

SD 15

Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion



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File:	121619250	Date:	August 31, 2020

Reference: Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion

BACKGROUND AND PURPOSE

This memo has been prepared in response to a July 22, 2020 request for additional information from Fisheries and Oceans Canada (DFO) regarding the Touquoy Gold Mine Project Pit Expansion (the Project). The following additional information was requested by DFO:

1. *“A description of the dataset used for the hydrological modelling.”*
2. *“A analysis comparing the predicted changes to baseflow and groundwater levels made prior to development of the current pit shell and the measured flows and groundwater levels from surface water and groundwater monitoring stations following development of the current pit shell. This will inform the accuracy of the hydrological modelling used to predict changes to Moose River from the expanded pit shell.”*
3. *“An assessment of whether the location of the existing surface water and groundwater monitoring stations are adequate to detect hydrological changes to Moose River following development of the expanded pit shell.”*
4. *“A description of the “natural flow regime”, as defined in DFO 2013 (Attachment 1)¹, in Moose River in the vicinity of the open pit based on available data, including data collected from surface water monitoring station SW-2 (e.g., mean monthly flows, relationship between rate of flow and water level).”*
5. *“An analysis that describes the likelihood that instantaneous flows under the “natural flow regime” (i.e., prior to development of the current open pit) in Moose River in the vicinity of the open pit would fall below 30% of the MAD during the months of July, August, and September.”*
6. *An analysis that shows whether either or both of the guidelines/criteria described in DFO 2013 (Attachment 1) would be exceeded as a result of the proposed pit expansion.”*
7. *“A description of the fish habitat in Moose River (e.g., depth, channel width, substrate, riffle, run, pool, etc.) between monitoring station SW-2 and the location approximately 650 m downstream where the river channel widens (coordinates 504329m E, 4980165m N).”*
8. *“Photos with date/time stamp of Moose River in the vicinity of monitoring station SW-2 (station, upstream and downstream) showing the habitat and corresponding water level on the staff gauge.”*

¹ The attachment that was provided was DFO (2013):
Fisheries and Oceans Canada. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. Canadian Science Advisory Secretariat Science Advisory Report 2013/017.

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9. *“A description of any effects to fish and fish habitat that may occur from the predicted change in baseflows in Moose River, including any potential changes to fish passage, water levels, and water temperatures.”*

This memo addresses items 7 and 8 relating to fish habitat downstream of SW-2.

METHODS

On July 30, 2020, a fish habitat survey was conducted in Moose River by a Stantec aquatic biologist. A segment approximately 650 m long was surveyed, beginning at surface water monitoring station SW-2 and proceeding downstream (Figure 1). As requested by DFO, the fish habitat assessment methodology was provided to and approved by Christopher Burbidge of DFO on July 29, 2020. The assessment included collection of the following habitat information: channel width, channel depth, bank height, substrate composition, gradient, bank cover, bank slope, stream cover, habitat type (e.g., pool, riffle, run), vegetation. Habitat information was collected at six georeferenced transect locations and photos were taken as per request 8 above.

Two locations were identified as areas of interest (AOI) where the channel geometry was relatively shallow over the entire channel width, there was no defined channel, and presence of dense aquatic vegetation. These two AOIs could be a concern for fish movement if water levels dropped substantially such that passage was impeded. A detailed depth profile was obtained at each AOI with measurements taken every 0.5 m.

In situ water quality data were collected at two transect locations and included water temperature, pH, dissolved oxygen, and conductivity. Water temperature, dissolved oxygen, and conductivity were measured using a YSI2030 meter and pH was measured using a Hanna Instruments 98127 pH meter. Water quality meters were calibrated prior to use. Habitat information was recorded in the field using a Stantec proprietary digital field data collection tool, which was downloaded to our centralized database.

RESULTS

Generally, Moose River is a low gradient stream characterized by small boulder, cobble, and large gravel substrate, which indicates that it has undergone periods of high flow. Six stream transects (T1 to T6) were assessed for aquatic habitat, beginning at SW-2 and ending approximately 650 m downstream. Locations are shown on Figure 1 (Attachment A). The surveyed area consisted of both swift-flowing and slow-moving sections and the gradient shift over the course of the survey area ranged from 2.0 to 2.5%. Except for some areas on the banks, the riverbed in the survey area contains very little fine material (i.e., sand and fines).

