beaver dam

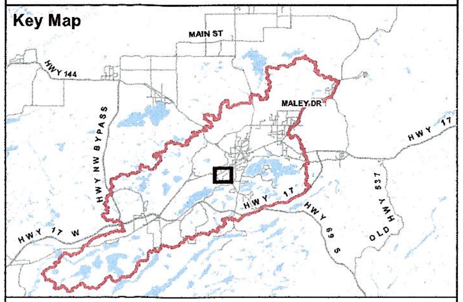
DAM 37

Map 5

Junction Creek Subwatershed Study

Preliminary Reach Delineation

Key Map



Legend

- Reach Break
- Junction Creek
- Primary Road
- Secondary Road
- Permanent Watercourse
- Intermittent Watercourse
- Contours (5m)

Natural Resource Solutions Inc.
Aquatic, Terrestrial and Wetland Biologists

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Project: 1844A
Date: May 12, 2017

NAD83 - UTM Zone 17
Size: 11x17"
1:6,000

N

0 100 200 300 Meters

GEO | MORPHIX
Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 16, 2017	**Stream/Reach:**	J9
Weather:	Overcast	**Location:**	Martindale to Regent
Field staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Creek
UTM (Upstream)	499593 5147561	**UTM (Downstream)**	498686 5146749

Land Use (Table 1): 7,5, 9 **Valley Type** (Table 2): 3 **Channel Type** (Table 3): 7 **Channel Zone** (Table 4): 2 **Flow Type** (Table 5): 1 ☒ Groundwater Evidence: iron staining

Riparian Vegetation

Dominant Type: (Table 6) 1/3
Species: ________

Coverage: ☐ None ☒ Fragmented ☐ Continuous

Channel widths: ☒ 1-4 ☐ 4-10 ☐ > 10

Age Class (yrs): ☐ Immature (<5) ☐ Established (5-30) ☒ Mature (>30)

Encroachment: (Table 7) 1

Aquatic/Instream Vegetation

Type (Table8) 2 Coverage of Reach (%) 2

Woody Debris: ☒ Present in Cutbank ☒ Present in Channel ☐ Not Present

Density of WD: ☐ Low ☒ Moderate ☐ High WDJ/50m: 0.5

Water Quality

Odour (Table 16): 1
Turbidity (Table 17): 2

Channel Characteristics

Sinuosity (Type) (Table 9): 1 **Sinuosity (Degree)** (Table 10): 1 **Gradient** (Table 11): 1 **Number of Channels** (Table 12): 1

Entrenchment (Table 13): 2 **Type of Bank Failure** (Table 14): 2/6 **Downs's Classification** (Table 15): C

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	☐	☒	☒	☒	☒	☐	☐
Pool Substrate	☒	☒	☒	☒	☐	☐	☐
Bank Material	☐	☒	☒	☐	☐	☐	☐

UPSTREAM B.D.

Bankfull Width (m)	8.9	13.5	10.5
Wetted Width (m)	5.8	9.5	6.5
Bankfull Depth (m)	71.0	0.6	0.5
Wetted Depth (m)	72.4	2.0	1.9

Riffle/Pool Spacing (m) NA **% Riffles:** 5 **% Pools:** 95 **Meander Amplitude:** N/A

Pool Depth (m) @ BF 71.0 **Riffle Length (m)** 5.10 **Undercuts (m)** 0.1 **Comments:**

Velocity (m/s) 0.12 0.2 0.3 Wiffle ball / ADV / Estimated

Bank Angle: ☐ 0 – 30 ☐ 30 – 60 ☒ 60 – 90 ☒ Undercut

Bank Erosion: ☐ < 5% ☐ 5 – 30% ☐ 30 – 60% ☒ 60 – 100%

Notes:
erosion scar: 3.5 m ('delta')
undercuts ~ 1 m all over the reach

shallow in the middle
→ V_1 = 0.33 m/s
→ V_2 0.08 m/s

V_1 = 0.26 m/s
V_2 = 0.41 m/s
J.4+

Lobate bar
Bedforms

Completed by: ________ Checked by: [signature]

- BANK material
↳ gravel
↳ mostly sand
· beaver activity
- silt and clay ⇒ culvert
- sand deposition flood plain
- point bar formation
- beaver dam
- tree planting
- 8054

- some root exposure

① Riffle depth 0.2m/0.4/0.3
LENGTH 9m
VELOCITY: 0.6 m/s

pool depth - 0.6m/0.4m/0.7

② RIFFLE
LENGTH: 10.2m
③ RIFFLE
L: 10.9m

WETTED
0.35m 0.96m 0.65m
④ RIFFLE 10m
⑤ RIFFLE 10m

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General Site Characteristics

Project Code: PN16107

Date:	MAY/16/2017	**Stream/Reach:**	J9
Weather:	OVERCAST	**Location:**	St. Francis bridge
Field Staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Creek

Features
- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

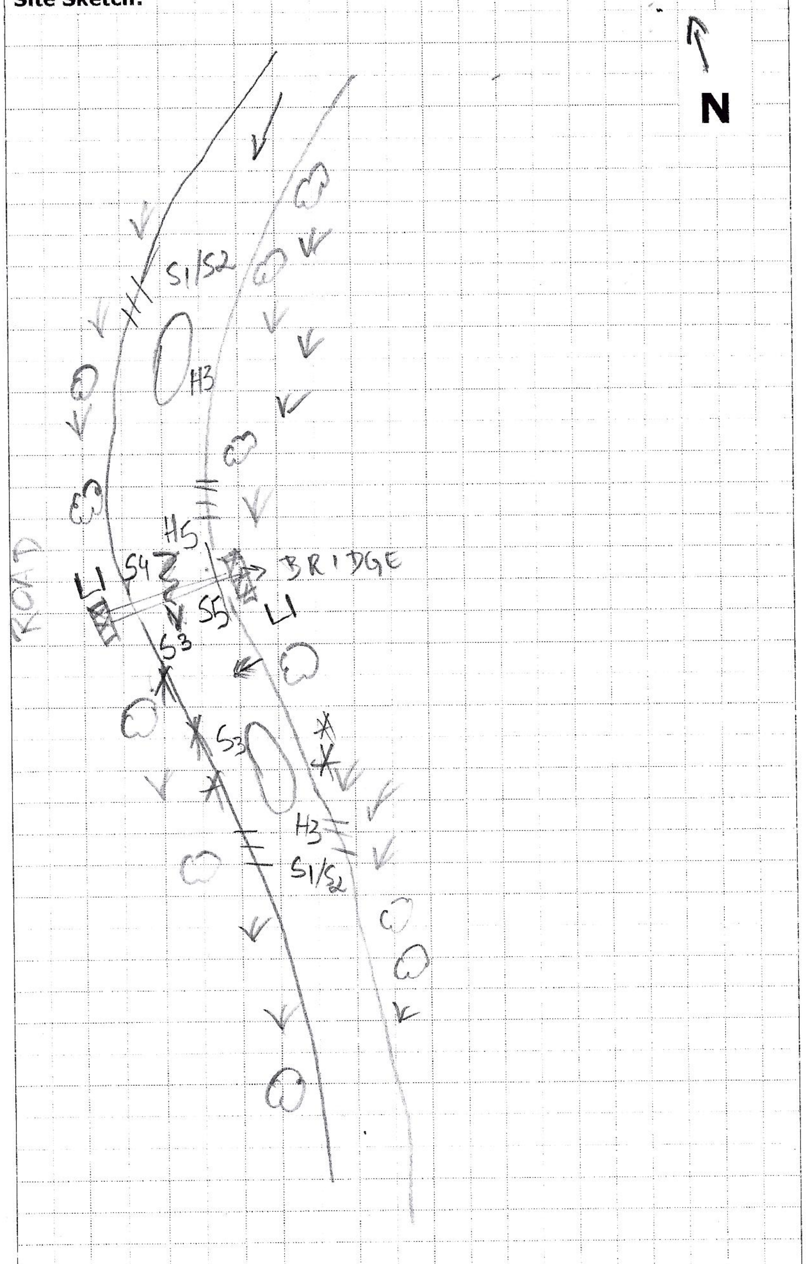
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Scale: 5m

