GEO | MORPHIX

| Date: | May 16, 2017 | Reach: | J13 | 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.<br>• 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<br>• Relatively diverse velocity and depth of flow | • Riffles, runs and pool habitat present<br>• Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water) |
| N/A | • Riffle ~~substrate~~ composition: predominantly gravel with high amount of sand<br>• < 5% cobble | • Riffle substrate composition: predominantly small cobble, gravel and sand<br>• 5-24% cobble | • Riffle substrate composition: good mix of gravel, cobble, and rubble material<br>• 25-49% cobble | • Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand<br>• > 50% cobble |
| N/A | • 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 |
| N/A | • 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 |
| N/A | • 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 | N/A • 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<br>• TDS: > 150 mg/L | • Grey colour<br>• TDS: 101-150 mg/L | • Slightly grey colour<br>• TDS: 50-100 mg/L | • Clear flow<br>• 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) = 24 | Poor (<13) | Fair (13-24) | Good (25-34) | Excellent (>35) |
|---|---|---|---|---|

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

Beaver Dam

Slumping + house close to creek

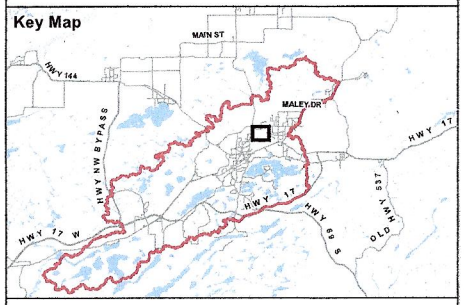
J13

Map 11

# Junction Creek Subwatershed Study

## 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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## Reach Characteristics

**Project Code/Phase:** PN 16107

| | | | |
|---|---|---|---|
| **Date:** | MAY 17, 2017 | **Stream/Reach:** | J14 |
| **Weather:** | SUNNY | **Location:** | Attlee Ave, Sudbury |
| **Field staff:** | AL, PP, GM | **Watershed/Subwatershed:** | JC |
| **UTM (Upstream)** | 504037 5151575 | **UTM (Downstream)** | 503207 5151810 |

**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): 2 | ☐ Groundwater | Evidence: None

### 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) 2

### Aquatic/Instream Vegetation

**Type** (Table8) 6 | Coverage of Reach (%) 20

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

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

WDJ/50m: 10.5

### Water Quality

**Odour** (Table 16): 1

**Turbidity** (Table 17): 3

### Channel Characteristics

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

**Entrenchment** (Table 13): 2 | **Type of Bank Failure** (Table 14): 1/5/6 | **Downs's Classification** (Table 15): E

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Bankfull Width (m)** | 7.1 | 6.1 | 7.1 | **Wetted Width (m)** | 6.3 | 5.5 | 5.8 |
| **Bankfull Depth (m)** | >1.9 | >1.86 | 0.9 | **Wetted Depth (m)** | >1.0 | >0.5 | 0.5 |

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

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

**Riffle/Pool Spacing (m)** NA | **% Riffles:** only one | **% Pools:** 30 | **Meander Amplitude:** NA

**Pool Depth (m)** 0.36 | **Riffle Length (m)** ~10 | **Undercuts (m)** 0.2 | **Comments:** mostly runs

**Veloctity (m/s)** 0.19 | 0.38 | 0.30 | Wiffle ball / ADV / Estimated

**Notes:**

J9
J5

1 RIFFLE

Completed by: _____ Checked by: CJ

RIFFLE

D: 0.15m

Pool

D. 0.36m

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## General Site Characteristics

**Project Code:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | MAY 17, 2017 | **Stream/Reach:** | J34 |
| **Weather:** | Sunny | **Location:** | Athlee Ave, Sudbury |
| **Field Staff:** | GM, PP, AL | **Watershed/Subwatershed:** | JC |

