

Habitat Assessments of the Johnson Creek Watershed



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Executive Summary

In summer 2020, EOS performed habitat assessments within the Johnson Creek Watershed to help establish baseline conditions of streams and identify areas of concern for future, potential restoration projects. This assessment consisted of collecting information on physical characteristics, riparian conditions, and basic water quality parameters in 100 m increments throughout the streams.

EOS assessed a total of 5.5 km in the Johnson Creek Watershed: 2.0 km of Johnson Creek, 2.2 km of East Brook, and 1.3 km of North Brook. Therefore, a total of 55, 100 m reaches were assessed. Restrictions for these assessments included limited road access and challenging field conditions. A points system was used to rank each 100 m assessment. Six factors were used in the points system to define a potential restoration site, and the number of points were used to classify 100 m assessments as healthy, healthy with problems, or unhealthy.

In summary, 73% (40 reaches) of assessments in the Johnson Creek Watershed were deemed healthy, 25% (14 reaches) were healthy with problems, and 2% (1 reach) were unhealthy. Common themes across sites in Johnson Creek, East Brook, and North Brook were high amounts of fine sediment, banks bare of vegetation or banks covered with grasses, and low shade cover. There were also sites experiencing some form of erosion and low dissolved oxygen.

Recommendations for the Johnson Creek Watershed consist of tree planting in riparian zones for sites with stream banks that are bare of vegetation or have large amounts of grassy vegetation. Additionally, removal of large debris in streams and the construction of brush mats along silty stream bends could assist with removing fine sediment at sites where there is abundant sand and silt. These recommendations are to help direct EOS we continue our efforts in the Johnson Creek Watershed. The recommendations are not all inclusive but rather an overview of the restoration activities that could be undertaken.

Stream habitat assessment data gathered from this project will provide a record of the current state of stream and riparian health of the Johnson Creek Watershed. Using this data, EOS can plan restoration projects for problem areas and work to prevent potential future problems by maintaining the healthy reaches of streams. In the future EOS would like to extend assessments of the Johnson Creek Watershed to areas that were not reached, as well as other streams in the Rockport – Dorchester area and Tantramar River Watershed area. These assessments will ultimately help with developing a watershed management plan.

Introduction

In 2020, EOS Eco-Energy received funding from the New Brunswick Wildlife Trust Fund to conduct stream habitat assessments along Johnson Creek and its tributaries East Brook and North Brook. Habitat assessments are a great way to find what types of habitat exist, how healthy they are, and also identify any issues facing the riparian and aquatic habitats throughout the watershed.

Healthy riparian zones provide a number of ecosystem services which protect and strengthen the environment, such as improved water quality, water storage and flood mitigation, erosion protection, and groundwater recharge. In addition, healthy riparian zones will benefit wildlife greatly as species living in riparian zones and the river are dependent on the riparian zone for habitat and food requirements. Healthy riparian zones lead to healthy aquatic ecosystems. They help improve water quality and reduce sedimentation into the river, which can be detrimental to aquatic ecosystems by suffocating fish and burying aquatic insects.

There are many unknowns in terms of watershed health in our region due to the previous lack of a watershed group, until the establishment of EOS's Chignecto Watersheds Committee in 2017. EOS assessed three streams within the Johnson Creek Watershed, with no baseline data available. These streams contribute greatly to habitat diversity, the food chain, and water chemistry within the watershed. They ultimately flow into the Johnson's Mills Shorebird Reserve in the Inner Bay of Fundy. This site is an Important Bird Area (IBA) and a Ramsar Wetland of International Importance that sees massive flocks of migratory shorebirds. Land uses in the area include forestry activity, residential and commercial developments, municipal sewage lagoons and private wells, and agriculture, all of which can have varying degrees of impact on our watershed habitat. Degradation of various habitat diminishes a watershed's capacity to provide critical ecosystem functions, which in turn impacts aquatic ecosystems.

The goal of this work was to obtain baseline data on the Johnson Creek Watershed, and identify any and all problem areas within Johnson Creek & its tributaries to guide future restoration activities. The Information gathered from this project will provide valuable data including stream channel characteristics (wet width, depth), riparian characteristics (vegetative cover, shade cover, bank conditions), and aquatic habitat conditions (substrate composition, flow). These assessments are among the first steps in establishing baseline conditions for this watershed, through identifying existing areas of concern, and will ultimately help with developing a watershed management plan. Using this data, we can work towards improving and maintaining healthy aquatic & riparian habitats.

Methodology

Stream habitat assessments were conducted based on the "Habitat Assessment Field Sheet" developed by the Kennebecasis Watershed Restoration Committee (KWRC) that was adapted from the Department of Natural Resources model for habitat assessment. A copy of the Habitat Assessment Field Sheet can be found in Appendix 1. The assessments included a number of

measurements, such as: GPS coordinates, photos, reach length (100 m reaches were used), stream channel characteristics (wet width, depth), riparian characteristics (vegetative cover, shade cover, bank conditions), and aquatic habitat conditions (substrate composition, flow). Any other notes of interest were included (e.g. any wildlife seen, aquatic barriers, bridges, culverts, threats to water quality, garbage/dump sites, beaver activity, etc.). In-situ water quality measurements (temperature, pH, conductivity, dissolved oxygen, total dissolved solids, salinity) were also taken using a Hanna Multiparameter probe. Most of the data was based on observation and therefore subject to interpretation.

Following data collection, EOS staff compiled site information into a condensed, readable format (Appendix 2). An interactive google map was created, mapping the coordinates and habitat information for each assessment. Mapped assessments also included photos of riparian and stream habitat, and a link to raw data sheets that were transcribed onto google docs (Figure 1).