Additional Notes:

Completed by: ________ Checked by: ________

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Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 16, 2017	**Stream/Reach:**	J9
Weather:	overcast	**Location:**	St. Francis bridge
Field Staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Creek

Process	No.	Description	Present? Yes	No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar	✓		3/6
	2	Coarse materials in riffles embedded		✓	
	3	Siltation in pools		✓	
	4	Medial bars		✓	
	5	Accretion on point bars	NA		
	6	Poor longitudinal sorting of bed materials	✓		
	7	Deposition in the overbank zone	✓		
		Sum of indices =	3	3	0.5
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		0/8
	2	Exposed sanitary / storm sewer / pipeline / etc.		✓	
	3	Elevated storm sewer outfall(s)		✓	
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools downstream of culverts / storm sewer outlets		✓	
	6	Cut face on bar forms		✓	
	7	Head cutting due to knick point migration		✓	
	8	Terrace cut through older bar material		✓	
	9	Suspended armour layer visible in bank		✓	
	10	Channel worn into undisturbed overburden / bedrock		✓	
		Sum of indices =	0	8	0.0
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	✓		4/7
	2	Occurrence of large organic debris	✓		
	3	Exposed tree roots	✓		
	4	Basal scour on inside meander bends	NA		
	5	Basal scour on both sides of channel through riffle		✓	
	6	Outflanked gabion baskets / concrete walls / etc.	NA		
	7	Length of basal scour >50% through subject reach ✓	✓		
	8	Exposed length of previously buried pipe / cable / etc.		✓	
	9	Fracture lines along top of bank		✓	
	10	Exposed building foundation	NA		
		Sum of indices =	4	3	0.57
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)		✓	0/7
	2	Single thread channel to multiple channel		✓	
	3	Evolution of pool-riffle form to low bed relief form		✓	
	4	Cut-off channel(s)		✓	
	5	Formation of island(s)		✓	
	6	Thalweg alignment out of phase with meander form		✓	
	7	Bar forms poorly formed / reworked / removed		✓	
		Sum of indices =	0	7	0.0

Additional notes:

Stability Index (SI) = (AI+DI+WI+PI)/4 =			0.27
Condition	**In Regime**	**In Transition/Stress**	**In Adjustment**
SI score =	☐ **0.00 - 0.20**	☑ **0.21 - 0.40**	☐ **0.41**

Completed by: ________ Checked by: CH

apid Stream Assessment Technique **Project Code:** PN116107

Date:	May 16, 2017	**Stream/Reach:**	9
Weather:	overcast	**Location:**	St Francis bridge
Field Staff:	AL, PP, GM	**Watershed/Subwatershed:**	Lucton Creek

Evaluation Category	Poor	Fair	Good	Excellent
Channel Stability	• < 50% of bank network stable • Recent bank sloughing, slumping or failure frequently observed	• 50-70% of bank network stable • Recent signs of bank sloughing, slumping or failure fairly common	• 71-80% of bank network stable • Infrequent signs of bank sloughing, slumping or failure	• > 80% of bank network stable • No evidence of bank sloughing, slumping or failure
	• Stream bend areas highly unstable • Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) • Bank overhang > 0.8-1.0 m	• Stream bend areas unstable • Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) • Bank overhang 0.8-0.9m	• Stream bend areas stable • Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas) • Bank overhang 0.6-0.8 m	• Stream bend areas very stable • Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) • Bank overhang < 0.6 m
	• Young exposed tree roots abundant • > 6 recent large tree falls per stream mile	• Young exposed tree roots common • 4-5 recent large tree falls per stream mile	• Exposed tree roots predominantly old and large, smaller young roots scarce • 2-3 recent large tree falls per stream mile	• Exposed tree roots old, large and woody • Generally 0-1 recent large tree falls per stream mile
	• Bottom 1/3 of bank is highly erodible material • Plant/soil matrix severely compromised	• Bottom 1/3 of bank is generally highly erodible material • Plant/soil matrix compromised	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally V- or U-shaped	• Channel cross-section is generally V- or U-shaped
Point range	☐ 0 ☐ 1 ☐ 2	☒ 3 ☐ 4 ☐ 5	☐ 6 ☐ 7 ☐ 8	☐ 9 ☐ 10 ☐ 11
Channel Scouring/ Sediment Deposition	• > 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60-85% embedded for large mainstem areas)	• 25-49% embedded (35-59% embedded for large mainstem areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
	• Few, if any, deep pools • Pool substrate composition >81% sand-silt	• Low to moderate number of deep pools • Pool substrate composition 60-80% sand-silt	• Moderate number of deep pools • Pool substrate composition 30-59% sand-silt	• High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) • Pool substrate composition <30% sand-silt
	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits uncommon	• Streambed streak marks and/or "banana"-shaped sediment deposits absent
	• Fresh, large sand deposits very common in channel • Moderate to heavy sand deposition along major portion of overbank area	• Fresh, large sand deposits common in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits uncommon in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits rare or absent from channel • No evidence of fresh sediment deposition on overbank
	• Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	• Point bars common, moderate to large and unstable with high amount of fresh sand	• Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand	• Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☒ 5 ☐ 6	☐ 7 ☐ 8

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Date:	May 16, 2017	Reach:	J9	Project Code:	PN16107.

Evaluation Category	Poor	Fair	Good	Excellent
Physical Instream Habitat	• Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	• Wetted perimeter 40-60% of bottom channel width (45-65% for large mainstem areas)	• Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	• Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)
	• Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	• Few pools present, riffles and runs dominant. • Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)	• Good mix between riffles, runs and pools • Relatively diverse velocity and depth of flow	• Riffles, runs and pool habitat present • Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
	• Riffle substrate composition: predominantly gravel with high amount of sand • < 5% cobble	• Riffle substrate composition: predominantly small cobble, gravel and sand • 5-24% cobble	• Riffle substrate composition: good mix of gravel, cobble, and rubble material • 25-49% cobble	• Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand • > 50% cobble
	• Riffle depth < 10 cm for large mainstem areas	• Riffle depth 10-15 cm for large mainstem areas	• Riffle depth 15-20 cm for large mainstem areas	• Riffle depth > 20 cm for large mainstem areas
	• Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	• Large pools generally 30-46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	• Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	• Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	• Extensive channel alteration and/or point bar formation/enlargement	• Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	• Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	• No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	• Riffle/Pool ratio 0.5-0.69:1 ; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	NA • Summer afternoon water temperature > 27°C	• Summer afternoon water temperature 24-27°C	• Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☒ 4	☐ 5 ☐ 6	☐ 7 ☐ 8

Evaluation Category	Poor	Fair	Good	Excellent
Water Quality	• Substrate fouling level: High (> 50%)	• Substrate fouling level: Moderate (21-50%)	• Substrate fouling level: Very light (11-20%)	• Substrate fouling level: Rock underside (0-10%)
	• Brown colour • TDS: > 150 mg/L	• Grey colour • TDS: 101-150 mg/L	• Slightly grey colour • TDS: 50-100 mg/L	• Clear flow • TDS: < 50 mg/L
	• Objects visible to depth < 0.15m below surface	• Objects visible to depth 0.15-0.5m below surface	• Objects visible to depth 0.5-1.0m below surface	• Objects visible to depth > 1.0m below surface
	• Moderate to strong organic odour	• Slight to moderate organic odour	• Slight organic odour	• No odour
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☒ 5 ☐ 6	☐ 7 ☐ 8

Evaluation Category	Poor	Fair	Good	Excellent
Riparian Habitat Conditions	• Narrow riparian area of mostly non-woody vegetation	• Riparian area predominantly wooded but with major localized gaps	• Forested buffer generally > 31 m wide along major portion of both banks	• Wide (> 60 m) mature forested buffer along both banks
	• Canopy coverage: <50% shading (30% for large mainstem areas)	• Canopy coverage: 50-60% shading (30-44% for large mainstem areas)	• Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	• Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	☐ 0 ☐ 1 X	☐ 2 ☐ 3	☐ 4 ☐ 5	☐ 6 ☐ 7

Total overall score (0–42) = 19	Poor (<13)	Fair (13-24)	Good (25-34)	Excellent (>35)

Completed by: ________ Checked by: CT

J9

RIFFLE

erosion

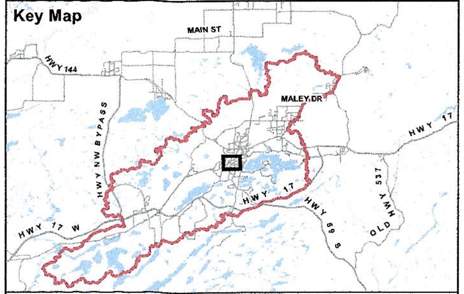
T.B.D.