Representative photos of the survey area and transects are provided in Attachment B (Photos 1-27). A summary of field data collected at each transect is provided in Attachment C.

This summer season has been exceptionally dry and water levels were interpreted to be low on the survey date with maximum wet depths at the 25%, 50%, and 75% channel widths ranging from 0.17 m to 0.58 m, for transects T2 and T1, respectively. Maximum channel depth was greater than that recorded for the three cross-sectional locations at each transect location except the two AOIs (see below). The

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channel width of Moose River ranged from 10.2 m to 16.1 m. At the time of the fish habitat survey the average wetted width was 9.86 m and average channel width was 12.08 m.

Two AOI were identified in the survey area that were generally shallow across the river bed. AOI 1 was located approximately 40 m upstream of transect T4 and AOI 2 was 2-3 m upstream of transect T6 at the end of the survey area where Moose River widens into a ponded area. Depth profiles for AOI 1 and AOI 2 are shown graphically in Figure X.X and data are provided in Appendix C. Given that adult and juvenile brook trout (*Salvelinus fontinalis*), juvenile landlocked Atlantic salmon (*Salmo salar*), American eel (*Anguilla rostrata*), and cyprinids including white sucker (*Catostomus commersonii*) have been previously reported to be within Moose River (CRA 2007), a minimum water depth of 5 cm would be required to allow upstream and downstream movements of these fish species and life stages. There was also an abundance of in-stream aquatic vegetation at these AOI which could become dense and further impede fish passage if water levels dropped to less than 5 cm. The maximum water depths in the AOIs at the time of the survey were 17 cm for AOI 1 and 9 cm for AOI 2 (19 cm).

In situ water quality data were collected near surface at transects T2 and T6. Temperatures ranged from 24°C to 28°C, dissolved oxygen was 7.3 mg/L at the transects (approximately 100% saturation), specific conductivity ranged from 26 µS/cm to 29 µS/cm, and pH ranged from 5.5 to 5.9. Flow measurements at AOI 2 averaged 0.54 meters per second. Dissolved oxygen levels were adequate for freshwater aquatic life and pH was below the Canadian Water Quality Guideline for the Protection of Aquatic Life (freshwater; 6.5 to 9.0) (CCME 2007). Slightly acidic surface water has been noted previously in the Eastern Shore region of Nova Scotia, due to the area's sensitivity to acid rain (Clair et al. 2007).

The range of in situ water quality measurements at T2 and T6 are consistent with historical water quality data collected at SW-2 (specific conductivity 20 µS/cm to 49 µS/cm; pH 4.9 to 6.9), which have been relatively stable since 2016 when the station was first established. Upstream of the mining area (SW-11), the water quality data have also been stable since 2016 with specific conductivity ranging from 17 µS/cm to 58 µS/cm and the pH ranging from 4.8 to 7.0 (Stantec 2020). Historical water temperatures at SW-2 indicate that Moose River typically experiences water temperatures in excess of 25°C during summer months, with the number of days of water temperatures ≥20°C being 57, 68, and 59 for 2017, 2018, and 2019, respectively.

Substrate data were collected at transects T2 to T6 and these locations were dominated by small boulder (~20%), cobble (~30%) and large gravel (~20%). Banks were generally stable and riparian vegetation was dominated by deciduous trees (~40%). Average total instream and overhead cover in the survey area was ~15%. Rooted aquatic vegetation within the transects was dominated by emergent vegetation (~20%) (Attachment B, Photos 5, 8, 14, 20, 25, 26).

During the survey, no fish were observed, which is not surprising given the warm water temperature (24°C to 28°C). Fish will move within a watercourse to areas with cooler water (i.e., thermal refugia) based on their preferred temperature regimes (Breau et al., 2001; Blair 2019). The upper temperature thresholds for fish reported to inhabit Moose River (CRA 2007) are as follows: juvenile Atlantic salmon: 27.8°C (Garside 1973), brook trout : 25°C (Morrison et al., 2020), American eel: 30°C (Barila and Stauffer 1979), and white sucker: 31.5° (EPA 1988). Given these thresholds, most fish species in this section of Moose River will likely have moved into areas with cooler water prior to the low and warm water periods typically experienced in July and August.