**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 |

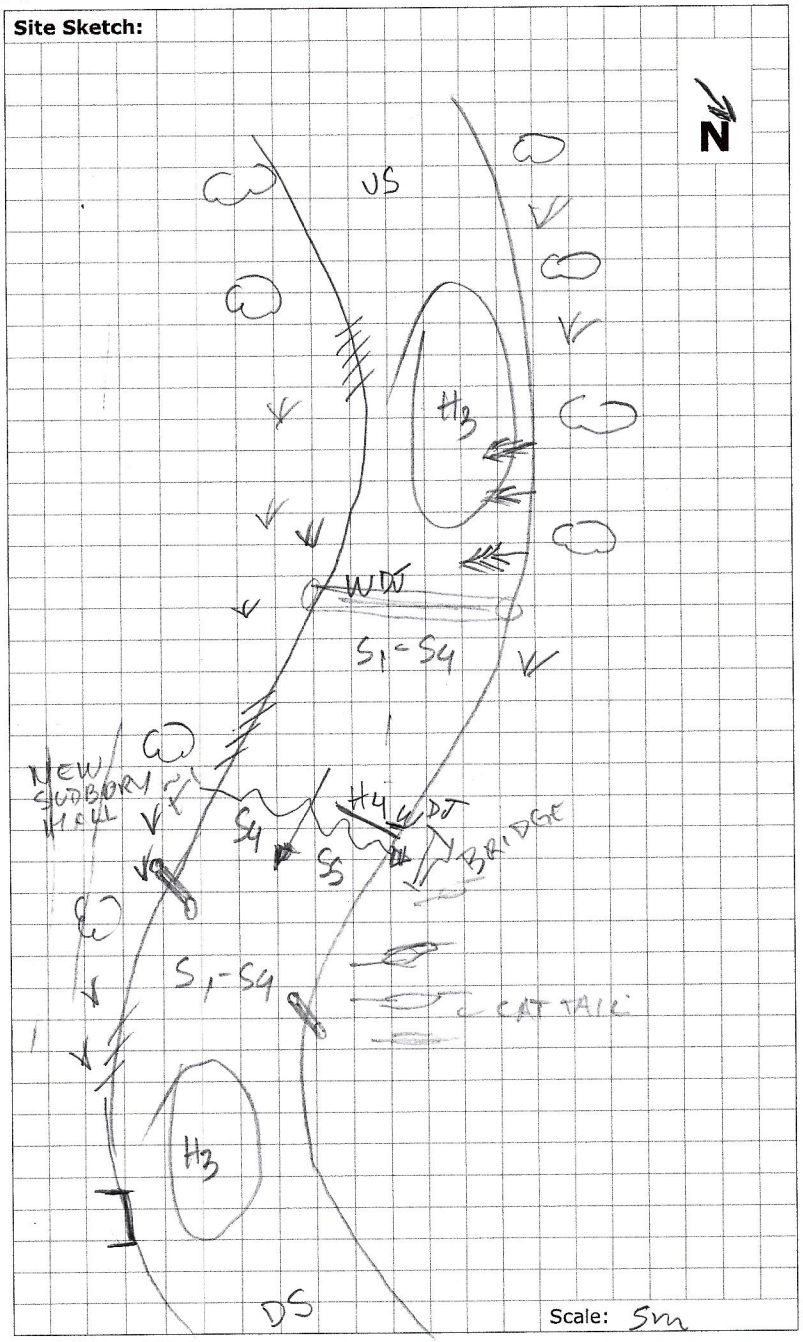
**Substrate**

| | | | |
|---|---|---|---|
| **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: _____

GEO | MORPHIX

**Rapid Geomorphic Assessment** **Project Code:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | May 17, 2017 | **Stream/Reach:** | J14 |
| **Weather:** | Sunny | **Location:** | Attlee Ave, Sudbury |
| **Field Staff:** | GM, PP, AL | **Watershed/Subwatershed:** | JC |

| Process | Geomorphic Indicator No. | Description | Present? Yes | 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 | 0.29 |
| 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. | ✓ | | 6/9 |
| | 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 = | 6 | 3 | 0.67 |
| 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 =** 0.29

| 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

GEO | MORPHIX

**Rapid Stream Assessment Technique** **Project Code:** PN 16107

| | | | |
|---|---|---|---|
| **Date:** | May 17, 2017 | **Stream/Reach:** | J 14 |
| **Weather:** | Sunny | **Location:** | Attlee Ave, Sudbury |
| **Field Staff:** | GM, AL, PP | **Watershed/Subwatershed:** | JC |