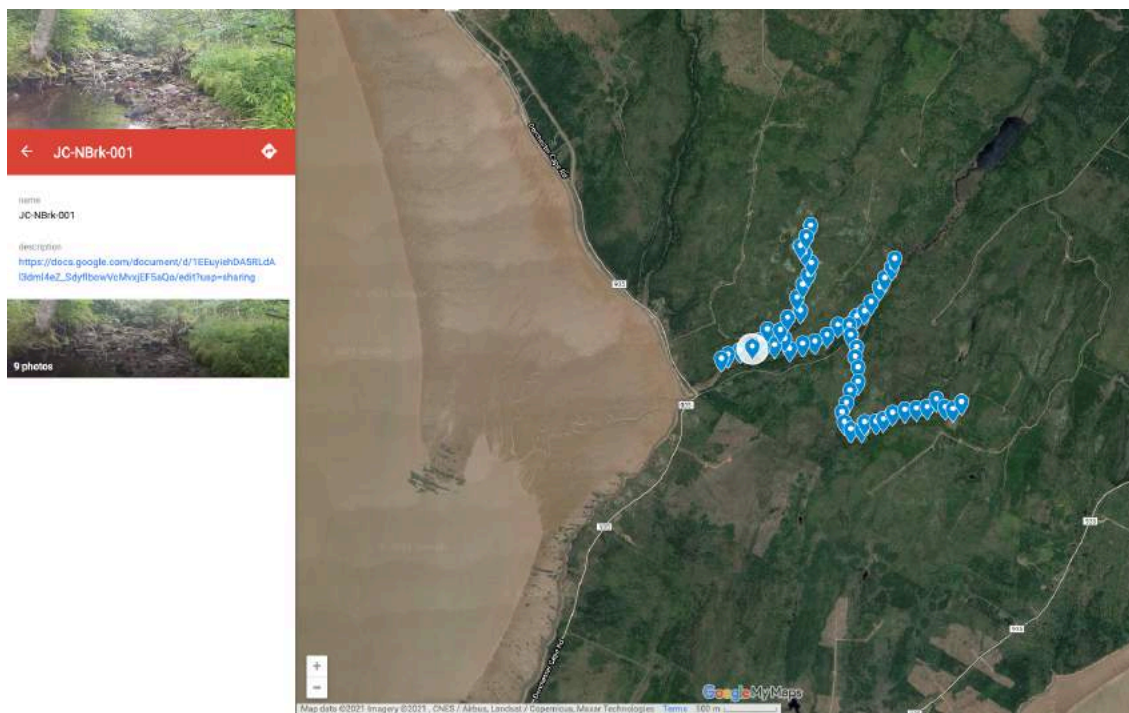


Figure 1: Screen Shot of Johnson Creek Watershed Interactive Google Map (Link: <https://www.google.com/maps/d/u/1/edit?mid=1y8mlU4lx4EmqDPZ6GIm1emdLiqq-9HbK&usp=sharing>)

Results

In the summer of 2020, EOS conducted stream habitat assessments covering 2.0 km of Johnson Creek, 2.2 km of East Brook, and 1.3 km of North Brook. Assessments were performed every 100m reach length; therefore, a total of 55 assessments covering 5.5km of stream were

completed within the Johnson Creek watershed. Restricted road access and challenging field conditions were limitations for this project.

Raw data was summarised into tables below that represent three main components of the habitat assessment: Riparian Zone Conditions (Table 1), Channel Conditions (Table 2), Aquatic Habitat Conditions (Table 3). Assessment conditions were averaged for each stream, with 20 assessments performed at Johnson Creek, 22 assessments performed at East Brook, and 13 assessments performed at North Brook. The following tables represent a summary of average habitat conditions for each stream, that are important for identifying healthy watersheds (Table 1, 2, and 3).

Riparian zone conditions were on average relatively healthy. Average bank conditions remained > 80% stable with erosion less than or equal to 10% (Table 1). Average vegetation cover for grasses were no more than 40% (Table 1). Combined averages of shrub and tree cover remained above 55% (Table 1). Lastly Johnson creek had the lowest average shade cover with 28% (Table 1), which is likely due to grasses having the highest percentage of vegetation cover.

Table 1: Averaged data for riparian zone conditions in the Johnson Creek Watershed

Stream Name	Riparian Zone Conditions										
	Left Bank Conditions			Right Bank Conditions			Vegetative Cover				
	Stable (%)	Slightly Eroding (%)	Heavily Eroding (%)	Stable (%)	Slightly Eroding (%)	Heavily Eroding (%)	Bare (%)	Grasses (%)	Shrubs (%)	Trees (%)	Shade Cover (%)
Johnson Creek	93	6	1	94	6	0	4	40	37	19	28
East Brook	90	9	1	90	8	2	10	33	22	35	54
North Brook	85	9	6	83	10	6	21	19	23	36	57

Channel conditions were on average relatively healthy, with the exception of high amounts of fine sediment in North Brook (Figure 2). Combined averages of bedrock and boulder remained above 50% for Johnson Creek and East Brook, while North brook had a lower average with 30% (Table 2). Combined averages of gravel and fines remained below 50% for Johnson Creek and East Brook, while North brook had an average of approximately 70% (Table 2). High amounts of fine sediment can disrupt important habitat for aquatic plants, insects, and fish. Fine sediment can smother aquatic insects which are an important food source for fish, restrict plant and algae growth, and can easily be resuspended which increases stress on fish.

Table 2: Averaged data for channel conditions in the Johnson Creek Watershed

Stream Name	Channel Conditions							
	Stream Measurements			Substrate Composition				
	Reach Length (m)	Average Depth (cm)	Average Width (m)	Bedrock (%)	Boulder (%)	Gravel (%)	Fines (%)	Embeddedness (%)
Johnson Creek	2000	28	6	11	48	6	35	38
East Brook	2200	22	3	9	42	15	34	39
North Brook	1300	18	3	2	28	5	64	52



Figure 2: Image of North Brook with High Percentage of Fine Sediment

Aquatic habitat conditions across all sites demonstrated average temperatures less than or equal to 20°C. Average dissolved oxygen (DO) remained above 6 mg/L and pH was an average of 7 (Table 3). Average conductivity, total dissolved solids, and salinity did not indicate signs of salt water intrusion. Lastly, average reach composition ranged from pool, riffle, to run, with run being the highest percentage (Table 3).

Table 3: Averaged data for aquatic habitat conditions in the Johnson Creek Watershed

Stream Name	Aquatic Habitat Conditions								
	Surface Water Measurements						Reach Composition		
	Water Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (uS/cm)	Total Dissolved Solids (ppm)	Salinity (ppt)	Pool (%)	Riffle (%)	Run (%)
Johnson Creek	20	8	7	299	149	0.1	26	21	52
East Brook	18	7	7	291	146	0.1	25	6	69
North Brook	17	7	7	91	45	0.04	26	5	66

Discussion

Habitat assessments are a great way to find what types of habitat exist, how healthy they are, and also identify any issues facing the riparian and aquatic habitats throughout the watershed. EOS assessed three streams within the Johnson Creek Watershed (Johnson Creek, East Brook, and North Brook), with no existing baseline data available. These streams contribute greatly to habitat diversity, the food chain, and water chemistry within the watershed. Johnson creek is of special concern as it flows into the Bay of Fundy where the Johnson’s Mills Shorebird Reserve is located, that sees massive flocks of migratory birds.

On average streams were identified as being relatively healthy, with the exception of North Brook that had higher amounts of fine sediment compared to Johnson Creek and East Brook. To take a closer look into stream habitat, EOS used a points system to rank each 100m assessment, to identify potential restoration sites within the Johnson Creek Watershed. Factors were used to assign points to sites based on the quality of habitat (Table 4). Using a points system allows for the identification of healthy habitat or sites in need of restoration. Six factors were used in the points system to define a potential restoration site (Table 4). Each factor was allotted a certain amount of points, while taking into consideration the impacts each factor has on the overall health of the watershed. Eleven is the highest amount of points a site can receive, which would indicate very poor habitat conditions, and be a site in absolute need of restoration. The point system is an easy way to identify sites in need of restoration; however, sites still require further evaluation to decide which restoration efforts are best suited for the area.

Table 4: Point System for Evaluating Potential Restoration Sites

Factors that Define a Potential Restoration Site	Points
60% or more of the substrate is composed of fines	1
25% or more of the stream banks are bare	2
60% or more of the vegetation present is grass	2
Vegetative shade is under 25%	1
Heavy erosion is over 25%/Slight erosion is over 40%	4
Dissolved oxygen is under 5 mg/L	1

The number of points assigned to each site were used to classify 100 m reaches as healthy (0 – 3 points), healthy with problems (4 – 6 points), or unhealthy (7 – 11 points) (Table 5). Reaches were colour coded as green for healthy, orange for healthy with problems, and red for unhealthy. Colour coding 100m reaches is an easy way to identify areas of stream habitat in need of restoration. The colour designation was used in a similar fashion by EOS for previous riparian health assessment projects.