Junction Creek Subwatershed Study

Map 6

Preliminary Reach Delineation

Key Map



Legend

- Reach Break
- Junction Creek
- Primary Road
- Secondary Road
- Permanent Watercourse
- Contours (5m)

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Map Produced by Natural Resource Solutions Inc. This map is proprietary and confidential and must not be duplicated or distributed by any means without express written permission of NRSI. Data provided by MNRF©
Copyright: Queen's Printer Ontario. Imagery: ESRI, 2012

Project: 1844A Date: May 12, 2017	NAD83 - UTM Zone 17 Size: 11x17" 1:6,000

0 100 200 300 Meters

N

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Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 16, 2017	**Stream/Reach:**	J10
Weather:	Overcast	**Location:**	Regent to Brady
Field staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction creek
UTM (Upstream)	500376 5148353	**UTM (Downstream)**	499683 5147779

Land Use (Table 1): 4,5,7 | **Valley Type** (Table 2): 1 | **Channel Type** (Table 3): 7 | **Channel Zone** (Table 4): 2 | **Flow Type** (Table 5): 1 | ☑ Groundwater | Evidence: iron staining

Riparian Vegetation

Dominant Type: (Table 6) 1,3,4

Species: ____________

Coverage: ☐ None ☑ Fragmented ☐ Continuous

Channel widths: ☑ 1-4 ☐ 4-10 ☐ > 10

Age Class (yrs) : ☐ Immature (<5) ☑ Established (5-30) ☐ Mature (>30)

Encroachment: (Table 7) 1

Aquatic/Instream Vegetation

Type (Table8) 2+6 (Note) (some) — Coverage of Reach (%) 10

Woody Debris: ☑ Present in Cutbank ☑ Present in Channel ☐ Not Present

Density of WD: ☐ Low ☑ Moderate ☐ High

WDJ/50m: <0.5

Water Quality

Odour (Table 16): 1

Turbidity (Table 17): 2

Channel Characteristics

Sinuosity (Type) (Table 9): 1 | **Sinuosity (Degree)** (Table 10): 1 | **Gradient** (Table 11): 2 | **Number of Channels** (Table 12): 1

Entrenchment (Table 13): 2 | **Type of Bank Failure** (Table 14): 2, 6 | **Downs's Classification** (Table 15): E

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	☐	☐	☑	☑	☑	☐	☐
Pool Substrate	☑	☑	☐	☐	☐	☑ till	☐
Bank Material	☐	☑	☐	☐	☐	☐	☐

Bankfull Width (m)	10.6m	8.7m	9.1m	**Wetted Width (m)**	7.9m	7.2m	6.1m
Bankfull Depth (m)	1.8m	1.6m	2.1m	**Wetted Depth (m)**	0.7m	0.5m	0.5m

Riffle/Pool Spacing (m) only pond | **% Riffles:** <3% | **% Pools:** 95% | **Meander Amplitude:** N/A

Pool Depth (m) 0.5m | **Riffle Length (m)** 25m | **Undercuts (m)** ______

Velocity (m/s) 0.23m/s | 0.18 m/s | 0.3m/s — **Wiffle ball / ADV / Estimated**

Bank Angle: ☐ 0 – 30 ☑ 30 – 60 ☐ 60 – 90 ☐ Undercut

Bank Erosion: ☐ < 5% ☐ 5 – 30% ☐ 30 – 60% ☑ 60 – 100%

Comments:
① 0.71m
② 0.36m
avg.

▷ Pool depth: 0.5m

▷ Riffle ①: 25m long

Notes: @ start (ds): culvert w/ huge boulders, lots of slumping, one trout found, cedar tree slumped in, gravels + large rocks on the side, debris in stream, slight turbid waters

@ middle: lots of slumping + undercutting, lots of woody debris + roots exposed on the sides of the wetted bank, road outcrops and rock waste on the sides. wider floodplain + lots of veg.

@ end: little submergent veg seen,

Completed by: ____________

Checked by: [signature]

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Geomorphology Earth Science Observations

General Site Characteristics

Project Code: PN16107

Date:	May 16, 2017	**Stream/Reach:**	J10
Weather:	Sunny w clouds	**Location:**	Brady & Douglas point
Field Staff:	DL PP GM	**Watershed/Subwatershed:**	Junction Creek

Features
- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

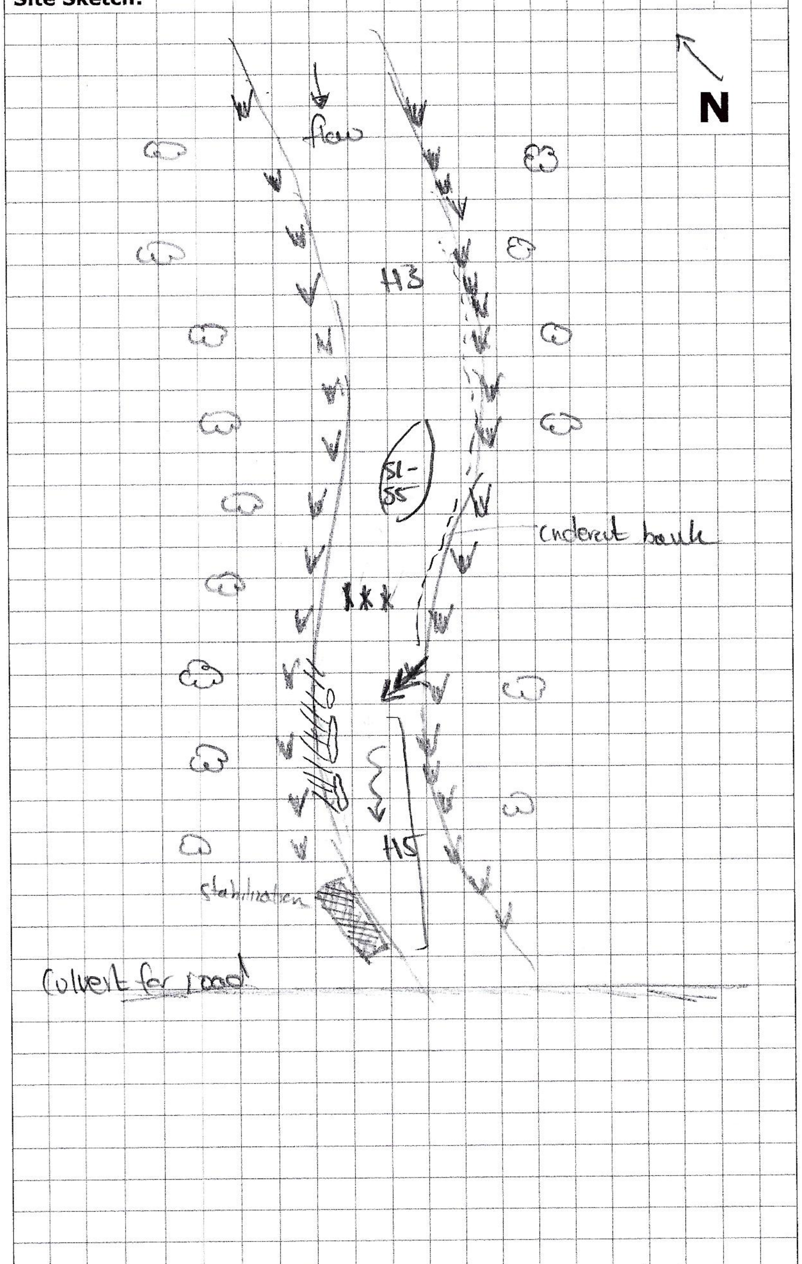
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Scale: 1 = 5m