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CLOSING

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Attachment: Attachment A – Figure 1
Attachment B - Photos
Attachment C - Field Data

References

- Barila, T. and J. Stauffer. 1979. Temperature behavioral responses of the American eel, *Anguilla rostrata* (Leseur), from Maryland. *Hydrobiologia*: 74.
- Blair, S. 2019. Seasonal habitat use and movement of native brook trout (*Salvelinus fontinalis*) in urban headwater streams. Masters Thesis. Trent University. Ontario, Canada.
- Breau, C., R. Cuniak and S. Peake. 2011. Behaviour during elevated water temperatures: can physiology explain movement of juvenile Atlantic salmon to cool water? *Journal of Animal Ecology*: 80 (4).

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Clair, T.A., I.F. Dennis, D.A. Scruton, and M. Gilliss. 2007. Freshwater acidification research in Atlantic Canada: a review of results and predictions for the future. *Environmental Reviews*, 2007, 15.

CRA (Conestoga-Rovers & Associates). 2007. Environmental Assessment Registration Document for the Touquoy Gold Project: Moose River Gold Mines, Nova Scotia.

EPA (United States Environmental Protection Agency). 1988. Factors influencing growth and survival of white sucker, *Catostomus commersonii*. EPA-600/S3-82-051

Garside, E. 1973. Upper lethal temperature of Atlantic salmon *Salmo salar* L. *Canadian Journal of Zoology*: 51 (8).

Morrison, S., T. Mackey, T. Durhack, J. Jeffrey, L. Wiens, N. Mochnacz, C. Hasler, E. Enders, J. Treberg, and K. Jeffries. 2020. Sub-lethal temperature thresholds indicate acclimation and physiological limits in brook trout *Salvelinus fontinalis*. *Journal of Fish Biology*: 97 (2).

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ATTACHMENT A

**Figure 1, Fish Habitat Assessment,
Moose River, NS**



Source: Stantec, Ltd.
 Service Layer Credits: Google Earth Image (July 27, 2015); Moose River Gold Mines, NS; CNR (AMIS) (Established October 9, 2015)

Disclaimer: This map is for illustrative purposes to support the 2020 project. Questions can be directed to the issuing agency.

Fish Habitat Assessment, Moose River
 July 30, 2020

Figure 1

ATTACHMENT B

**Photos of Fish Habitat Survey Transects at
Moose River, NS, July 30, 2020**

Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)



Photo 1. View upstream of transect T1 (Latitude: 44.979863, Longitude: -62.944511) approximately 10 m upstream from SW-2.



Photo 2. View downstream of transect T1 (Latitude: 44.979863, Longitude: -62.944511) approximately 10 m upstream from SW-2.



Photo 3. View of the left bank of transect T1 (Latitude: 44.979863, Longitude: -62.944511) approximately 10 m upstream from SW-2.

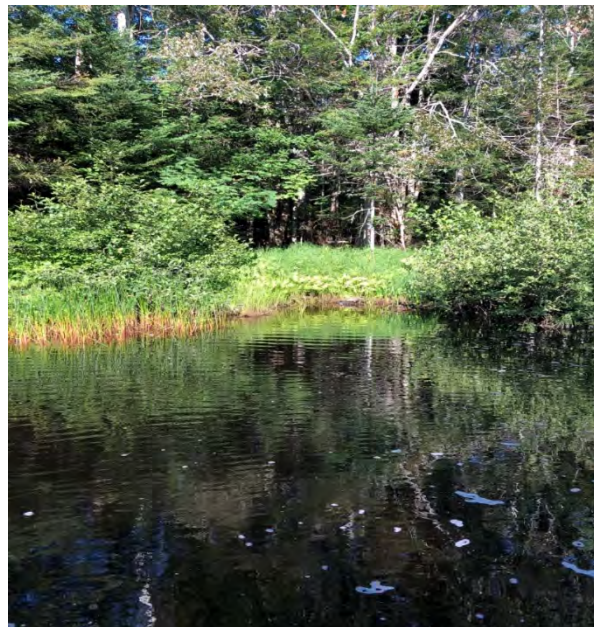


Photo 4. View of the right bank of transect T1 (Latitude: 44.979863, Longitude: -62.944511) approximately 10 m upstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**



Photo 5. View upstream of transect 2 (T2)
(Latitude: 44.97903, Longitude: -62.944)
approximately 125 m downstream from SW-2.



Photo 6. View downstream of transect 2 (T2)
(Latitude: 44.97903, Longitude: -62.944)
approximately 125 m downstream from SW-2.