| Evaluation Category | Poor | Fair | Good | Excellent |
|---|---|---|---|---|
| Channel Stability | • < 50% of bank network stable<br>• Recent bank sloughing, slumping or failure frequently observed | • 50-70% of bank network stable<br>• Recent signs of bank sloughing, slumping or failure fairly common | • 71-80% of bank network stable<br>• Infrequent signs of bank sloughing, slumping or failure | • > 80% of bank network stable<br>• No evidence of bank sloughing, slumping or failure |
| | • Stream bend areas highly unstable<br>• Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas)<br>• Bank overhang > 0.8-1.0 m | • Stream bend areas unstable<br>• Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas)<br>• Bank overhang 0.8-0.9m | • Stream bend areas stable<br>• Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas)<br>• Bank overhang 0.6-0.8 m | • Stream bend areas very stable<br>• Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas)<br>• Bank overhang < 0.6 m |
| | • Young exposed tree roots abundant<br>• > 6 recent large tree falls per stream mile | • Young exposed tree roots common<br>• 4-5 recent large tree falls per stream mile | • Exposed tree roots predominantly old and large, smaller young roots scarce<br>• 2-3 recent large tree falls per stream mile | • Exposed tree roots old, large and woody<br>• Generally 0-1 recent large tree falls per stream mile |
| | • Bottom 1/3 of bank is highly erodible material<br>• Plant/soil matrix severely compromised | • Bottom 1/3 of bank is generally highly erodible material<br>• 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<br>• Pool substrate composition >81% sand-silt | • Low to moderate number of deep pools<br>• Pool substrate composition 60-80% sand-silt | • Moderate number of deep pools<br>• Pool substrate composition 30-59% sand-silt | • High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas)<br>• 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<br>• Moderate to heavy sand deposition along major portion of overbank area | • Fresh, large sand deposits common in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits uncommon in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits rare or absent from channel<br>• 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 |

GEO | MORPHIX

| Date: | May 17, 2017 | Reach: | J14 | Project Code: | 1607 |
|---|---|---|---|---|---|

| 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.<br>• 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<br>• Relatively diverse velocity and depth of flow | • Riffles, runs and pool habitat present<br>• 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<br>• < 5% cobble | • Riffle substrate composition: predominantly small cobble, gravel and sand<br>• 5-24% cobble | • Riffle substrate composition: good mix of gravel, cobble, and rubble material<br>• 25-49% cobble | • Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand<br>• > 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 |

| | | | | |
|---|---|---|---|---|
| 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<br>• TDS: > 150 mg/L | • Grey colour<br>• TDS: 101-150 mg/L | • Slightly grey colour<br>• TDS: 50-100 mg/L | • Clear flow<br>• 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: _____

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Geomorphology Earth Science Observations

## Reach Characteristics

**Project Code/Phase:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | TJ-14 |
| **Weather:** | Cloudy | **Location:** | McLean Street |
| **Field staff:** | EG, CH, FBJ | **Watershed/Subwatershed:** | Junction |
| **UTM (Upstream)** | | **UTM (Downstream)** | |

**Land Use** (Table 1): 5,7 **Valley Type** (Table 2): 1 **Channel Type** (Table 3): 11 **Channel Zone** (Table 4): 2 **Flow Type** (Table 5): 1 ☑ Groundwater Evidence: iron staining

### Riparian Vegetation

**Dominant Type:** (Table 6) 1
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 and 2 **Coverage of Reach (%)** 40

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

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

WDJ/50m: 0.1

### 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 US 3 DS **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)** | 3.5 | 7m | | **Wetted Width (m)** | 3.1 | 6.8 | |
| **Bankfull Depth (m)** | 0.5 | 1.2 est. | | **Wetted Depth (m)** | 0.2 | 1m | |

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

**Pool Depth (m)** 1.5 **Riffle Length (m)** 5 **Undercuts (m)** none **Comments:**

**Veloctity (m/s)** 0 0 0 **Wiffle ball / ADV / Estimated**

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

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

**Notes:**
first 30m R-P
remainder is
backwatering

Completed by: _____ Checked by: CH

GEO | MORPHIX

## General Site Characteristics

**Project Code:** PN36107

| | | | |
|---|---|---|---|
| **Date:** | MAY 16, 2017 | **Stream/Reach:** | TJ14 |
| **Weather:** | cloudy | **Location:** | McLean St. |
| **Field Staff:** | EG, CH, FBJ | **Watershed/Subwatershed:** | JUNCTION |