Additional Notes:

Completed by: PP Checked by: CH

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Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 16 2017	**Stream/Reach:**	J10
Weather:	Sunny + cloudy	**Location:**	Douglas / Brady
Field Staff:	AL PP AM	**Watershed/Subwatershed:**	Junction Creek

Process	No.	Description	Present? Yes	Present? No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar	✓		2/7
	2	Coarse materials in riffles embedded		✓	
	3	Siltation in pools		✓	
	4	Medial bars		✓	
	5	Accretion on point bars		✓	
	6	Poor longitudinal sorting of bed materials		✓	
	7	Deposition in the overbank zone	✓		
		Sum of indices =	2	5	0.28
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	✓		2/10
	2	Exposed sanitary / storm sewer / pipeline / etc.		✓	
	3	Elevated storm sewer outfall(s)		✓	
	4	Undermined gabion baskets / concrete aprons / etc.		✓	
	5	Scour pools downstream of culverts / storm sewer outlets		✓	
	6	Cut face on bar forms		✓	
	7	Head cutting due to knick point migration		✓	
	8	Terrace cut through older bar material		✓	
	9	Suspended armour layer visible in bank		✓	
	10	Channel worn into undisturbed overburden / bedrock	✓		
		Sum of indices =	2	8	0.2
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	✓		4/9
	2	Occurrence of large organic debris		✓	
	3	Exposed tree roots	✓		
	4	Basal scour on inside meander bends		✓	
	5	Basal scour on both sides of channel through riffle		✓	
	6	Outflanked gabion baskets / concrete walls / etc.		✓	
	7	Length of basal scour >50% through subject reach	✓		
	8	Exposed length of previously buried pipe / cable / etc.		✓	
	9	Fracture lines along top of bank	✓		
	10	Exposed building foundation	NA		
		Sum of indices =	4	5	0.44
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	✓		1/7
	2	Single thread channel to multiple channel		✓	
	3	Evolution of pool-riffle form to low bed relief form		✓	
	4	Cut-off channel(s)		✓	
	5	Formation of island(s)		✓	
	6	Thalweg alignment out of phase with meander form		✓	
	7	Bar forms poorly formed / reworked / removed		✓	
		Sum of indices =	1	6	0.14

Additional notes:

Stability Index (SI) = (AI+DI+WI+PI)/4 = 0.26

Condition	In Regime	In Transition/Stress	In Adjustment
SI score =	☐ 0.00 - 0.20	☒ 0.21 - 0.40	☐ 0.41

Completed by: ________ Checked by: CH

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pid Stream Assessment Technique

Project Code: PN16107

ate:	May 16 2017	**Stream/Reach:**	S10
Weather:	overcast	**Location:**	Regent to Brady
Field Staff:	AI, PP, GM	**Watershed/Subwatershed:**	Junction Creek

Evaluation Category	Poor	Fair	Good	Excellent
Channel Stability	• < 50% of bank network stable • Recent bank sloughing, slumping or failure frequently observed	• 50-70% of bank network stable • Recent signs of bank sloughing, slumping or failure fairly common	• 71-80% of bank network stable • Infrequent signs of bank sloughing, slumping or failure	• > 80% of bank network stable • No evidence of bank sloughing, slumping or failure
	• Stream bend areas highly unstable • Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) • Bank overhang > 0.8-1.0 m	• Stream bend areas unstable • Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) • Bank overhang 0.8-0.9m	• Stream bend areas stable • Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas) • Bank overhang 0.6-0.8 m	• Stream bend areas very stable • Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) • Bank overhang < 0.6 m
	• Young exposed tree roots abundant • > 6 recent large tree falls per stream mile	• Young exposed tree roots common • 4-5 recent large tree falls per stream mile	• Exposed tree roots predominantly old and large, smaller young roots scarce • 2-3 recent large tree falls per stream mile	• Exposed tree roots old, large and woody • Generally 0-1 recent large tree falls per stream mile
	• Bottom 1/3 of bank is highly erodible material • Plant/soil matrix severely compromised	• Bottom 1/3 of bank is generally highly erodible material • Plant/soil matrix compromised	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally V- or U-shaped	• Channel cross-section is generally V- or U-shaped
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☒ 4 ☐ 5	☐ 6 ☐ 7 ☐ 8	☐ 9 ☐ 10 ☐ 11
Channel Scouring/ Sediment Deposition	• > 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60-85% embedded for large mainstem areas)	• 25-49% embedded (35-59% embedded for large mainstem areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
	• Few, if any, deep pools • Pool substrate composition >81% sand-silt	• Low to moderate number of deep pools • Pool substrate composition 60-80% sand-silt	• Moderate number of deep pools • Pool substrate composition 30-59% sand-silt	• High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) • Pool substrate composition <30% sand-silt
	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits uncommon	• Streambed streak marks and/or "banana"-shaped sediment deposits absent
	• Fresh, large sand deposits very common in channel • Moderate to heavy sand deposition along major portion of overbank area	• Fresh, large sand deposits common in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits uncommon in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits rare or absent from channel • No evidence of fresh sediment deposition on overbank
	• Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	• Point bars common, moderate to large and unstable with high amount of fresh sand	• Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand	• Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☐ 5 ☐ 6	☐ 7 ☐ 8

Date:	May 16, 2017	Reach:	S10	Project Code:	PN46107

Evaluation Category	Poor	Fair	Good	Excellent
Physical Instream Habitat	• Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	• Wetted perimeter 40-60% of bottom channel width (45-65% for large mainstem areas)	• Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	• Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)
	• Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	• Few pools present, riffles and runs dominant. • Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)	• Good mix between riffles, runs and pools • Relatively diverse velocity and depth of flow	• Riffles, runs and pool habitat present • Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
	• Riffle substrate composition: predominantly gravel with high amount of sand • < 5% cobble	• Riffle substrate composition: predominantly small cobble, gravel and sand • 5-24% cobble	• Riffle substrate composition: good mix of gravel, cobble, and rubble material • 25-49% cobble	• Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand • > 50% cobble
	• Riffle depth < 10 cm for large mainstem areas	• Riffle depth 10-15 cm for large mainstem areas	• Riffle depth 15-20 cm for large mainstem areas	• Riffle depth > 20 cm for large mainstem areas
	• Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	• Large pools generally 30-46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	• Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	• Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	• Extensive channel alteration and/or point bar formation/enlargement	• Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	• Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	• No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	• Riffle/Pool ratio 0.5-0.69:1 ; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	• Summer afternoon water temperature > 27°C	• Summer afternoon water temperature 24-27°C	• Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☒ 5 ☐ 6	☐ 7 ☐ 8

Water Quality	• Substrate fouling level: High (> 50%)	• Substrate fouling level: Moderate (21-50%)	• Substrate fouling level: Very light (11-20%)	• Substrate fouling level: Rock underside (0-10%)
	• Brown colour • TDS: > 150 mg/L	• Grey colour • TDS: 101-150 mg/L	• Slightly grey colour • TDS: 50-100 mg/L	• Clear flow • TDS: < 50 mg/L
	• Objects visible to depth < 0.15m below surface	• Objects visible to depth 0.15-0.5m below surface	• Objects visible to depth 0.5-1.0m below surface	• Objects visible to depth > 1.0m below surface
	• Moderate to strong organic odour	• Slight to moderate organic odour	• Slight organic odour	• No odour
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☐ 5 ☐ 6	☐ 7 ☐ 8