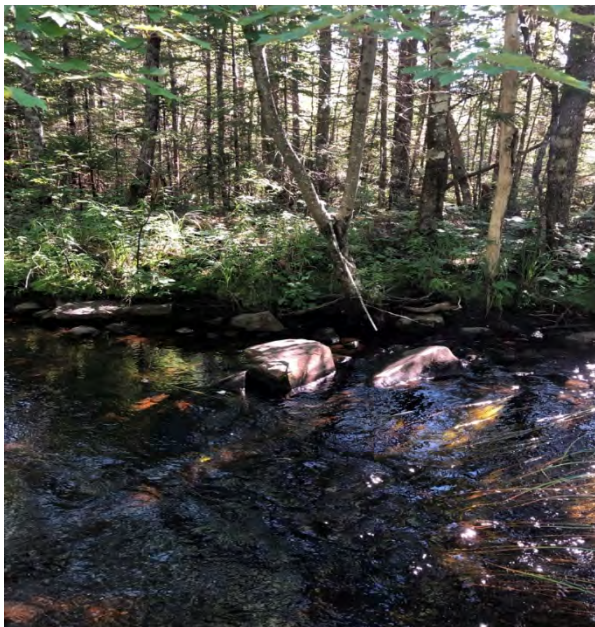


Photo 7. View of the left bank of transect T2
(Latitude: 44.97903, Longitude: -62.944)
approximately 125 m downstream from SW-2.

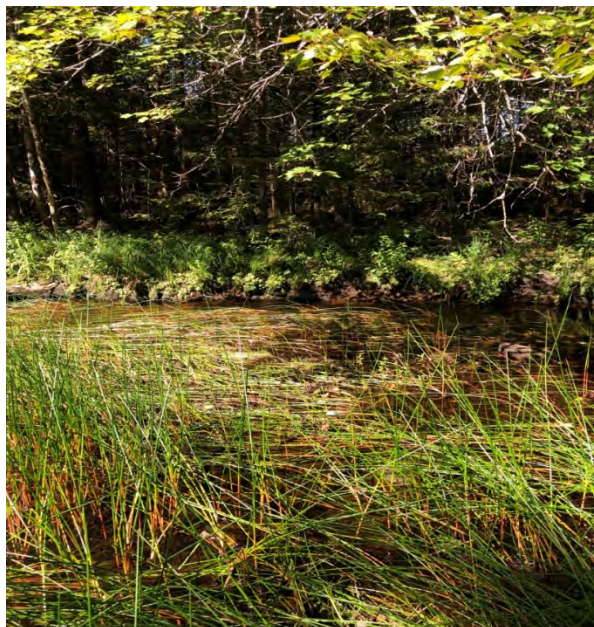


Photo 8. View of the right bank of transect T2
(Latitude: 44.97903, Longitude: -62.9440)
approximately 125 m downstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**

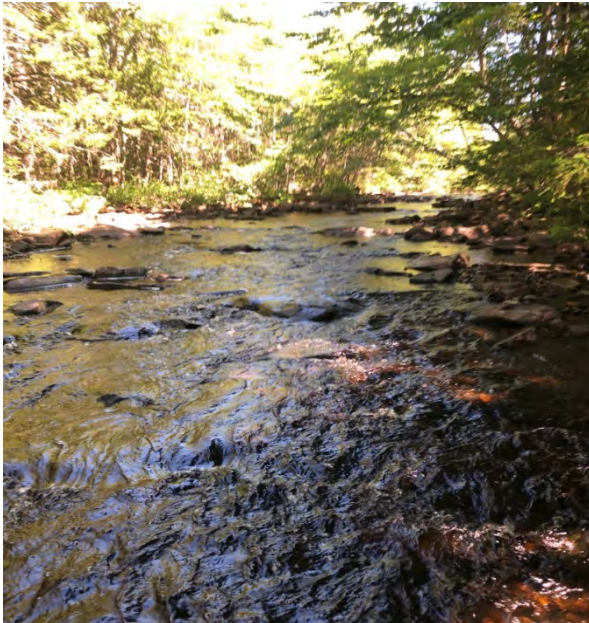


Photo 9. View upstream of transect T3 (Latitude: 44.97822, Longitude: -62.9436) approximately 245 m downstream from SW-2.



Photo 10. View downstream of transect T3 (Latitude: 44.97822, Longitude: -62.9436) approximately 245 m downstream from SW-2.