**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 |

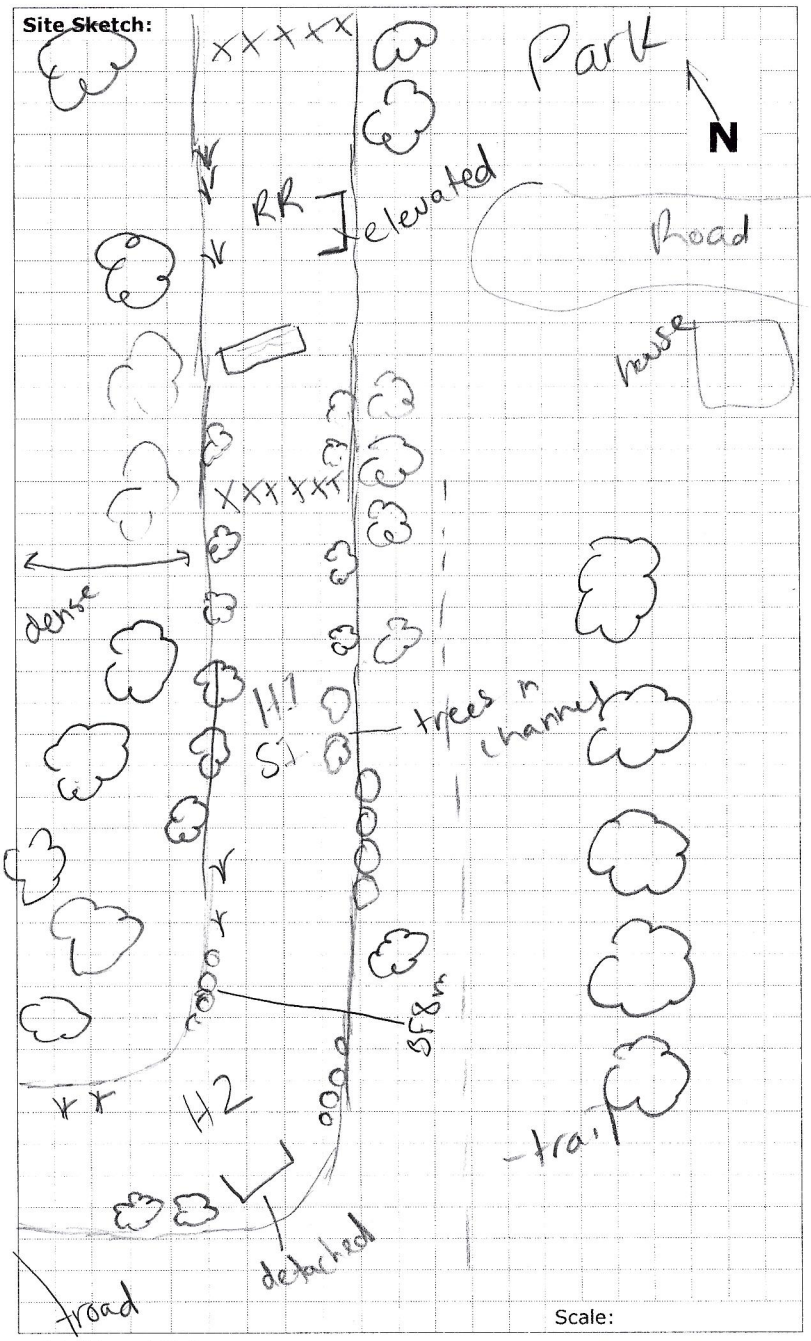
**Substrate**

| | | | |
|---|---|---|---|
| **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:

RR = Rip Rap

Completed by: EG Checked by: _____

GEO | MORPHIX

**Rapid Geomorphic Assessment** **Project Code:** PN 16 107

| | | | |
|---|---|---|---|
| **Date:** | MAY 16, 2017 | **Stream/Reach:** | TJ 14 |
| **Weather:** | cloudy | **Location:** | McLeon St. |
| **Field Staff:** | EG, CH, FBJ | **Watershed/Subwatershed:** | Junction |