Riparian Habitat Conditions	• Narrow riparian area of mostly non-woody vegetation	• Riparian area predominantly wooded but with major localized gaps	• Forested buffer generally > 31 m wide along major portion of both banks	• Wide (> 60 m) mature forested buffer along both banks
	• Canopy coverage: <50% shading (30% for large mainstem areas)	• Canopy coverage: 50-60% shading (30-44% for large mainstem areas)	• Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	• Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	☐ 0 ☐ 1	☐ 2 ☒ 3	☐ 4 ☐ 5	☐ 6 ☐ 7

Total overall score (0–42) = 23	Poor (<13)	Fair (13-24)	Good (25-34)	Excellent (>35)

Completed by: ________ Checked by: CH

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Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 17, 2017	**Stream/Reach:**	J 11
Weather:	Sun, 20°	**Location:**	Notre Dame - Lasalle
Field staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Creek
UTM (Upstream)	501250 5150750	**UTM (Downstream)**	500790 514925

Land Use (Table 1): 5,7,9 | **Valley Type** (Table 2): 3 | **Channel Type** (Table 3): 7 | **Channel Zone** (Table 4): 2 | **Flow Type** (Table 5): 1 | ☑ Groundwater | Evidence: iron staining

Riparian Vegetation

- **Dominant Type:** (Table 6) 3
- Species: deciduous/coniferous trees, shrubs
- **Coverage:** ☐ None ☑ Fragmented ☐ Continuous
- Channel widths: ☑ 1-4 ☐ 4-10 ☐ > 10
- **Age Class (yrs):** ☐ Immature (<5) ☑ Established (5-30) ☐ Mature (>30)
- **Encroachment:** (Table 7) 2

Aquatic/Instream Vegetation

- **Type** (Table8): 2/1 — Coverage of Reach (%): 10
- **Woody Debris:** ☑ Present in Cutbank ☑ Present in Channel ☐ Not Present
- **Density of WD:** ☐ Low ☑ Moderate ☐ High
- WDJ/50m: 20.5

Water Quality

- **Odour** (Table 16): 1
- **Turbidity** (Table 17): 3

Channel Characteristics

- **Sinuosity (Type)** (Table 9): 1
- **Sinuosity (Degree)** (Table 10): 1
- **Gradient** (Table 11): 1
- **Number of Channels** (Table 12): 1
- **Entrenchment** (Table 13): 2
- **Type of Bank Failure** (Table 14): 2, 6
- **Downs's Classification** (Table 15): E

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	☐	☐	☑	☑	☑	☐	☐
Pool Substrate	☑	☑	☑	☑	☐	☐	☐
Bank Material	☐	☑	☐	☐	☐	☐	☐

Bankfull Width (m)	7.8	10.7	14.7
Wetted Width (m)	6.8	7.6	9.4
Bankfull Depth (m)	0.78	0.79	1.5
Wetted Depth (m)	0.38	0.33	0.6

- **Riffle/Pool Spacing (m):** NA
- **% Riffles:** 10
- **% Pools:** 40
- **Meander Amplitude:** NA
- **Pool Depth (m)** @ BF: 1.5
- **Riffle Length (m):** ~10
- **Undercuts (m):** 0.26
- **Velocity (m/s):** 0.5 | 0.3 | 0.2 — Wiffle ball / ADV / Estimated

Bank Angle: ☐ 0 – 30 ☐ 30 – 60 ☑ 60 – 90 ☐ Undercut

Bank Erosion: ☐ < 5% ☐ 5 – 30% ☐ 30 – 60% ☑ 60 – 100%

Comments: Riffle/pool data N/A, 2 riffles
Mostly runs

Notes: Mostly confined, few sections of partial confinement

Completed by: ________ Checked by: CH

Riffle from pipe crossing to downstream culvert
0.36, 0.18 m deep
curved riffle ~60m

Erosion: Undercutting dominant 0.26m
Slumping minimal
exposed roots

boulders near culverts
Substrate: large/med cobbles, sand/silt, no sorting
aquatic veg: ~~none~~ some rooted grass, floating
some emergent
veg: con trees

Ve[illegible] [illegible]ed
turbid water in areas with
slow flow/finer substrate

Chuteson inside turn

First measurement
0.3/0.43/0.38 wet depth 6.8 wet width Flow 0.5 m/s
0.5 m/s
0.78 bank depth 7.8 Bankful width

Second

0.13/0.33/0.56 wet depth 7.6 wet width Flow 0.3 m/s
0.3 m/s
0.79 bank depth 10.7 B width

Third

0.64/0.64/0.58 9.4 m wet width Flow 0.2 m/s
0.2 m/s
1.5 m bank depth 14.7 m bank width

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General Site Characteristics

Project Code:

Date:	May 17, 2017	**Stream/Reach:**	J11
Weather:	Sun	**Location:**	Notre Dame
Field Staff:	AL, PP, GIh	**Watershed/Subwatershed:**	Junction Creek

Features

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

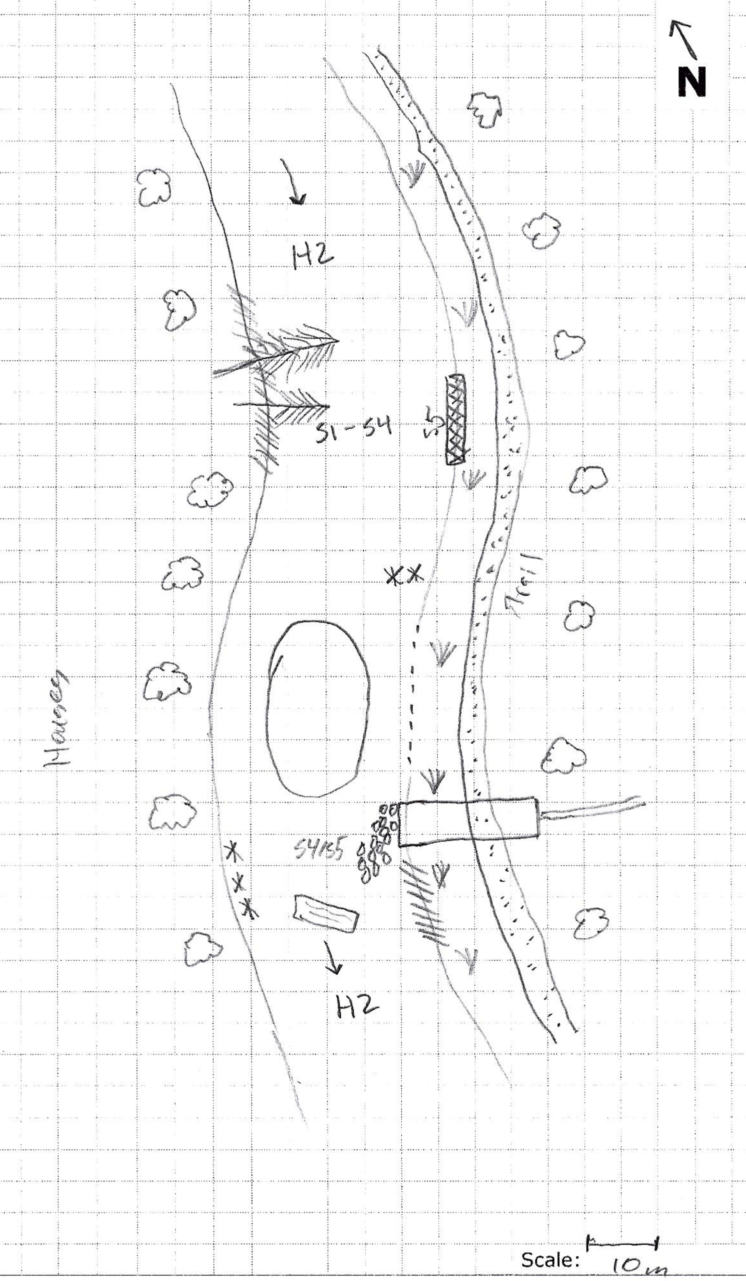
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Additional Notes:

Completed by: ________ Checked by: ________

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Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 16, 2017	**Stream/Reach:**	J11
Weather:	Sun, 20°C	**Location:**	Notre Dame - Velocity
Field Staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Creek

Process	No.	Description	Yes	No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar		✓	0/7
	2	Coarse materials in riffles embedded		✓	
	3	Siltation in pools		✓	
	4	Medial bars		✓	
	5	Accretion on point bars		✓	
	6	Poor longitudinal sorting of bed materials		✓	
	7	Deposition in the overbank zone		✓	
		Sum of indices =	0	7	0.0
Evidence of Degradation (DI)	1	Exposed bridge footing(s)		✓	1/10
	2	Exposed sanitary / storm sewer / pipeline / etc.		✓	
	3	Elevated storm sewer outfall(s)		✓	
	4	Undermined gabion baskets / concrete aprons / etc.	✓		
	5	Scour pools downstream of culverts / storm sewer outlets		✓	
	6	Cut face on bar forms		✓	
	7	Head cutting due to knick point migration		✓	
	8	Terrace cut through older bar material		✓	
	9	Suspended armour layer visible in bank		✓	
	10	Channel worn into undisturbed overburden / bedrock		✓	
		Sum of indices =	1	9	0.1
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	✓		5/9
	2	Occurrence of large organic debris	✓		
	3	Exposed tree roots	✓		
	4	Basal scour on inside meander bends		✓	
	5	Basal scour on both sides of channel through riffle		✓	
	6	Outflanked gabion baskets / concrete walls / etc.		✓	
	7	Length of basal scour >50% through subject reach	✓		
	8	Exposed length of previously buried pipe / cable / etc.		✓	
	9	Fracture lines along top of bank	✓		
	10	Exposed building foundation	N/A		
		Sum of indices =	5	4	0.55
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	✓		1/7
	2	Single thread channel to multiple channel		✓	
	3	Evolution of pool-riffle form to low bed relief form		✓	
	4	Cut-off channel(s)		✓	
	5	Formation of island(s)		✓	
	6	Thalweg alignment out of phase with meander form		✓	
	7	Bar forms poorly formed / reworked / removed		✓	
		Sum of indices =	1	6	0.14

Additional notes:

Stability Index (SI) = (AI+DI+WI+PI)/4 =	0.20		
Condition	**In Regime**	**In Transition/Stress**	**In Adjustment**
SI score =	☒ **0.00 - 0.20**	☐ **0.21 - 0.40**	☐ **0.41**

Completed by: ________ Checked by: CH

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Rapid Stream Assessment Technique

Project Code: PN16107

Date:	May 17, 2017	**Stream/Reach:**	S11
Weather:	Sun, 20°C	**Location:**	Notre Dame - Lasalle
Field Staff:	AL, PP, GM	**Watershed/Subwatershed:**	Inuction Creek

Evaluation Category	Poor	Fair	Good	Excellent
Channel Stability	• < 50% of bank network stable • Recent bank sloughing, slumping or failure frequently observed	• 50-70% of bank network stable • Recent signs of bank sloughing, slumping or failure fairly common	• 71-80% of bank network stable • Infrequent signs of bank sloughing, slumping or failure	• > 80% of bank network stable • No evidence of bank sloughing, slumping or failure
	• Stream bend areas highly unstable • Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) • Bank overhang > 0.8-1.0 m	• Stream bend areas unstable • Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) • Bank overhang 0.8-0.9m	• Stream bend areas stable • Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas) • Bank overhang 0.6-0.8 m	• Stream bend areas very stable • Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) • Bank overhang < 0.6 m
	• Young exposed tree roots abundant • > 6 recent large tree falls per stream mile	• Young exposed tree roots common • 4-5 recent large tree falls per stream mile	• Exposed tree roots predominantly old and large, smaller young roots scarce • 2-3 recent large tree falls per stream mile	• Exposed tree roots old, large and woody • Generally 0-1 recent large tree falls per stream mile
	• Bottom 1/3 of bank is highly erodible material • Plant/soil matrix severely compromised	• Bottom 1/3 of bank is generally highly erodible material • Plant/soil matrix compromised	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally V- or U-shaped	• Channel cross-section is generally V- or U-shaped
Point range	☐ 0 ☐ 1 ☐ 2	☒ 3 ☐ 4 ☐ 5	☐ 6 ☐ 7 ☐ 8	☐ 9 ☐ 10 ☐ 11

Channel Scouring/ Sediment Deposition	• > 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60-85% embedded for large mainstem areas)	• 25-49% embedded (35-59% embedded for large mainstem areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
	• Few, if any, deep pools • Pool substrate composition >81% sand-silt	• Low to moderate number of deep pools • Pool substrate composition 60-80% sand-silt	• Moderate number of deep pools • Pool substrate composition 30-59% sand-silt	• High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) • Pool substrate composition <30% sand-silt
	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits uncommon	• Streambed streak marks and/or "banana"-shaped sediment deposits absent
	• Fresh, large sand deposits very common in channel • Moderate to heavy sand deposition along major portion of overbank area	• Fresh, large sand deposits common in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits uncommon in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits rare or absent from channel • No evidence of fresh sediment deposition on overbank
	• Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	• Point bars common, moderate to large and unstable with high amount of fresh sand	• Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand	• Point bars few, small and stable, ~~well-vegetated~~ and/or armoured with little or no fresh sand
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☐ 5 ☒ 6	☐ 7 ☐ 8

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Date:	May 17, 2017	Reach:	JL1	Project Code:	PN16107

Evaluation Category	Poor	Fair	Good	Excellent
Physical Instream Habitat	• Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	• Wetted perimeter 40-60% of bottom channel width (45-65% for large mainstem areas)	• Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	• Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)
	• Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	• Few pools present, riffles and runs dominant. • Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)	• Good mix between riffles, runs and pools • Relatively diverse velocity and depth of flow	• Riffles, runs and pool habitat present • Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
	• Riffle substrate composition: predominantly gravel with high amount of sand • < 5% cobble	• Riffle substrate composition: predominantly small cobble, gravel and sand • 5-24% cobble	• Riffle substrate composition: good mix of gravel, cobble, and rubble material • 25-49% cobble	• Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand • > 50% cobble
	• Riffle depth < 10 cm for large mainstem areas	• Riffle depth 10-15 cm for large mainstem areas	• Riffle depth 15-20 cm for large mainstem areas	• Riffle depth > 20 cm for large mainstem areas
	• Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	• Large pools generally 30-46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	• Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	• Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	• Extensive channel alteration and/or point bar formation/enlargement	• Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	• Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	• No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	• Riffle/Pool ratio 0.5-0.69:1 ; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	• Summer afternoon water temperature > 27°C	• Summer afternoon water temperature 24-27°C	• Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☒ 5 ☐ 6	☐ 7 ☐ 8
Water Quality	• Substrate fouling level: High (> 50%)	• Substrate fouling level: Moderate (21-50%)	• Substrate fouling level: Very light (11-20%)	• Substrate fouling level: Rock underside (0-10%)
	• Brown colour • TDS: > 150 mg/L	• Grey colour • TDS: 101-150 mg/L	• Slightly grey colour • TDS: 50-100 mg/L	• Clear flow • TDS: < 50 mg/L
	• Objects visible to depth < 0.15m below surface	• Objects visible to depth 0.15-0.5m below surface	• Objects visible to depth 0.5-1.0m below surface	• Objects visible to depth > 1.0m below surface
	• Moderate to strong organic odour	• Slight to moderate organic odour	• Slight organic odour	• No odour
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☒ 5 ☐ 6	☐ 7 ☐ 8
Riparian Habitat Conditions	• Narrow riparian area of mostly non-woody vegetation	• Riparian area predominantly wooded but with major localized gaps	• Forested buffer generally > 31 m wide along major portion of both banks	• Wide (> 60 m) mature forested buffer along both banks
	• Canopy coverage: <50% shading (30% for large mainstem areas)	• Canopy coverage: 50-60% shading (30-44% for large mainstem areas)	• Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	• Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	☐ 0 ☐ 1	☐ 2 ☐ 3	☐ 4 ☐ 5	☐ 6 ☐ 7