Table 5: Potential for Restoration Colour Designation Based on Points System

Green (Healthy)	0 – 3 points
Orange (Healthy with problems)	4 – 6 points
Red (Unhealthy)	7 – 11 points

Johnson Creek

Habitat assessments on Johnson Creek began ~300m down British Settlement Rd. off Route 935 and commenced for 2km, resulting in 20 assessments. Of these 20 assessments, six out of 20 sites had a total score of zero, meaning 30% of these sites were in good condition, while, 70% of sites could benefit from potential restoration projects. The remaining 14 sites ranged in the number of total points. Most sites were designated as healthy (i.e., 0 – 3 points), with the exception of two sites designated as healthy with problems (i.e., 4 – 6 points) (Figure 3) (Appendix 2, Table 6).

Of these 14 sites, one site recorded DO < 5 mg/L, four sites recorded stream substrate containing 60% or more fine sediment, five sites recorded < 25% shade cover, one site recorded stream banks that were 25% or more bare of vegetation, and 12 sites recorded vegetation consisting of 60% or more grasses (Appendix 2, Table 6).

Photos below demonstrate the state of stream habitat at 4 different sites (Figure 4, 5, 6, and 7). Additional site photos can be found in the google map, as mentioned above in the methods section (Figure 1).

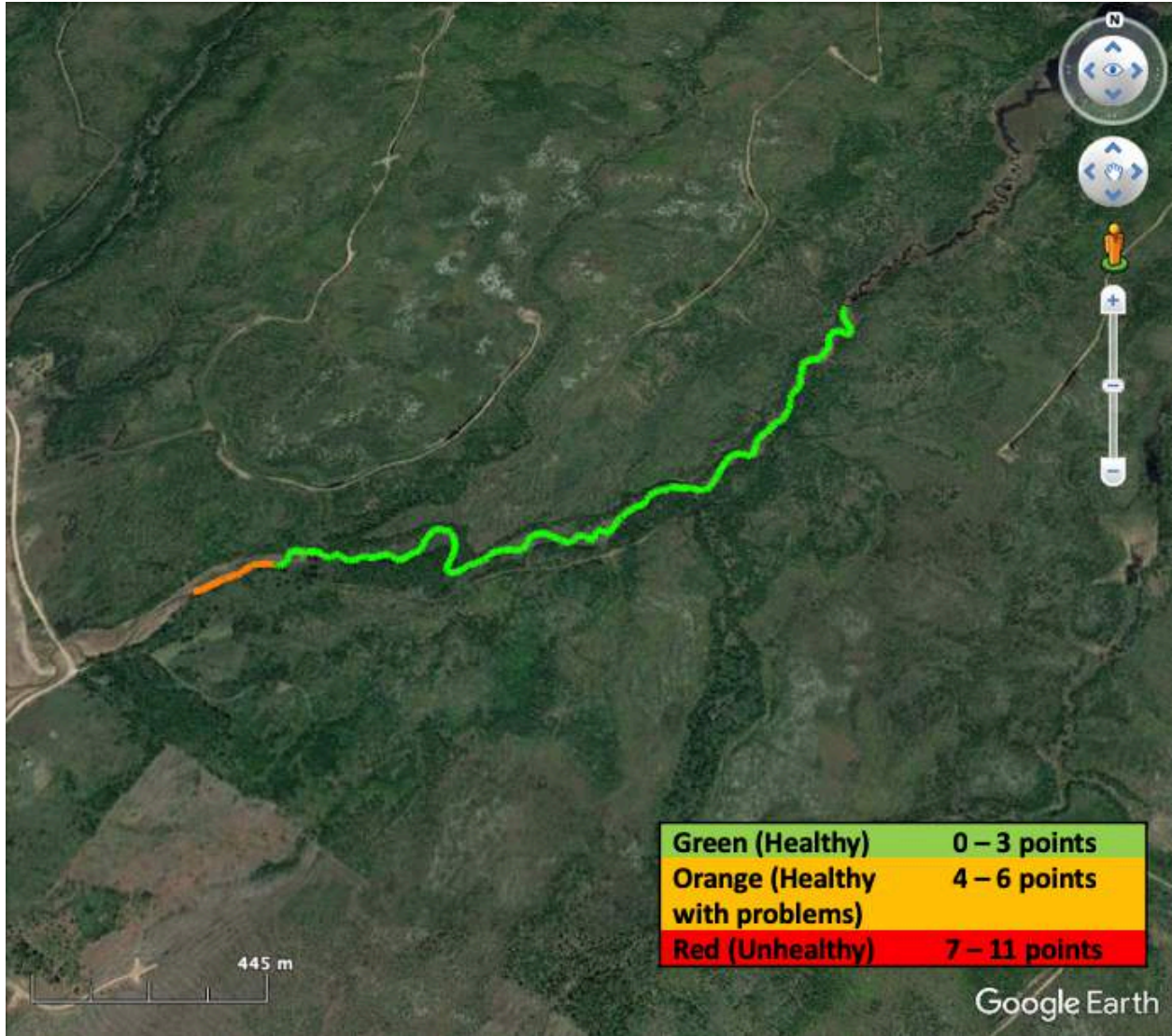


Figure 3: Johnson Creek Point System Map



Figure 4: Photo from JC-001 showing grassy vegetation and fine sediment



Figure 5: Photo from JC-009 showing low shade cover



Figure 6: Photo from JC-016 showing grassy vegetation



Figure 7: Photo from JC-019 showing grassy vegetation

East Brook

Habitat assessments on East Brook began ~1.5 km down British Settlement Rd. off Route 935 and commenced for 2.2km, resulting in 22 assessments. Of these 22 assessments, only one out of 22 sites had a total score of zero, meaning 5% of these sites were in good condition, while, 95% of sites could benefit from potential restoration projects. The remaining 21 sites ranged in the number of total points. There were 13 sites designated as healthy (i.e., 0 – 3 points) and eight sites designated as healthy with problems (i.e., 4 – 6 points) (Figure 8) (Appendix 2, Table 7).

Of these 21 sites, two sites recorded DO < 5 mg/L, one site recorded over 40% of stream banks that were slightly eroded, five sites recorded stream substrate containing 60% or more fine sediment, one site recorded < 25% shade cover, 10 sites recorded stream banks that were 25% or more bare of vegetation, and 15 sites recorded vegetation consisting of 60% or more grasses (Appendix 2, Table 7).

Photos below demonstrate the state of stream habitat at 4 different sites (Figure 9, 10, 11, and 12). Additional site photos can be found in the google map, as mentioned above in the methods section (Figure 1).

