0	0	25	0	0	0	100	0	0
44.98652	-62.94699	8	Upper	53438	Riffle	24	0	0	0	0	0	0	0	0	0	0	0
44.9863	-62.94682	9	Upper	53443	Run (Unclassified)	20	0	0	10	0	0	0	0	0	0	0	0
44.9861	-62.94675	10	Upper	53442	Riffle	15	0	0	5	0	40	0	0	0	100	0	0
44.98566	-62.94696	11	Upper	53445	Pool (unclassified)	56	0	0	0	0	40	50	0	0	50	0	0
44.98561	-62.94703	12	Upper	53441	Run (Unclassified)	120	0	0	0	0	20	50	0	0	50	0	0
44.98507	-62.94828	12	Upper	53885	Run (Unclassified)	57	0	0	0	0	65	50	0	0	50	0	0
44.9848	-62.94896	13	Upper	53883	Riffle	56	0	0	0	0	30	50	0	0	50	0	0
44.98434	-62.94895	14	Upper	53884	Riffle	110	0	0	10	0	10	0	0	0	100	0	0
44.98362	-62.94821	15	Upper	53887	Run (Unclassified)	151	0	0	0	0	0	0	0	0	0	0	0
44.98247	-62.9471	16	Upper	53889	Run	48	0	0	20	0	20	50	0	0	50	0	0
44.98219	-62.94686	17	Upper	53888	Riffle	113	0	0	5	0	30	0	0	0	100	0	0
44.98131	-62.94632	18	Upper	53882	Riffle	35	0	0	20	5	0	0	0	0	0	0	0
44.981	-62.94629	19	Upper	53892	Riffle	60	0	0	5	0	20	0	0	0	0	0	0
44.98062	-62.94577	20	Upper	53893	Pool (unclassified)	10	0	0	5	0	10	0	0	0	100	0	0
44.98056	-62.94574	21	Upper	53890	Riffle	30	0	0	5	0	10	0	0	0	100	0	0
44.98036	-62.94553	22	Upper	53891	Run (Unclassified)	75	0	0	5	0	10	0	0	0	100	0	0
44.98037	-62.94547	22b	Upper	53886	Run (Unclassified)	30	0	0	5	0	10	0	0	0	100	0	0
44.98022	-62.94478	23	Upper	53881	Run (Unclassified)	41	0	0	5	0	10	0	0	0	100	0	0
44.97483	-62.94509	24	Upper	53459	Pool (unclassified)	75	1	0	0	5	5	100	0	0	0	0	0
44.97424	-62.94534	25	Lower	53463	Run (Unclassified)	130	0	0	0	0	5	100	0	0	0	0	0
44.97329	-62.94587	26	Lower	53464	Riffle	125	0	0	20	0	20	0	0	0	100	0	0
44.97221	-62.94565	27	Lower	53455	Pool (unclassified)	130	0	0	5	0	0	0	0	0	0	0	0
44.97128	-62.94462	28	Lower	53457	Run (Unclassified)	30	0	0	5	0	40	100	0	0	0	0	0
44.97098	-62.94467	29	Lower	53458	Run (Unclassified)	60	0	0	5	0	40	100	0	0	0	0	0
44.9705	-62.94438	30	Lower	53461	Run (Unclassified)	42	0	0	5	0	20	0	0	0	100	0	0
44.97044	-62.94388	31	Lower	53462	Run (Unclassified)	26	0	0	5	0	0	0	0	0	0	0	0
44.97027	-62.94356	32	Lower	53465a	Run (Unclassified)	65	0	0	10	0	35	0	0	0	100	0	0
44.97027	-62.94356	33	Lower	53465	Run (Unclassified)	91	0	0	10	0	35	0	0	0	100	0	0
44.96904	-62.94269	34	Lower	53460	Riffle	115	0	0	10	0	60	0	0	0	100	0	0
44.9689	-62.94149	35	Lower	53454a	Run (Unclassified)	20	0	0	10	0	0	0	0	0	0	0	0
44.9689	-62.94149	36	Lower	53454	Run (Unclassified)	220	0	0	10	0	0	0	0	0	0	0	0
44.96728	-62.94009	37	Lower	53456	Run (Unclassified)	375	0	0	0	0	0	0	0	0	0	0	0