| Process | Geomorphic Indicator No. | Description | Present? Yes | No | Factor Value |
|---|---|---|---|---|---|
| Evidence of Aggradation (AI) | 1 | Lobate bar | | X | 1/6 |
| | 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 = | 1 | 5 | 0.17 |
| Evidence of Degradation (DI) | 1 | Exposed bridge footing(s) | N/A | | 1/9 |
| | 2 | Exposed sanitary / storm sewer / pipeline / etc. | | X | |
| | 3 | Elevated storm sewer outfall(s) | X | | |
| | 4 | Undermined gabion baskets / concrete aprons / etc. | | X | |
| | 5 | Scour pools downstream of culverts / storm sewer outlets | | X | |
| | 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 | 8 | 0.11 |
| Evidence of Widening (WI) | 1 | Fallen / leaning trees / fence posts / etc. | | X | 1/8 |
| | 2 | Occurrence of large organic debris | X | | |
| | 3 | Exposed tree roots | N/A | | |
| | 4 | Basal scour on inside meander bends | | X | |
| | 5 | Basal scour on both sides of channel through riffle | | X | |
| | 6 | Outflanked gabion baskets / concrete walls / etc. | | X | |
| | 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 | X | |
| | | Sum of indices = | 1 | 7 | 0.13 |
| Evidence of Planimetric Form Adjustment (PI) | 1 | Formation of chute(s) | X | | 2/7 |
| | 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 = | | | 0.29 |

Additional notes:

**Stability Index (SI) = (AI+DI+WI+PI)/4 =** 0.18

| 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:** | TJ 14 |
| **Weather:** | cloudy | **Location:** | McLean St. |
| **Field Staff:** | EG, CH, FBJ | **Watershed/Subwatershed:** | Junction |

| Evaluation Category | Poor | Fair | Good | Excellent |
|---|---|---|---|---|
| Channel Stability | • < 50% of bank network stable<br>• Recent bank sloughing, slumping or failure frequently observed | • 50-70% of bank network stable<br>• Recent signs of bank sloughing, slumping or failure fairly common | • 71-80% of bank network stable<br>• Infrequent signs of bank sloughing, slumping or failure | • > 80% of bank network stable<br>• No evidence of bank sloughing, slumping or failure |
| | • Stream bend areas highly unstable<br>• Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas)<br>• Bank overhang > 0.8-1.0 m | • Stream bend areas unstable<br>• Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas)<br>• Bank overhang 0.8-0.9m | • Stream bend areas stable<br>• Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas)<br>• Bank overhang 0.6-0.8 m | • Stream bend areas very stable<br>• Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas)<br>• Bank overhang < 0.6 m |
| | • Young exposed tree roots abundant<br>• > 6 recent large tree falls per stream mile | • Young exposed tree roots common<br>• 4-5 recent large tree falls per stream mile | • Exposed tree roots predominantly old and large, smaller young roots scarce<br>• 2-3 recent large tree falls per stream mile | • Exposed tree roots old, large and woody<br>• Generally 0-1 recent large tree falls per stream mile |
| | • Bottom 1/3 of bank is highly erodible material<br>• Plant/soil matrix severely compromised | • Bottom 1/3 of bank is generally highly erodible material<br>• 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<br>• Pool substrate composition >81% sand-silt | • Low to moderate number of deep pools<br>• Pool substrate composition 60-80% sand-silt | • Moderate number of deep pools<br>• Pool substrate composition 30-59% sand-silt | • High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas)<br>• 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<br>• Moderate to heavy sand deposition along major portion of overbank area | • Fresh, large sand deposits common in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits uncommon in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits rare or absent from channel<br>• 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 |

N/A

| Date: | | Reach: | | Project Code: | |
|---|---|---|---|---|---|

| 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.<br>• 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<br>• Relatively diverse velocity and depth of flow | • Riffles, runs and pool habitat present<br>• 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<br>• < 5% cobble | • Riffle substrate composition: predominantly small cobble, gravel and sand<br>• 5-24% cobble | • Riffle substrate composition: good mix of gravel, cobble, and rubble material<br>• 25-49% cobble | • Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand<br>• > 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 |

N/A

| | | | | |
|---|---|---|---|---|
| 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<br>• TDS: > 150 mg/L | • Grey colour<br>• TDS: 101-150 mg/L | • Slightly grey colour<br>• TDS: 50-100 mg/L | • Clear flow<br>• 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) = 27.5 | Poor (<13) | Fair (13-24) | Good (25-34) | Excellent (>35) |
|---|---|---|---|---|