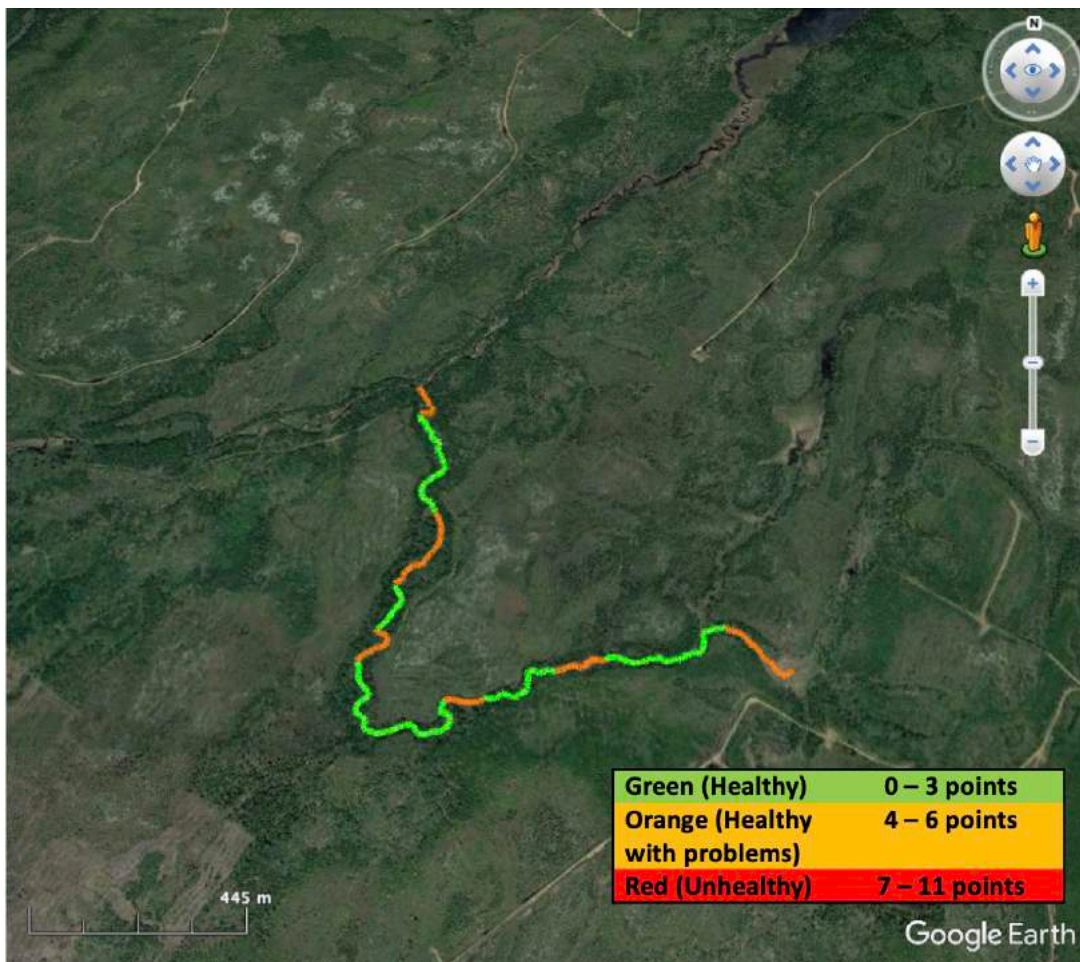


Figure 8: East Brook Point System Map



Figure 9: Photo from JC-EBrk-002 showing grassy vegetation



Figure 10: Photo from JC-EBrk-011 showing grassy vegetation and fine sediment



Figure 11: Photo from JC-EBrk-015 showing grassy vegetation and fine sediment



Figure 12: Photo from JC-EBrk-021 showing grassy vegetation

North Brook

Habitat assessments on North Brook began ~550m down British Settlement Rd. off Route 935 and commenced for 1.3km, resulting in 13 assessments. Of these 13 assessments, no sites had a total score of zero, meaning 100% of sites could benefit from potential restoration projects. Sites ranged in the number of total points. There were eight sites designated as healthy (i.e., 0 – 3 points), four sites designated as healthy with problems (i.e., 4 – 6 points), and one site designated as unhealthy (Figure 13) (Appendix 2, Table 8).

Of these 13 sites, one site recorded DO < 5 mg/L, three sites recorded over 25% of stream banks with heavy erosion, 10 sites recorded stream substrate containing 60% or more fine sediment, 11 sites recorded stream banks that were 25% or more bare of vegetation, and one sites recorded vegetation consisting of 60% or more grasses (Appendix 2, Table 8).

Photos below demonstrate the state of stream habitat at 4 different sites (Figure 14, 15, 16, and 17). Additional site photos can be found in the google map, as mentioned above in the methods section (Figure 1).

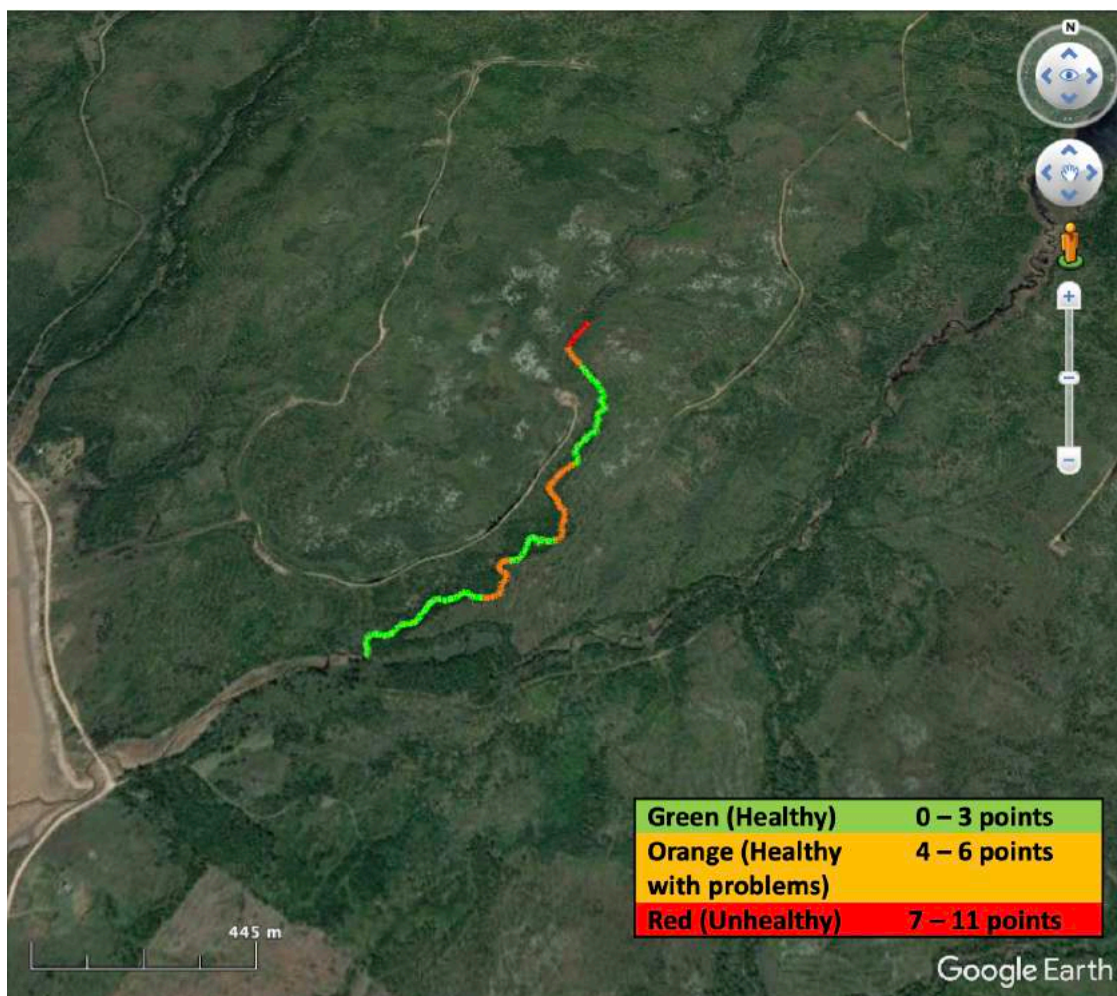


Figure 13: North Brook Point System Map



Figure 14: Photo from JC-NBrk-007 showing fine sediment and under-cut stream banks



Figure 15: Photo from JC-NBrk-009 showing fine sediment and under-cut stream banks



Figure 16: Photo from JC-NBrk-012 showing heavy erosion and fine sediment



Figure 17: Photo from JC-NBrk-013 showing heavy erosion and fine sediment

Recommendations and Next Steps

In summary, 73% (40 reaches) of assessments in the Johnson Creek Watershed were deemed healthy, 25% (14 reaches) were healthy with problems, and 2% (1 reach) were unhealthy. Common themes across sites in Johnson Creek, East Brook, and North Brook were high amounts of fine sediment, banks bare of vegetation or banks covered with grasses, and low shade cover. There were also sites experiencing some form of erosion and low DO.