Total overall score (0–42) = 20.5	Poor (<13)	Fair (13-24)	Good (25-34)	Excellent (>35)

Completed by: ________ Checked by: JJ

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Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 17, 2017	**Stream/Reach:**	J12
Weather:	Sun + 20°C	**Location:**	Notre Dame Ave, Sudbury
Field staff:	AL, PP, GM	**Watershed/Subwatershed:**	Junction Crk
UTM (Upstream)		**UTM (Downstream)**	

Land Use (Table 1): wetland 9 | **Valley Type** (Table 2): 1 | **Channel Type** (Table 3): 12 | **Channel Zone** (Table 4): 3 | **Flow Type** (Table 5): 1 | ☐ Groundwater | Evidence: ____

Riparian Vegetation

Dominant Type: (Table 6) 2,3
Species: ____

Coverage:
- ☐ None
- ☐ Fragmented
- ☑ Continuous

Channel widths
- ☐ 1-4
- ☑ 4-10
- ☐ > 10

Age Class (yrs):
- ☑ Immature (<5)
- ☐ Established (5-30)
- ☐ Mature (>30)

Encroachment: (Table 7) 2

Aquatic/Instream Vegetation

Type (Table8): 1/2 | Coverage of Reach (%): 10

Woody Debris
- ☐ Present in Cutbank
- ☑ Present in Channel
- ☐ Not Present

Density of WD:
- ☐ Low
- ☑ Moderate
- ☐ High

WDJ/50m: <0.5

Water Quality

Odour (Table 16): 1
Turbidity (Table 17): 2

Channel Characteristics

Sinuosity (Type) (Table 9): 1 | **Sinuosity (Degree)** (Table 10): 2 | **Gradient** (Table 11): 1 | **Number of Channels** (Table 12): 1

Entrenchment (Table 13): 1 | **Type of Bank Failure** (Table 14): 1 | **Downs's Classification** (Table 15): S

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
~~Riffle~~ Substrate	☑	☑	☐	☐	☐	☐	☐
~~Pool Substrate~~	☐	☐	☐	☐	☐	☐	☐
Bank Material	☑	☑	☐	☐	☐	☐	☐

Bankfull Width (m): wetland
Bankfull Depth (m): feature.
Wetted Width (m):
Wetted Depth (m):
Riffle/Pool Spacing (m): NA | **% Riffles:** NA | **% Pools:** NA | **Meander Amplitude:** N/A
Pool Depth (m): | **Riffle Length (m):** NA | **Undercuts (m):** None
Velocity (m/s): very little flow | Wiffle ball / ADV / Estimated

Comments: Only D/s portion assessed due to access of wetland

Bank Angle
- ☑ 0 – 30
- ☑ 30 – 60
- ☐ 60 – 90
- ☐ Undercut

Bank Erosion
- ☐ < 5%
- ☑ 5 – 30%
- ☐ 30 – 60%
- ☐ 60 – 100%

Notes:
Wetland feature
Beaverdams.

RGA + RSAT N/A due to minimal access and wetland feature

Completed by: ____ Checked by: CH

GEO MORPHIX Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 16, 2017	**Stream/Reach:**	J13
Weather:	Mix of Sun 3 Cloud 15°C	**Location:**	Arthur
Field staff:	F.B.J., C.H., E.G	**Watershed/Subwatershed:**	Junction
UTM (Upstream)		**UTM (Downstream)**	

Land Use (Table 1): 1 **Valley Type** (Table 2): 1 **Channel Type** (Table 3): 12 **Channel Zone** (Table 4): 2 **Flow Type** (Table 5): 1 ☒ Groundwater **Evidence:** Iron Staining

Riparian Vegetation

Dominant Type: (Table 6) 1,2,3

Species: ______

Coverage: ☐ None ☐ Fragmented ☒ Continuous

Channel widths: ☐ 1-4 ☐ 4-10 ☒ > 10

Age Class (yrs): ☐ Immature (<5) ☒ Established (5-30) ☐ Mature (>30)

Encroachment: (Table 7) 1

Aquatic/Instream Vegetation

Type (Table8) None Coverage of Reach (%) N/A

Woody Debris: ☐ Present in Cutbank ☒ Present in Channel ☐ Not Present

Density of WD: ☒ Low ☐ Moderate ☐ High WDJ/50m: 0.25

Water Quality

Odour (Table 16): 1

Turbidity (Table 17): 3

Channel Characteristics

Sinuosity (Type) (Table 9): 2 **Sinuosity (Degree)** (Table 10): 2 **Gradient** (Table 11): 1 **Number of Channels** (Table 12): 1

Entrenchment (Table 13): 1 **Type of Bank Failure** (Table 14): 1 3 2 **Downs's Classification** (Table 15): C

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
~~Riffle Substrate~~	☐	☐	☒	☐	☐	☐	☐
~~Pool~~ Substrate	☒	☒	☐	☐	☐	☐	☐
Bank Material	☒ Si	☒	☐	☐	☐	☒ till	☐

Bankfull Width (m)	9.2	6.0	est 8.0	**Wetted Width (m)**	8.4	6.0	est 8.0
Bankfull Depth (m)	1.3	1.4	est 1.4	**Wetted Depth (m)**	0.7	1.1	1.1 est.

Riffle/Pool Spacing (m) N/A **% Riffles:** N/A **% Pools:** N/A **Meander Amplitude:** Unable to measure

Pool Depth (m) N/A **Riffle Length (m)** N/A **Undercuts (m)** 0.20 **Comments:** erosion scar near house

Velocity (m/s) 0 | | | **Wiffle ball / ADV / Estimated**

Bank Angle: ☐ 0 – 30 ☐ 30 – 60 ☒ 60 – 90 ☒ Undercut

Bank Erosion: ☐ < 5% ☐ 5 – 30% ☐ 30 – 60% ☐ 60 – 100%

Notes: Slumping
overbank sand
Deposits US of Dam

Completed by: F.B.J. Checked by: CH

GEO | MORPHIX
Geomorphology Earth Science Observations

General Site Characteristics

Project Code: PN16107

Date:	May 16, 2017	**Stream/Reach:**	J13
Weather:	Sun/Cloud 15°C	**Location:**	Arthur
Field Staff:	FBJ, CH, EG	**Watershed/Subwatershed:**	Junction Creek