Completed by: E.G Checked by: GH

TJ-14

as far as we could go

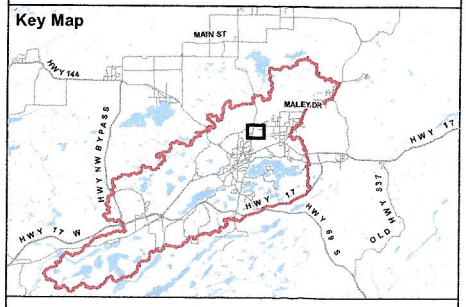
Beaver dam

Map 10

# Junction Creek Subwatershed Study

## 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"
1:5,000

0 100 200 300 Meters

N

GEO | MORPHIX
Geomorphology Earth Science Observations

## Reach Characteristics

**Project Code/Phase:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | TJ-14-1 |
| **Weather:** | Overcast 12°C | **Location:** | Lasalle Blvd. |
| **Field staff:** | F.B.J, C.H, E.G | **Watershed/Subwatershed:** | Junction Creek |
| **UTM (Upstream)** | | **UTM (Downstream)** | |

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

### Riparian Vegetation

**Dominant Type:** (Table 6) 1
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) 3

### Aquatic/Instream Vegetation

**Type** (Table8) 6 Coverage of Reach (%) 60

**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) 2 **Number of Channels** (Table 12) 1

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

| | Clay/Silt | Sand | Gravel | Cobble | Boulder | Parent | Rootlets |
|---|---|---|---|---|---|---|---|
| **Riffle Substrate** | ☐ | ☒ | ☒ | ☒ | ☒ | ☐ | ☐ |
| **Pool Substrate** | ☐ | ☒ | ☒ | ☒ | ☐ | ☐ | ☐ |
| **Bank Material** | ☒ | ☒ | ☐ | ☐ | ☐ | ☒ red rock | ☐ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Bankfull Width (m)** | 6.6 | 5.0 | 7.5 | **Wetted Width (m)** | 3.4 | 2.6 | 4.3 |
| **Bankfull Depth (m)** | 0.55 | 0.6 | 0.45 0.6 0.8 | **Wetted Depth (m)** | 0.10 | 0.23 0.18 0.15 | 0.1 0.17 0.3 |

**Riffle/Pool Spacing (m)** 20 **% Riffles:** 50 **% Pools:** 50 **Meander Amplitude:** N/A

**Pool Depth (m)** >1.0 **Riffle Length (m)** 7-15 **Undercuts (m)** None **Comments:** WD for Pool - 0.4m

**Veloctity (m/s)** [ ] 0.23 0.2 **Wiffle ball / ADV / Estimated** BFD - 0.9m

**Bank Angle**
- ☐ 0 – 30
- ☒ 30 – 60
- ☒ 60 – 90
- ☐ Undercut

**Bank Erosion**
- ☐ < 5%
- ☐ 5 – 30%
- ☒ 30 – 60%
- ☐ 60 – 100%

**Notes:**
Manholes follow along L-R
Some boulders for bank protection

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

GEO | MORPHIX
Geomorphology Earth Science Observations

## General Site Characteristics

**Project Code:** PN1407

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | TJ-14-1 |
| **Weather:** | overcast 12°C | **Location:** | Lasalle Blvd. |
| **Field Staff:** | FB, E.G, C.H | **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**