ND = No data; Habitat units are listed sequentially from upstream to downstream

Table C.1 Raw Fish Habitat Data, Moose River, NS

Latitude	Longitude	Order	Reach	Habitat Unit Number	Dominant Habitat Unit Type	Unit Length (m)	Comment	Width (m)		Depth (m)				Gradient (%)
Decimal Degrees								Wet	Channel	Wet 25% From Left Bank	Wet 50% From Left Bank	Wet 75% From Left Bank (m)	Maximum Depth (m)	
44.98788	-62.94535	1	Upper	53452	Cascade/Rapid	23	-	4	4.8	0.41	0.45	0.32	0.45	10
44.98782	-62.94557	2	Upper	53453	Run (Unclassified)	12	Difficult to see substrate with water depth/colour	7	7.5	0.8	1.5	0.5	1.5	0.5
44.98783	-62.9458	3	Upper	53437	Run (Unclassified)	76	-	11.5	12	0.15	0.34	0.2	0.66	1
44.98765	-62.94653	3b	Upper	53447	Run (Unclassified)	36	-	8	8.2	0.21	0.2	0.16	0.4	1
44.98772	-62.94617	3c	Upper	53451	Run (Unclassified)	41	Small side channel	1.7	1.7	0.17	0.15	0.19	0.27	1
44.98763	-62.94658	4	Upper	53446	Riffle	43	-	5	5	0.35	0.36	0.35	0.35	3
44.98746	-62.94656	4b	Upper	53450	Run (Unclassified)	15	Small side channel	3.6	3.6	0.19	0.17	0.3	0.49	1
44.98747	-62.94633	4c	Upper	53448	Riffle	19	Small side channel	2.65	2.65	0.25	0.25	0.25	0.25	5
44.98728	-62.94664	5	Upper	53449	Riffle	58	Small side channel	10.1	10.1	0.17	0.3	0.48	0.48	2
44.98731	-62.94645	5b	Upper	53440	Pool (unclassified)	15	Small side channel	4	4	0.42	0.36	0.41	0.52	0
44.98685	-62.94688	6	Upper	53444	Run (Unclassified)	35	-	12.5	12.7	0.42	0.34	0.44	0.42	1
44.98658	-62.94706	7	Upper	53439	Pool (unclassified)	10	-	12.6	12.6	0.3	0.7	0.6	0.7	0.5
44.98652	-62.94699	8	Upper	53438	Riffle	24	-	7.5	7.5	0.3	0.5	0.4	0.5	1
44.9863	-62.94682	9	Upper	53443	Run (Unclassified)	20	-	9	9	0.48	0.4	0.3	0.48	1
44.9861	-62.94675	10	Upper	53442	Riffle	15	-	13.7	13.7	0.45	0.3	0.4	0.45	1
44.98566	-62.94696	11	Upper	53445	Pool (unclassified)	56	Too deep to safely measure	ND	30.7	ND	ND	ND	ND	0
44.98561	-62.94703	12	Upper	53441	Run (Unclassified)	120	-	12.2	12.2	0.5	0.66	0.67	0.7	0.5
44.98507	-62.94828	12	Upper	53885	Run (Unclassified)	57	Assessment from shore	19.4	19.4	0.8	0.3	0.5	0.8	0.5
44.9848	-62.94896	13	Upper	53883	Riffle	56	Assessment from shore	13.1	13.3	0.35	0.3	0.3	0.3	1
44.98434	-62.94895	14	Upper	53884	Riffle	110	Assessment from shore	11.6	11.8	0.4	0.4	0.6	ND	0.5
44.98362	-62.94821	15	Upper	53887	Run (Unclassified)	151	Assessment from shore	19.3	19.3	1	ND	ND	ND	0
44.98247	-62.9471	16	Upper	53889	Run	48	Assessment from shore	13.5	13.6	0.58	0.6	0.58	0.58	1
44.98219	-62.94686	17	Upper	53888	Riffle	113	-	13.8	13.9	0.58	0.62	0.4	0.62	0.5
44.98131	-62.94632	18	Upper	53882	Riffle	35	Swift	13	13.05	0.35	0.4	0.5	0.5	4
44.981	-62.94629	19	Upper	53892	Riffle	60	Swift	11.8	11.8	0.3	0.1	0.28	ND	1
44.98062	-62.94577	20	Upper	53893	Pool (unclassified)	10	Deep pool can't see much substrate	16.7	16.9	0.39	ND	ND	ND	0
44.98056	-62.94574	21	Upper	53890	Riffle	30	Deep pool can't see much substrate	12.5	12.8	0.3	0.2	0.35	ND	2
44.98036	-62.94553	22	Upper	53891	Run (Unclassified)	75	Deep pool can't see much substrate	9.3	9.4	0.3	0.35	0.32	0.35	1
44.98037	-62.94547	22b	Upper	53886	Run (Unclassified)	30	Difficult to see substrate with water depth/colour, except at edges, small side channel	2	3	0.05	0.06	0.07	0.07	0.5
44.98022	-62.94478	23	Upper	53881	Run (Unclassified)	41	Difficult to see substrate with water depth/colour, except at edges	8	8.2	ND	ND	ND	ND	0
44.97483	-62.94509	24	Upper	53459	Pool (unclassified)	75	Visibility limited	40	40	ND	ND	ND	ND	0.5
44.97424	-62.94534	25	Lower	53463	Run (Unclassified)	130	Visibility limited	16.5	16.8	1.1	1.3	1.4	1.4	0
44.97329	-62.94587	26	Lower	53464	Riffle	125	Visibility limited	14.2	14.3	0.45	0.6	0.5	0.6	1
44.97221	-62.94565	27	Lower	53455	Pool (unclassified)	130	Visibility limited	35	35	1	ND	ND	ND	0
44.97128	-62.94462	28	Lower	53457	Run (Unclassified)	30	Visibility limited	9.46	9.7	1.6	1.2	ND	ND	0.5
44.97098	-62.94467	29	Lower	53458	Run (Unclassified)	60	Visibility limited	12.2	12.3	1.25	0.6	0.6	1.25	0.5
44.9705	-62.94438	30	Lower	53461	Run (Unclassified)	42	Visibility limited	18.3	18.3	0.8	ND	ND	ND	0
44.97044	-62.94388	31	Lower	53462	Run (Unclassified)	26	Visibility limited	9.93	10	0.7	ND	ND	ND	0
44.97027	-62.94356	32	Lower	53465a	Run (Unclassified)	65	Visibility limited	9.25	9.3	0.3	0.4	0.6	0.6	1
44.97027	-62.94356	33	Lower	53465	Run (Unclassified)	91	Visibility limited	12.1	12.1	0.6	ND	ND	ND	0
44.96904	-62.94269	34	Lower	53460	Riffle	115	Visibility limited	23.6	24	0.5	0.6	0.7	0.7	1
44.9689	-62.94149	35	Lower	53454a	Run (Unclassified)	20	Visibility limited, deep and slow	18.8	18.8	ND	ND	ND	ND	0
44.9689	-62.94149	36	Lower	53454	Run (Unclassified)	220	Visibility limited, deep and slow	14.2	14.2	0.9	0.9	ND	ND	0.5
44.96728	-62.94009	37	Lower	53456	Run (Unclassified)	375	Visibility limited, deep and slow	16.8	16.8	0.5	ND	ND	ND	0