Photo 11. View of the left bank of transect T3 (Latitude: 44.97822, Longitude: -62.9436) approximately 245 m downstream from SW-2.



Photo 12. View of the right bank of transect T3 (Latitude: 44.97822, Longitude: -62.9436) approximately 245 m downstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**



Photo 13. View upstream of transect T4 (Latitude: 44.97685, Longitude: -62.9432) approximately 395 m downstream from SW-2.

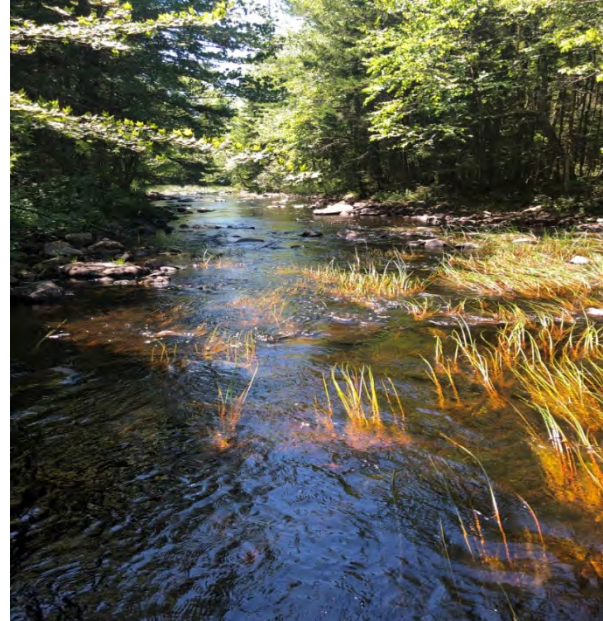


Photo 14. View downstream of transect T4 (Latitude: 44.97685, Longitude: -62.9432) approximately 395 m downstream from SW-2.



Photo 15. View of the left bank of transect T4 (Latitude: 44.97685, Longitude: -62.9432) approximately 395 m downstream from SW-2.



Photo 16. View of the right bank of transect T4 (Latitude: 44.97685, Longitude: -62.9432) approximately 395 m downstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**

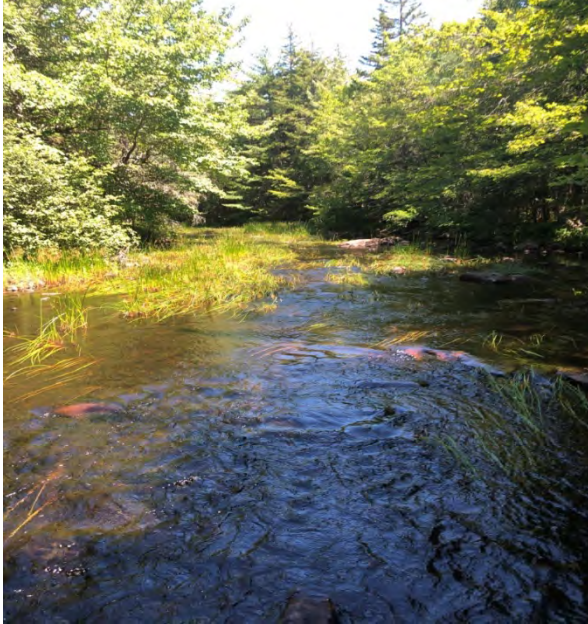


Photo 17. View upstream of transect T5 (Latitude: 44.97668, Longitude: -62.9435) approximately 520 m downstream from SW-2.

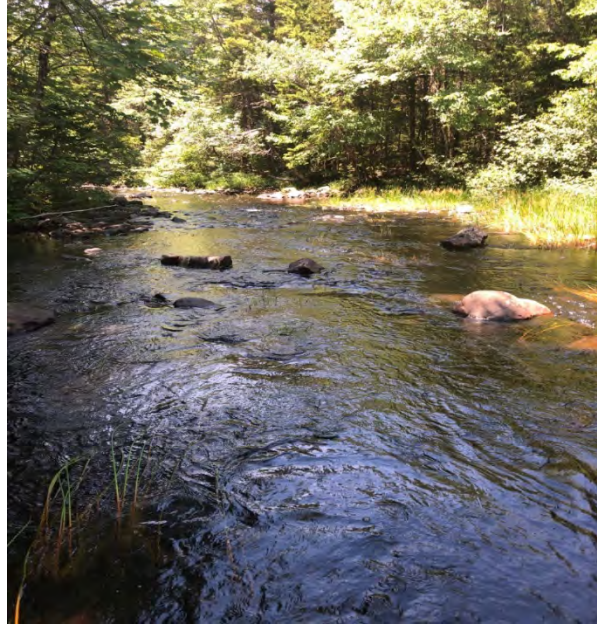


Photo 18. View downstream of transect T5 (Latitude: 44.97668, Longitude: -62.9435) approximately 520 m downstream from SW-2.