Potential restoration efforts could focus primarily on diversifying riparian vegetation through planting native trees and shrubs in areas with a high percentage of grass. High amounts of grass can be associated with other poor stream habitat factors consisting of low shade cover, erosion, and fine sediment. Grass provides little shade cover over stream habitat and has a shallow root system with poor soil stabilizing qualities. Increasing and maintaining deep-rooted, native vegetation along the riparian area will help stabilize streambanks, as well as encourage further growth of vegetation. Therefore, restoration activities for these streams could be as easy as tree planting. However, it is important to keep in mind, these sites would need further investigation before planning restoration activities.

Additional efforts for stream restoration could consist of removing large debris from streams, and installing brush mats along silty stream banks that, over time, would collect fine sediment and assist with restoring rocky stream beds. Brush mats consist of using spruce bows, steaks, and twine to create a mat on the outer stream bank where fine sediment is naturally depositing. A high amount of fine sediment is a concern in streams as it can smother aquatic insects which are an important food source for fish, restrict plant and algae growth, and can easily be resuspended which increases stress on fish.

Specific recommendations for the Johnson Creek Watershed consist of:

- 1) Tree planting in riparian zones for sites with stream banks that are 25% or more bare of vegetation and/or has vegetation consisting of 60% or more grasses.
- 2) Remove large debris at sites with substrate containing 60% or more fine sediment to allow for better flow to free-up loose sediment.
- 3) Install brush mats at sites with substrate containing 60% or more fine sediment to capture sediment and build-up healthy stream banks with gradual slope.

Stream habitat assessment data gathered from this project will provide a record of the current state of stream and riparian health of the Johnson Creek Watershed. Using this data, EOS can plan restoration projects for problem areas and work to prevent potential future problems by maintaining the healthy reaches of streams. In the future, EOS would like to extend assessments of the Johnson Creek Watershed to areas that were not reached, as well as assess other streams in the Rockport – Dorchester, and Tantramar River areas. Lastly, these assessments are among the first steps of establishing baseline conditions for our local watersheds, through identifying existing areas of concern, and will ultimately help with developing a watershed management plan.

Appendix 1 – Habitat Assessment Field Sheet

HABITAT ASSESSMENT FIELD SHEET

GENERAL INFORMATION

Date: _____ Assessment Team: _____

River: _____ Tributary: _____

Stream order: _____ Set Reach Length: 30m 50m 100m

Downstream Coordinates: N _____ W _____

Upstream Coordinates: N _____ W _____

Weather: Air temp: _____ °C Elevation: _____ m

Water Temp: _____ °C DO _____ ppm Specific Conductivity _____ us/cm
Conductivity _____ us/cm

Notes on Location: _____

CHANNEL CHARACTERISTICS

Average Depth: _____ cm

Average wet width _____ cm

Bank Full Width _____ cm

%pool _____

%riffle _____

%run _____

Left Bank:

Height: _____ cm

% Stable _____

% Slightly Eroded _____

% Heavily Eroded _____

Right Bank:

Height: _____ cm

% Stable _____

% Slightly Eroded _____

% Heavily Eroded _____

Notes on Channel: _____

SUBSTRATE CHARACTERISTICS

% Embeddedness _____

% fines _____

% sand _____

% gravel _____

% cobble _____

% boulder _____

% bedrock _____

Notes on Substrate: _____

RIPARIAN CHARACTERISTICS

Left Bank - %Shade cover _____

% bare _____
% grasses _____
% shrubs _____
% trees _____

Right Bank - %Shade cover _____

% bare _____
% grasses _____
% shrubs _____
% trees _____

Land use description:

Tree type present:

Landowners:

Notes on Riparian Area:

OTHER GENERAL INFORMATION

Pictures: US _____ DS _____ Other _____

Notable Issues:

- ___ Dump Site
- ___ Dead Fish/Animals
- ___ Beaver Dam
- ___ Man Made Obstruction
- ___ Ford/Culvert/Bridge
- ___ Other

Recommendations:

Other Notes:

Appendix 2 – Data Tables

Table 6: Johnson Creek Habitat Assessment Data

Station	Downstream Northing	Downstream Westing	Length (m)	Water Temp (°C)	DO (mg/L)	pH	Conductivity (uS/cm)	TDS (ppm)	Salinity (ppt)	Average Depth (cm)	Average Width (m)	%pool	%riffle	%run	LB Average Height (cm)	LB %Stable	LB %Slightly Eroded	LB %Heavily Eroded	RB Average Height (cm)	RB %Stable	RB %Slightly Eroded	RB %Heavily Eroded
JC - 001	45.808381	-64.485221	100	21.6	8.75	7.47	404	202	0.19	30.3	3.13	0.0	0.0	100.0	87.0	100.0	0.0	0.0	75.0	100.0	0.0	0.0
JC - 002	45.808739	-64.484401	100	21.02	9.3	7.03	311	155	0.15	24.63	4.7	0.0	5.0	95.0	78.8	100.0	0.0	0.0	51.0	100.0	0.0	0.0
JC - 003	45.809165	-64.482944	100	20.08	9.18	7.23	289	143	0.14	19.75	7.63	5.0	20.0	75.0	63.0	95.0	5.0	0.0	19.5	100.0	0.0	0.0
JC - 004	45.809422	-64.481622	100	18.81	9.15	7.12	371	185	0.18	32.35	5.73	10.0	26.7	63.3	49.0	95.0	5.0	0.0	42.0	82.5	17.5	0.0
JC - 005	45.809418	-64.480201	100	18.36	8.83	7.00	325	161	0.14	36.58	6.04	5.0	25.0	70.0	41.0	70.0	5.0	25.0	49.3	90.0	10.0	0.0
JC - 006	45.809544	-64.4788	100	18.07	8.91	6.94	300	150	0.14	30.18	5.12	12.5	27.5	60.0	39.3	77.5	22.5	0.0	45.5	87.5	12.5	0.0
JC - 007	45.81004	-64.477697	100	21	5.96	6.97	339	171	0.16	27.2	5.36	25.0	32.5	42.5	54.3	85.0	15.0	0.0	32.3	90.0	10.0	0.0
JC - 008	45.809259	-64.477291	100	20.39	6.6	7.08	340	169	0.16	18.75	5.72	30.0	37.5	32.5	70.4	92.5	7.5	0.0	61.8	92.5	7.5	0.0
JC - 009	45.809705	-64.475543	100	19.01	6.08	7.02	341	170	0.16	26.23	6.03	20.0	30.0	50.0	74.5	100.0	0.0	0.0	19.5	100.0	0.0	0.0
JC - 010	45.809841	-64.474078	100	18.18	6.18	7.16	332	164	0.16	35.9	6.2	35.0	22.5	42.5	55.3	92.5	7.5	0.0	67.3	95.0	5.0	0.0
JC - 011	45.810467	-64.472515	100	16.75	4.82	7.04	332	166	0.16	15.78	5.94	45.0	17.5	37.5	53.8	90.0	10.0	0.0	41.5	90.0	10.0	0.0
JC - 012	45.811221	-64.471266	100	16.45	5.85	6.78	325	162	0.16	17.75	5.84	25.0	40.0	35.0	48.7	80.0	20.0	0.0	44.8	92.5	7.5	0.0
JC - 013	45.81124	-64.469948	100	20.66	7.12	7.00	239	118	0.11	22.7	6.29	25.0	26.3	48.7	38.0	92.5	7.5	0.0	47.3	86.3	13.7	0.0
JC - 014	45.8121	-64.469033	100	21.48	8.95	7.15	237	117	0.11	16.4	5.42	40.0	28.8	31.2	49.9	95.0	5.0	0.0	36.5	97.5	2.5	0.0
JC - 015	45.812462	-64.468073	100	22.93	9.47	7.32	252	126	0.12	19.9	5.43	26.7	13.3	60.0	30.5	98.8	1.2	0.0	38.5	100.0	0.0	0.0
JC - 016	45.81311	-64.46735	100	25.12	9.05	7.17	255	128	0.12	23.8	7.73	20.0	42.5	37.5	30.3	97.5	2.5	0.0	34.3	82.5	17.5	0.0
JC - 017	45.814118	-64.466134	100	21	7.28	6.48	237	113	0.11	22.3	4.27	55.0	15.0	30.0	43.5	100.0	0.0	0.0	30.8	97.5	2.5	0.0
JC - 018	45.815071	-64.465776	100	21.28	6.84	6.46	258	128	0.12	44.3	7.12	55.0	10.0	35.0	43.5	92.5	7.5	0.0	28.0	100.0	0.0	0.0
JC - 019	45.815961	-64.464853	100	21.64	6.43	6.02	249	122	0.12	46.5	6.9	42.5	5.0	52.5	42.3	100.0	0.0	0.0	45.0	100.0	0.0	0.0
JC - 020	45.816727	-64.4645	100	21.41	5.35	5.70	244	122	0.11	54	3.9	50.0	0.0	50.0	48.0	100.0	0.0	0.0	48.0	100.0	0.0	0.0

Station	% Embeddedness	% fines	% gravel	% boulder	% bedrock	LB %Shade Cover	LB %bare	LB % grasses	LB %shrubs	LB %trees	RB %Shade Cover	RB %bare	RB % grasses	RB %shrubs	RB %trees	Total Points
JC - 001		90.0	0.0	10.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	4
JC - 002		70.0	0.0	30.0	0.0	0.0	0.0	100.0	0.0	0.0	3.8	0.0	95.0	0.0	5.0	4
JC - 003	50.0	30.0	0.0	70.0	0.0	13.8	2.5	50.0	15.0	32.5	10.0	0.0	82.5	0.0	17.5	3
JC - 004	50.0	20.0	0.0	60.0	20.0	42.5	2.5	25.0	42.5	30.0	30.0	0.0	20.0	55.0	25.0	0
JC - 005	30.0	20.0	0.0	60.0	20.0	36.3	0.0	12.5	82.5	5.0	45.0	22.5	8.8	55.0	13.8	0
JC - 006	0.0	10.0	0.0	20.0	70.0	47.5	5.0	27.5	40.0	27.5	52.5	0.0	17.5	67.5	15.0	0
JC - 007	60.0	50.0	0.0	50.0	0.0	75.0	7.5	30.0	30.0	32.5	72.5	7.5	25.0	35.0	32.5	0
JC - 008	50.0	30.0	10.0	60.0	0.0	15.0	5.0	25.0	42.5	27.5	22.5	0.0	28.8	28.8	42.4	0
JC - 009	5.0	5.0	5.0	20.0	70.0	10.0	5.0	27.5	52.5	15.0	12.5	2.5	27.5	65.0	5.0	1
JC - 010	40.0	40.0	10.0	50.0	0.0	35.0	0.0	41.3	56.3	2.5	40.0	0.0	43.7	50.0	6.3	2
JC - 011	50.0	10.0	20.0	70.0	0.0	25.0	15.0	30.0	35.0	20.0	20.0	0.0	43.8	40.0	16.2	3
JC - 012	30.0	20.0	10.0	70.0	0.0	43.8	12.5	45.0	22.5	20.0	13.8	7.5	47.5	27.5	17.5	2
JC - 013	25.0	15.0	10.0	75.0	0.0	45.0	0.0	37.5	52.5	10.0	47.5	18.8	37.5	35.0	8.8	2
JC - 014	40.0	40.0	0.0	60.0	0.0	37.5	5.0	15.0	57.5	22.5	33.8	0.0	32.5	52.5	15.0	0
JC - 015	0.0	70.0	0.0	30.0	0.0	20.0	2.5	32.5	48.8	16.2	33.8	0.0	58.8	28.8	12.5	3
JC - 016	40.0	5.0	50.0	20.0	25.0	30.0	18.8	16.3	21.3	43.8	30.0	18.8	16.3	21.3	43.8	2
JC - 017	50.0	60.0	0.0	40.0	0.0	35.0	0.0	22.5	62.5	15.0	42.5	0.0	50.0	42.5	7.5	3
JC - 018	70.0	30.0	0.0	70.0	0.0	12.5	0.0	37.5	40.0	22.5	27.5	0.0	42.5	47.5	10.0	2
JC - 019	60.0	50.0	0.0	50.0	0.0	20.0	0.0	30.0	42.5	27.5	22.5	0.0	41.2	40.0	18.8	2
JC - 020						0.0	0.0	40.0	10.0	50.0	5.0	0.0	40.0	35.0	25.0	3

Table 7: Johnson Creek – East Brook Habitat Assessment Data

Station	Downstream Northing	Downstream Westing	Length (m)	Water Temp (°C)	DO (mg/L)	pH	Conductivity (uS/cm)	TDS (ppm)	Salinity (ppt)	Average Depth (cm)	Average Width (m)	%pool	%riffle	%run	LB Average Height (cm)	LB %Stable	LB %Slightly Eroded	LB %Heavily Eroded	RB Average Height (cm)	RB %Stable	RB %Slightly Eroded	RB %Heavily Eroded
JC - EBrk-001	45.811209	-64.469895	100	17.33	7.61	6.89	793	394	0.39	22.95	4.46	42.5	22.5	35.0	55.5	67.5	32.5	0.0	54.5	87.5	12.5	0.0
JC - EBrk-002	45.810408	-64.469772	100	17.47	6.4	6.51	877	440	0.43	21.55	2.96	37.5	12.5	50.0	63.3	82.5	17.5	0.0	49.8	82.5	17.5	0.0