ND = No data; Habitat units are listed sequentially from upstream to downstream

Table C.2 Raw Fish Water Quality Data, Moose River, NS

Reach ID	StationID	Latitude	Longitude	Water Clarity	Date	Time (UTC)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Specific Conductivity (µs/cm)	pH	Turbidity (NTU)
Upper	R1A	44.98728	-62.9466	Brown/Yellow	2020-11-02	19:03:01	9.0	10.90	95.0	29.2	4.80	ND
Upper	R1B	44.98549	-62.9471	Brown/Yellow	2020-11-04	15:12:22	4.6	12.04	92.8	31.0	3.87	1.38
Upper	R1C	44.98214	-62.947	Brown/Yellow	2020-11-04	18:07:32	5.0	12.29	95.6	32.0	4.14	1.39
Upper	R1D	44.97992	-62.9445	Brown/Yellow	2020-11-04	19:59:14	5.0	12.45	96.8	32.0	4.20	1.46
Lower	R3A	44.97401	-62.9453	Brown/Yellow	2020-11-03	14:51:21	6.6	11.70	96.0	31.1	4.60	ND
Lower	R3B	44.97045	-62.944	Brown/Yellow	2020-11-03	16:51:42	6.7	11.70	96.0	30.7	4.85	ND
Lower	R3C	44.96679	-62.9392	Brown/Yellow	2020-11-03	18:53:06	6.6	11.50	94.0	31.7	4.90	ND

Note: ND = No data collected