Features

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

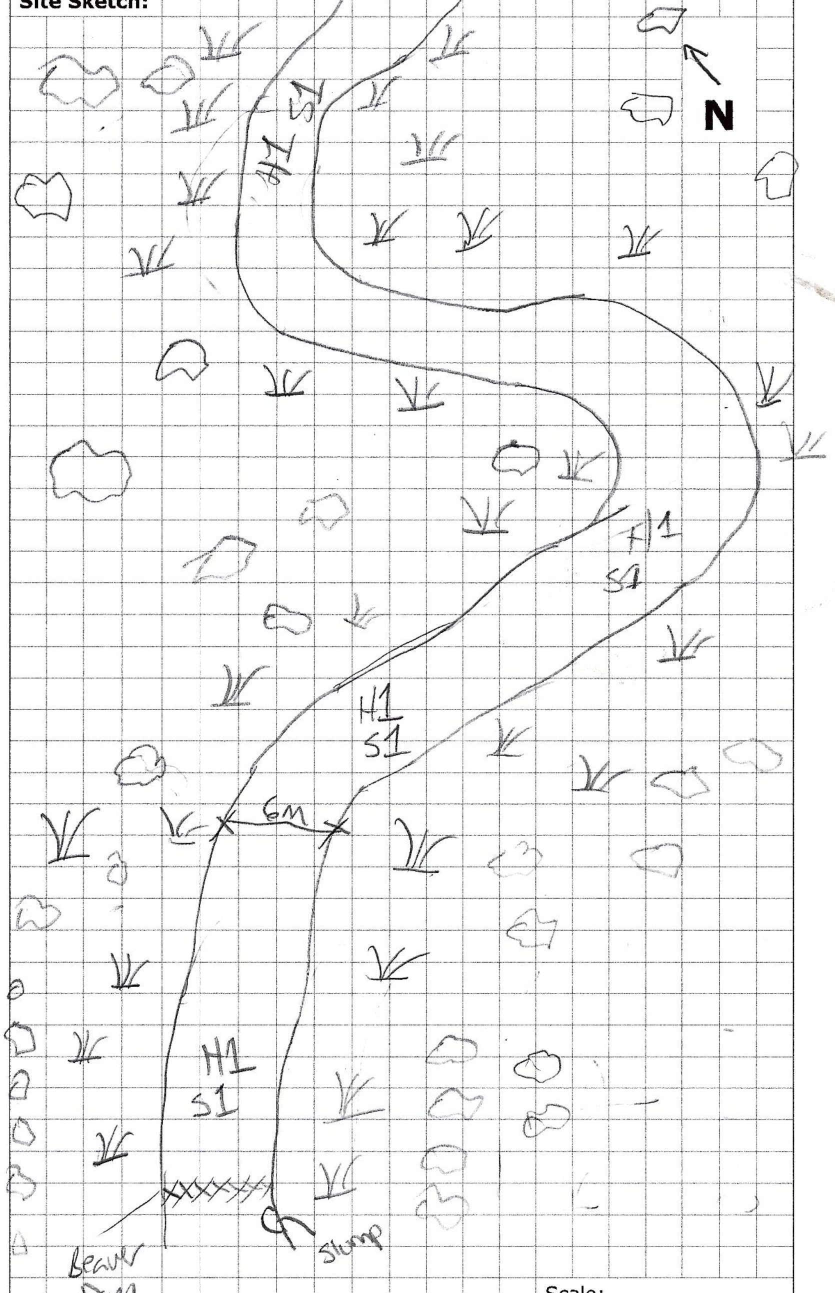
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Scale:

Additional Notes:

Completed by: ________ Checked by: CH

GEO | MORPHIX

Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 16, 2017	**Stream/Reach:**	J13
Weather:	Sun / cloud 15°C	**Location:**	Arthur
Field Staff:	CH, FBJ, EG	**Watershed/Subwatershed:**	Junction

Process	No.	Description	Yes	No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar		X	2/6
	2	Coarse materials in riffles embedded		N/A	
	3	Siltation in pools	X		
	4	Medial bars		X	
	5	Accretion on point bars		X	
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
		Sum of indices =	2	4	0.33
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	N/A		1/6
	2	Exposed sanitary / storm sewer / pipeline / etc.		X	
	3	Elevated storm sewer outfall(s)	N/A		
	4	Undermined gabion baskets / concrete aprons / etc.	N/A		
	5	Scour pools downstream of culverts / storm sewer outlets			
	6	Cut face on bar forms		X	
	7	Head cutting due to knick point migration		X	
	8	Terrace cut through older bar material		X	
	9	Suspended armour layer visible in bank		X	
	10	Channel worn into undisturbed overburden / bedrock	X		
		Sum of indices =	1	5	0.17
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		4/7
	2	Occurrence of large organic debris	X		
	3	Exposed tree roots	X		
	4	Basal scour on inside meander bends		X	
	5	Basal scour on both sides of channel through riffle		N/A	
	6	Outflanked gabion baskets / concrete walls / etc.		N/A	
	7	Length of basal scour >50% through subject reach		X	
	8	Exposed length of previously buried pipe / cable / etc.		X	
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation		N/A	
		Sum of indices =	4	3	0.57
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)		X	0/7
	2	Single thread channel to multiple channel		X	
	3	Evolution of pool-riffle form to low bed relief form		X	
	4	Cut-off channel(s)		X	
	5	Formation of island(s)		X	
	6	Thalweg alignment out of phase with meander form		X	
	7	Bar forms poorly formed / reworked / removed		X	
		Sum of indices =		7	0.0

Additional notes:

Stability Index (SI) = (AI+DI+WI+PI)/4 = 0.27

Condition	In Regime	In Transition/Stress	In Adjustment
SI score =	☐ **0.00 - 0.20**	☒ **0.21 - 0.40**	☐ **0.41**

Completed by: ________ Checked by: CH

Rapid Stream Assessment Technique

Project Code: PN16107

Date:	May 16, 2017	**Stream/Reach:**	JB
Weather:	Sun/Cloud	**Location:**	Arthur
Field Staff:	F.B, J.C, H, E.G	**Watershed/Subwatershed:**	Junction

Evaluation Category	Poor	Fair	Good	Excellent
Channel Stability	• < 50% of bank network stable • Recent bank sloughing, slumping or failure frequently observed	• ~~50-70% of bank network stable~~ • Recent signs of bank sloughing, slumping or failure fairly common	• 71-80% of bank network stable • Infrequent signs of bank sloughing, slumping or failure	• > 80% of bank network stable • No evidence of bank sloughing, slumping or failure
	• Stream bend areas highly unstable • Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) • Bank overhang > 0.8-1.0 m	• Stream bend areas unstable • Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) • Bank overhang 0.8-0.9m	• Stream bend areas stable • Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas) • Bank overhang 0.6-0.8 m	• Stream bend areas very stable • Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) • Bank overhang < 0.6 m
	• Young exposed tree roots abundant • > 6 recent large tree falls per stream mile	• Young exposed tree roots common • 4-5 recent large tree falls per stream mile	• Exposed tree roots predominantly old and large, smaller young roots scarce • 2-3 recent large tree falls per stream mile	• Exposed tree roots old, large and woody • Generally 0-1 recent large tree falls per stream mile
	• Bottom 1/3 of bank is highly erodible material • Plant/soil matrix severely compromised	• Bottom 1/3 of bank is generally highly erodible material • Plant/soil matrix compromised	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material	• Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally trapezoidally-shaped	• Channel cross-section is generally V- or U-shaped	• Channel cross-section is generally V- or U-shaped
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4 ☐ 5	☐ 6 ☒ 7 ☐ 8	☐ 9 ☐ 10 ☐ 11

Evaluation Category	Poor	Fair	Good	Excellent
N/A	• > 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60-85% embedded for large mainstem areas)	• 25-49% embedded (35-59% embedded for large mainstem areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
	• Few, if any, deep pools • Pool substrate composition >81% sand-silt	• Low to moderate number of deep pools • Pool substrate composition 60-80% sand-silt	• Moderate number of deep pools • Pool substrate composition 30-59% sand-silt	• High number of deep pools (> 61 cm deep) (~~> 122 cm deep~~ for large mainstem areas) • Pool substrate composition <30% sand-silt
Channel Scouring/ Sediment Deposition	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits common	• Streambed streak marks and/or "banana"-shaped sediment deposits uncommon	• Streambed streak marks and/or "banana"-shaped sediment deposits absent
	• Fresh, large sand deposits very common in channel • Moderate to heavy sand deposition along major portion of overbank area	• Fresh, large sand deposits common in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits uncommon in channel • Small localized areas of fresh sand deposits along top of low banks	• Fresh, large sand deposits rare or absent from channel • No evidence of fresh sediment deposition on overbank
	• Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	• Point bars common, moderate to large and unstable with high amount of fresh sand	• Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand	• Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand
Point range	☐ 0 ☐ 1 ☐ 2	☐ 3 ☐ 4	☐ 5 ☒ 6	☐ 7 ☐ 8