JC - EBrk-003	45.809383	-64.469087	100	17.71	8.26	6.88	906	451	0.45	24.5	3.23	15.0	17.5	67.5	53.0	92.5	7.5	0.0	60.5	85.0	15.0	0.0
JC - EBrk-004	45.808595	-64.469224	100	17.5	5.67	5.70	878	440	0.44	19.5	2.9	22.5	17.5	60.0	41.8	100.0	0.0	0.0	55.0	85.0	15.0	0.0
JC - EBrk-005	45.807655	-64.468927	100	18.1	7.2	6.12	146	73	0.07	21.25	3.4	25.0	20.0	55.0	30.8	80.0	20.0	0.0	41.3	95.0	5.0	0.0
JC - EBrk-006	45.806516	-64.469083	100	18.35	7.47	5.60	142	71	0.07	36.5	3.3	40.0	10.0	50.0	46.5	85.0	10.0	5.0	57.8	86.3	11.3	2.5
JC - EBrk-007	45.805832	-64.46994	100	14.53	3.96	7.14	325	164	0.16	24.88	3.13	37.5	0.0	62.5	41.8	97.5	2.5	0.0	43.8	95.0	5.0	0.0
JC - EBrk-008	45.804757	-64.470353	100	14.45	7.12	7.11	308	154	0.15	22.1	3.11	25.0	16.3	58.8	52.3	88.7	11.3	0.0	51.3	87.5	6.3	6.3
JC - EBrk-009	45.804032	-64.470841	100	16.62	7.17	7.24	195	98	0.09	24.5	2.37	15.0	0.0	85.0	43.5	93.8	0.0	6.3	43.3	100.0	0.0	0.0
JC - EBrk-010	45.805179	-64.470591	100	17.43	7.81	7.30	176	88	0.08	22.25	3.09	16.3	0.0	83.8	59.3	85.0	15.0	0.0	54.5	78.7	21.3	0.0
JC - EBrk-011	45.802527	-64.469751	100	18.47	8.02	7.60	161	81	0.08	21	2.1	5.0	5.0	90.0	63.0	82.5	17.5	0.0	62.0	91.3	8.7	0.0
JC - EBrk-012	45.802519	-64.46848	100	17.51	7.88	7.32	226	112	0.11	22.25	1.86	21.3	0.0	78.8	55.5	85.0	15.0	0.0	63.8	88.8	11.2	0.0
JC - EBrk-013	45.803209	-64.468103	100	18.07	6.57	7.76	152	76	0.07	15.25	2.25	16.3	0.0	83.8	59.5	78.7	21.3	0.0	54.3	85.0	15.0	0.0
JC - EBrk-014	45.803239	-64.803799	100	19.83	7.16	7.49	150	74	0.07	13.75	2.4	20.0	0.0	80.0	57.3	86.7	6.3	7.5	34.5	91.3	8.7	0.0
JC - EBrk-015	45.803386	-64.465833	100	21.03	7.27	7.38	150	75	0.07	20	2.6	21.3	0.0	78.7	59.8	100.0	0.0	0.0	50.5	95.0	5.0	0.0
JC - EBrk-016	45.803931	-64.464786	100	22.31	6.7	7.65	146	73	0.07	29	2.3	30.0	0.0	70.0	55.0	95.0	5.0	0.0	59.8	95.0	5.0	0.0
JC - EBrk-017	45.80419	-64.463251	100	18.97	6.14	7.54	152	77	0.07	20.5	2.6	6.3	0.0	93.7	48.3	95.0	5.0	0.0	41.8	95.0	5.0	0.0
JC - EBrk-018	45.804349	-64.461915	100	18.48	5.43	6.80	94	47	0.04	20.8	2.7	45.0	0.0	55.0	44.0	95.0	5.0	0.0	48.5	88.7	5.0	6.3
JC - EBrk-019	45.804268	-64.460622	100	18.57	5.75	7.10	108	54	0.05	21.5	2.9	13.8	0.0	86.3	54.3	88.8	11.2	0.0	51.5	95.0	5.0	0.0
JC - EBrk-020	45.805074	-64.459492	100	17.85	6.45	6.80	107	53	0.05	29.3	2.1	43.8	6.3	50.0	58.0	91.3	2.5	6.2	50.5	93.7	0.0	6.3
JC - EBrk-021	45.80444	-64.45839	100	18.06	6.51	6.80	103	52	0.05	23.75	1.22	28.8	0.0	71.2	31.0	100.0	0.0	0.0	34.3	100.0	0.0	0.0
JC - EBrk-022	45.804138	-64.457542	100	19.39	4.99	6.93	115	58	0.05	15.3	0.91	17.5	0.0	82.5	36.8	100.0	0.0	0.0	36.5	87.5	0.0	12.5

Station	% Embeddedness	%fines	%gravel	%boulder	%bedrock	LB %Shade Cover	LB %bare	LB %grasses	LB %shrubs	LB %trees	RB %Shade Cover	RB %bare	RB %grasses	RB %shrubs	RB %trees	Total Points
JC - NBrk-001	50.0	20.0	20.0	60.0	0.0	85.0	20.0	20.0	0.0	60.0	72.5	15.0	20.0	17.5	47.5	6
JC - EBrk-002	30.0	20.0	0.0	0.0	80.0	30.0	0.0	38.8	42.5	18.8	30.0	0.0	35.0	32.5	32.5	2
JC - EBrk-003	60.0	50.0	10.0	40.0	0.0	77.5	16.2	23.8	32.5	27.5	60.0	10.0	27.5	32.5	30.0	2
JC - EBrk-004	30.0	0.0	20.0	50.0	30.0	52.5	0.0	20.0	50.0	30.0	67.5	12.5	15.0	47.5	25.0	0
JC - EBrk-005	25.0	20.0	0.0	80.0	0.0	72.5	21.2	23.8	7.5	47.5	62.5	15.0	37.5	2.5	45.0	4
JC - EBrk-006	40.0	20.0	40.0	40.0	0.0	67.5	17.5	27.5	7.5	47.5	53.8	10.0	32.5	5.0	52.5	4
JC - EBrk-007	50.0	0.0	20.0	0.0	80.0	77.5	17.5	12.5	2.5	67.5	65.0	20.0	25.0	7.5	47.5	3
JC - EBrk-008	25.0	20.0	0.0	80.0	0.0	67.5	15.0	35.0	5.0	45.0	60.0	20.0	27.5	12.5	40.0	4
JC - EBrk-009	40.0	30.0	0.0	70.0	0.0	52.5	0.0	48.8	12.5	38.7	50.0	13.7	21.3	5	60.0	2
JC - EBrk-010	25.0	20.0	30.0	50.0	0.0	52.5	0.0	48.8	12.5	38.7	50.0	13.7	21.3	5.0	60.0	2
JC - EBrk-011	60.0	30.0	30.0	40.0	0.0	55.0	0.0	57.5	28.7	13.8	50.0	2.5	37.5	37.5	22.5	2
JC - EBrk-012	60.0	40.0	30.0	30.0	0.0	57.5	0.0	45.0	47.5	7.5	52.5	0.0	38.7	47.5	13.8	2
JC - EBrk-013	50.0	15.0	10.0	75.0	0.0	62.5	42.5	17.5	10.0	30.0	75.0	37.5	12.5	10.0	40.0	2