Photo 19. View of the left bank of transect T5 (Latitude: 44.97668, Longitude: -62.9435) approximately 520 m downstream from SW-2.



Photo 20. View of the right bank of transect T5 (Latitude: 44.97668, Longitude: -62.9435) approximately 520 m downstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**



Photo 21. View upstream of transect T6 (Latitude: 44.97576, Longitude: -62.9445) approximately 650 m downstream from SW-2.



Photo 22. View downstream of transect T6 (Latitude: 44.97576, Longitude: -62.9445) to AOI 2 approximately 650 m downstream from SW-2.



Photo 23. View of the left bank of transect T6 (Latitude: 44.97576, Longitude: -62.9445) approximately 650 m downstream from SW-2.



Photo 24. View of the right bank of transect T6 (Latitude: 44.97576, Longitude: -62.9445) approximately 650 m downstream from SW-2.

**Photos of Fish Habitat Survey Transects at Moose River, NS July 30, 2020
(see Figure 1 for locations of transects and AOI)**



Photo 25. View upstream of potential AOI 1 (Latitude: 44.97707, Longitude: -62.9434) approximately 40 m upstream from T4.

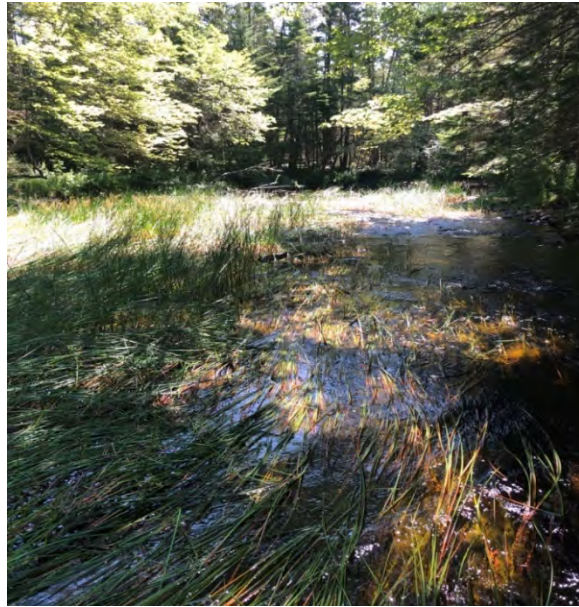


Photo 26. View downstream of potential AOI 1 (Latitude: 44.97707, Longitude: -62.9434) approximately 40 m upstream from T4.



Photo 27. View of the staff gauge in Moose River located at SW-2. Gauge units are equivalent to 1/10th of a meter, therefore '4' on the staff gauge indicates 0.4 m water depth; gauge shows 0.315 m water depth.

ATTACHMENT C
Field Data

Survey Date: 2020-07-30
 Crew: EA/BM/LS

Table C.1 Field Survey Results

Transect:		T1	T2	T3	T4	T5	T6	AOI 1	AOI 2 (see T6)
Coordinates	Latitude	44.979863	44.97903	44.978217	44.976852	44.976682	44.975755	44.977073	44.974991
	Longitude	-62.944511	-62.944037	-62.943643	-62.943168	-62.943452	-62.944501	-62.943359	-62.945096
Habitat Unit Number			16285	16286	16279	16280	16283	16277	-
Dominant Habitat Unit Type		Flat	Riffle	Run 3 (<0.5 m)	Riffle	Riffle	-	-	-
Length (m)		-	43	78	30	152	135	27	-
Left Bank Stability (%)	Unstable	-	5	5	5	0	5	5	-
	Moderately Stable	-	15	5	5	5	5	15	-
	Stable	-	80	90	90	95	90	80	-
Right Bank Stability (%)	Unstable	-	20	5	5	5	5	5	-
	Moderately Stable	-	15	5	15	10	10	5	-
	Stable	-	65	90	80	85	85	90	-
Left Stream Bank Riparian Composition (%)	Bare	-	5	5	10	5	5	5	-
	Grass	-	15	10	15	10	25	10	-
	Shrub	-	15	35	15	15	25	40	-
	Conifer	-	10	15	35	15	10	20	-
	Deciduous	-	60	40	25	55	35	25	-
	Wetland	-	0	0	0	0	0	0	-
Right Stream Bank Riparian Composition (%)	Bare	-	5	5	10	5	5	5	-
	Grass	-	15	5	10	5	25	10	-
	Shrub	-	15	15	20	25	25	30	-
	Conifer	-	10	10	25	10	10	20	-
	Deciduous	-	60	65	35	55	35	35	-
		Wetland	-	0	0	0	0	0	0
Substrate (%)	Organics	-	5	0	0	0	0	5	-
	Fines (<0.06mm)	-	5	0	0	0	0	5	-
	Sand (0.06-2 mm)	-	5	5	5	5	5	10	-

Survey Date: 2020-07-30
 Crew: EA/BM/LS

Table C.1 Field Survey Results

Transect:		T1	T2	T3	T4	T5	T6	AOI 1	AOI 2 (see T6)
Substrate (%)	Small Gravel (2-16 mm)	-	25	5	10	10	5	15	-
	Large Gravel (17-64 mm)	-	25	15	10	10	20	20	-
	Cobble(65-256 mm)	-	20	20	50	35	35	30	-
	Small Boulder (257-1000mm)	-	10	25	15	20	20	5	-
	Large Boulder (>1000mm)	-	5	30	10	20	15	10	-
	Bedrock	-	0	0	0	0	0	0	-
	Embeddedness	-	Medium: 25-50% embedded	Low: <25% embedded	Medium: 25-50% embedded	Medium: 25-50% embedded	Medium: 25-50% embedded	Medium: 25-50% embedded	Medium: 25-50% embedded
Total Cover (% survey area)		-	30	45	30	20	20	15	-
Overhead Cover (%)	Undercut Bank	-	30	5	5	15	10	70	-
	Grass/Forbe	-	20	50	25	20	25	30	-
	Tree/Shrub	-	0	0	0	0	0	0	-
	Large Woody Debris	-	0	0	0	0	0	0	-
Instream Cover (%)	Large Woody Debris	-	0	0	0	0	0	0	-
	Small Woody Debris	-	15	45	10	15	20	10	-
	Boulders	-	0	0	0	0	0	10	-
	Water Visibility	-	20	15	50	20	15	15	-
	Aquatic Vegetation	-	40	5	0	50	15	70	-

Survey Date: 2020-07-30
 Crew: EA/BM/LS

Table C.1 Field Survey Results

Transect:		T1	T2	T3	T4	T5	T6	AOI 1	AOI 2 (see T6)
Aquatic Vegetation Composition (%)	Emergent	-	25	0	5	45	15	60	-
	Floating Leafed	-	0	0	0	0	0	0	-
	Free Floating	-	0	0	0	0	0	0	-
	Submerged	-	15	0	0	0	0	0	-
	Filamentous Algae	-	0	0	0	0	0	0	-
	Macrophytic Algae	-	0	0	0	0	0	0	-
Width (m)	Wet Width (m)	8.75	14.44	6.8	9.95	11.34	7.85	-	8.9
	Channel Width (m)	10.25	14.69	10.2	10.65	16.14	10.55	-	-
Wet Depth from Left Bank (m)	25%	0.41	0.17	0.07	0.215	0.17	0.15	-	0.12
	50%	0.58	0.12	0.2	0.19	0.2	0.23	-	0.11
	75%	0.51	0.145	0.115	0.18	0.2	0.135	-	0.08
Bankfull Maximum Depth (m)		1.03	0.37	0.5	0.565	0.55	0.5	-	-
In-situ Water Quality	Water Clarity	-	Clear	-	-	-	Clear	-	-
	Temperature °C	-	24.1	-	-	-	27.9	-	-
	Dissolved Oxygen (mg/L)	-	7.3	-	-	-	7.3	-	-
	Dissolved Oxygen (%)	-	88	-	-	-	95	-	-
	Specific Conductivity (µS/cm)	-	9.5	-	-	-	28.9	-	-
	pH	-	5.5	-	-	-	5.9	-	-
Comments		-	None	None	None	None	None	None	None