JC - EBrk-014	40.0	60.0	20.0	20.0	0.0	57.5	15.0	42.5	12.5	30.0	67.5	15.0	22.5	10.0	52.5	5
JC - EBrk-015	50.0	60.0	20.0	20.0	0.0	27.5	2.5	42.5	21.3	33.7	35.0	12.5	23.8	18.7	45.0	3
JC - EBrk-016	30.0	20.0	0.0	80.0	0.0	22.5	0.0	42.5	32.5	25.0	27.5	2.5	30.0	37.5	30.0	2
JC - EBrk-017	30.0	5.0	25.0	70.0	0.0	55.0	21.3	32.5	10.0	36.2	57.5	10.0	30.0	15.0	45.0	4
JC - EBrk-018	50.0	20.0	30.0	50.0	0.0	55.0	5.0	30.0	27.5	37.5	57.5	20.0	17.5	12.5	50.0	2
JC - EBrk-019	60.0	75.0	0.0	25.0	0.0	67.5	0.0	28.7	42.5	28.8	67.5	7.5	17.5	37.5	37.5	1
JC - EBrk-020	60.0	30.0	20.0	50.0	0.0	55.0	0.0	35.0	40.0	25.0	52.5	2.5	30.0	30.0	37.5	2
JC - EBrk-021	0.0	100.0	0.0	0.0	0.0	10.0	2.5	82.5	10.0	5.0	10.0	0.0	82.5	12.5	5.0	4
JC - EBrk-022	0.0	100.0	0.0	0.0	0.0	42.5	0.0	55.0	35.0	10.0	40.0	0.0	47.5	45.0	7.5	4

Table 8: Johnson Creek – North Brook Habitat Assessment Data

Station	Downstream Northing	Downstream Westing	Length (m)	Water Temp (°C)	DO (mg/L)	pH	Conductivity (uS/cm)	TDS (ppm)	Salinity (ppt)	Average Depth (cm)	Average Width (m)	%pool	%riffle	%run	LB Average Height (cm)	LB %Stable	LB %Slightly Eroded	LB %Heavily Eroded	RB Average Height (cm)	RB %Stable	RB %Slightly Eroded	RB %Heavily Eroded
JC - NBrk-001	45.809397	-64.481472	100	17.58	5.65	7.68	77	39	0.04	18.5	2.83	18.8	18.8	62.5	44.0	81.3	18.7	0.0	46.8	93.8	6.2	0.0
JC - NBrk-002	45.810021	-64.48069	100	17.58	8.15	7.30	74	38	0.03	22.8	2.28	37.5	11.3	51.3	39.0	87.5	12.5	0.0	42.5	91.3	8.7	0.0
JC - NBrk-003	45.810685	-64.479633	100	17.65	6.14	7.25	87	44	0.04	21	2.56	13.8	6.3	80.0	47.3	85.0	15.0	0.0	37.0	76.3	23.7	0.0
JC - NBrk-004	45.810787	-64.478128	100	17.7	7.31	7.20	83	41	0.04	18	3.18	22.5	5.0	72.5	55.2	97.5	2.5	0.0	57.3	91.3	8.7	0.0
JC - NBrk-005	45.81173	-64.477368	100	18.07	7.86	7.11	58	29	0.03	15.8	2.57	22.5	5.0	72.5	64.0	88.8	11.2	0.0	62.8	88.8	11.2	0.0
JC - NBrk-006	45.812259	-64.475947	100	17.8	6.55	7.20	83	40	0.03	22.25	2.6	36.3	2.5	61.3	62.0	83.8	0.0	16.2	85.0	76.3	7.5	16.2
JC - NBrk-007	45.813158	-64.475879	100	17.75	4.33	6.95	106	53	0.05	20.25	3.3	30.0	6.7	63.3	64.8	85.0	8.8	6.2	59.8	82.5	11.2	6.3
JC - NBrk-008	45.81428	-64.475373	100	18.6	6.14	7.08	87	43	0.04	22	2.61	15.0	5.0	80.0	53.3	90.0	10.0	0.0	68.3	90.0	5.0	5.0
JC - NBrk-009	45.815427	-64.474735	100	16.4	6.46	7.27	106	54	0.05	14.3	2.31	25.0	6.7	68.3	46.3	91.6	8.4	0.0	60.7	88.3	8.3	3.4
JC - NBrk-010	45.816346	-64.474501	100	16.68	8.17	7.29	99	49	0.05	12	2.55	25.0	0.0	75.0	61.0	87.5	12.5	0.0	46.8	87.5	12.5	0.0
JC - NBrk-011	45.817167	-64.475265	100	16.52	8.01	7.04	104	52	0.05	13.8	1.7	6.3	0.0	63.8	71.0	86.3	5.0	8.7	59.0	86.3	5.0	8.7
JC - NBrk-012	45.817784	-64.475757	100	16.7	6.38	7.05	102	51	0.05	19.5	2.4	51.3	0.0	48.8	69.3	73.7	6.3	20.0	66.8	75.0	6.3	18.7
JC - NBrk-013	45.818622	-64.475022	100	17.26	7.48	7.09	113	57	0.05	18.75	1.8	37.5	0.0	62.5	65.8	66.2	12.5	21.3	70.3	57.5	20.0	22.5

Station	% Embeddedness	% fines	% gravel	% boulder	% bedrock	LB %Shade Cover	LB %bare	LB % grasses	LB %shrubs	LB %trees	RB %Shade Cover	RB %bare	RB % grasses	RB %shrubs	RB %trees	Total Points
JC - NBrk-001	35.0	50.0	0.0	50.0	0.0	63.8	11.3	20.0	20.0	48.7	63.8	13.7	13.8	20.0	52.5	2
JC - NBrk-002	20.0	40.0	0.0	60.0	0.0	52.5	40.0	15.0	10.0	35.0	45.0	40.0	8.8	5.0	46.2	2
JC - NBrk-003	30.0	60.0	0.0	40.0	0.0	41.3	7.5	47.5	17.5	27.5	38.8	7.5	10.0	15.0	42.5	1
JC - NBrk-004	50.0	60.0	0.0	40.0	0.0	47.5	26.3	21.2	12.5	40.0	35.0	12.5	42.5	13.7	31.3	5
JC - NBrk-005	25.0	80.0	0.0	20.0	0.0	47.5	22.5	25.0	15.0	37.5	45.0	17.5	20.0	26.3	36.3	3
JC - NBrk-006	50.0	20.0	50.0	0.0	30.0	70.0	17.5	30.0	5.0	47.5	70.0	30.0	20.0	15.0	35.0	6
JC - NBrk-007	60.0	60.0	0.0	40.0	0.0	46.3	27.5	15.0	12.5	45.0	48.8	25.0	13.8	18.7	42.5	4
JC - NBrk-008	60.0	80.0	0.0	20.0	0.0	50.0	13.8	21.2	35.0	30.0	55.0	17.5	17.5	22.5	42.5	3
JC - NBrk-009	60.0	60.0	0.0	40.0	0.0	68.3	36.7	6.7	33.3	23.3	60.0	20.0	23.3	20.0	36.7	3
JC - NBrk-010	65.0	80.0	0.0	20.0	0.0	63.8	27.5	27.5	30.0	15.0	66.2	27.5	17.5	12.5	42.5	3
JC - NBrk-011	60.0	60.0	20.0	20.0	0.0	72.5	17.5	17.5	47.5	17.5	75.0	15.0	15.0	40.0	30.0	3
JC - NBrk-012	75.0	90.0	0.0	10.0	0.0	76.3	10.0	10.0	55.0	25.0	76.3	10.0	10.0	55.0	25.0	5
JC - NBrk-013	80.0	90.0	0.0	10.0	0.0	52.5	18.8	20.0	20.0	41.2	55.0	20.0	12.5	22.5	45.0	7