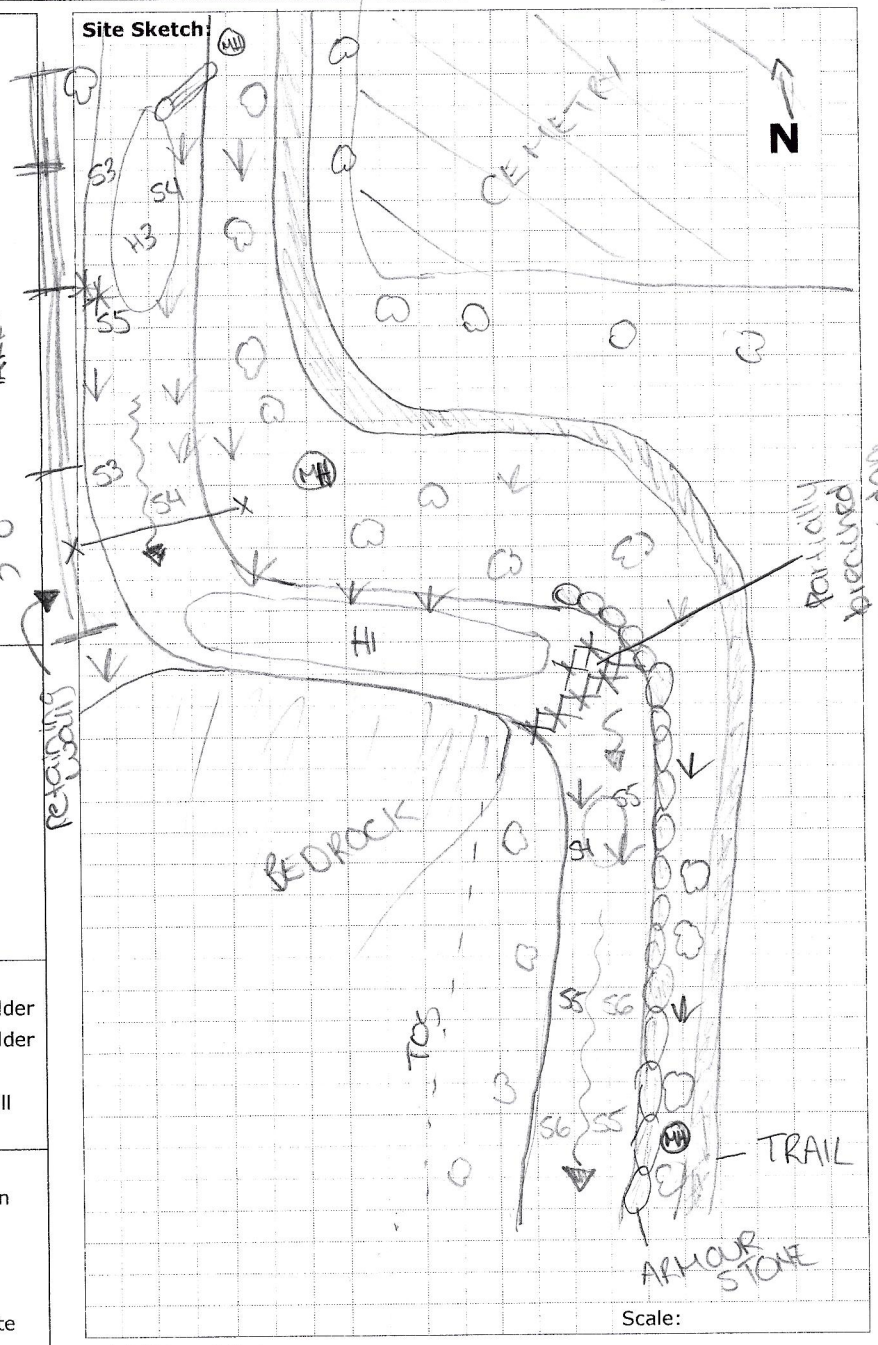
| | | | |
|---|---|---|---|
| **S1** | Silt | **S6** | Small boulder |
| **S2** | Sand | **S7** | Large boulder |
| **S3** | Gravel | **S8** | Bimodal |
| **S4** | Small cobble | **S9** | Bedrock/till |
| **S5** | Large cobble | | |

**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 |

MH - manhole.

**Site Sketch:**




Scale:

Additional Notes:

Completed by: _____ Checked by: CH

GEO | MORPHIX

**Rapid Geomorphic Assessment** **Project Code:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | TJ-14-1 |
| **Weather:** | Overcast 12°C | **Location:** | Lasalle Blvd. |
| **Field Staff:** | F.B.J, C.H, E.G | **Watershed/Subwatershed:** | Junction Creek |

| Process | Geomorphic Indicator No. | Description | Present? Yes | No | Factor Value |
|---|---|---|---|---|---|
| Evidence of Aggradation (AI) | 1 | Lobate bar | | X | 1/7 |
| | 2 | Coarse materials in riffles embedded | | X | |
| | 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 = | 1 | 6 | 0.14 |
| Evidence of Degradation (DI) | 1 | Exposed bridge footing(s) | N/A | | 0/7 |
| | 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 | | X | |
| | 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 = | 0 | 7 | 0.0 |
| Evidence of Widening (WI) | 1 | Fallen / leaning trees / fence posts / etc. | X | | 2/9 |
| | 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 | | X | |
| | 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 | | X | |
| | | Sum of indices = | 2 | 7 | 0.22 |
| 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 = | 0 | 7 | 0.0 |

Additional notes:

**Stability Index (SI) = (AI+DI+WI+PI)/4 =** 0.09

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

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

**Rapid Stream Assessment Technique** **Project Code:** DN16107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | TJ-14-1 |
| **Weather:** | overcast 12°C | **Location:** | Lasalle Blvd |
| **Field Staff:** | F.B.J, C.H, E.G | **Watershed/Subwatershed:** | Junction Creek |

| Evaluation Category | Poor | Fair | Good | Excellent |
|---|---|---|---|---|
| Channel Stability | • < 50% of bank network stable<br>• Recent bank sloughing, slumping or failure frequently observed | • 50-70% of bank network stable<br>• Recent signs of bank sloughing, slumping or failure fairly common | • 71-80% of bank network stable<br>• Infrequent signs of bank sloughing, slumping or failure | • > 80% of bank network stable<br>• No evidence of bank sloughing, slumping or failure |
| | • Stream bend areas highly unstable<br>• Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas)<br>• Bank overhang > 0.8-1.0 m | • Stream bend areas unstable<br>• Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas)<br>• Bank overhang 0.8-0.9m | • Stream bend areas stable<br>• Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas)<br>• Bank overhang 0.6-0.8 m | • Stream bend areas very stable<br>• Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas)<br>• Bank overhang < 0.6 m |
| | • Young exposed tree roots abundant<br>• > 6 recent large tree falls per stream mile | • Young exposed tree roots common<br>• 4-5 recent large tree falls per stream mile | • Exposed tree roots predominantly old and large, smaller young roots scarce<br>• 2-3 recent large tree falls per stream mile | • Exposed tree roots old, large and woody<br>• Generally 0-1 recent large tree falls per stream mile |
| | • Bottom 1/3 of bank is highly erodible material<br>• Plant/soil matrix severely compromised | • Bottom 1/3 of bank is generally highly erodible material<br>• 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<br>• Pool substrate composition >81% sand-silt | • Low to moderate number of deep pools<br>• Pool substrate composition 60-80% sand-silt | • Moderate number of deep pools<br>• Pool substrate composition 30-59% sand-silt | • High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas)<br>• 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<br>• Moderate to heavy sand deposition along major portion of overbank area | • Fresh, large sand deposits common in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits uncommon in channel<br>• Small localized areas of fresh sand deposits along top of low banks | • Fresh, large sand deposits rare or absent from channel<br>• 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: | TJ-14-1 | 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.<br>• 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<br>• Relatively diverse velocity and depth of flow | • Riffles, runs and pool habitat present<br>• 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<br>• < 5% cobble | • Riffle substrate composition: predominantly small cobble, gravel and sand<br>• 5-24% cobble | • Riffle substrate composition: good mix of gravel, cobble, and rubble material<br>• 25-49% cobble | • Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand<br>• > 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 |
| N/A | • 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<br>• TDS: > 150 mg/L | • Grey colour<br>• TDS: 101-150 mg/L | • Slightly grey colour<br>• TDS: 50-100 mg/L | • Clear flow<br>• 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) = 29 | Poor (<13) | Fair (13-24) | Good (25-34) | Excellent (>35) |
|---|---|---|---|---|

Completed by: F.B.J Checked by: [illegible]

Beaver Dam

TJ-14-1

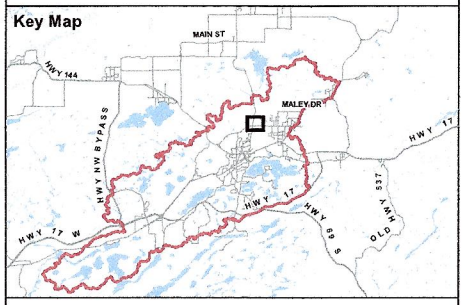
Creek encroaching onto Parking lot

Map 9

# Junction Creek Subwatershed Study

## Preliminary Reach Delineation

Key Map




**Legend**

- Reach Break
- 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

Sharing crew: ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |||

GEO | MORPHIX
Geomorphology Earth Science Observations

## Reach Characteristics

**Project Code/Phase:** PN 16 107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | JC main branch J15 |
| **Weather:** | Cloudy, 11°C | **Location:** | New Sudbury |
| **Field staff:** | AW, AV, SC | **Watershed/Subwatershed:** | JC |
| **UTM (Upstream)** | | **UTM (Downstream)** | |

**Land Use** (Table 1): 7.9 **Valley Type** (Table 2): 3 **Channel Type** (Table 3): 13 **Channel Zone** (Table 4): 2 **Flow Type** (Table 5): 1 ☒ Groundwater Evidence: iron staining

### Riparian Vegetation

**Dominant Type:** (Table 6) 2/3
Species: dogwood, some ferns, 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) 1

### Aquatic/Instream Vegetation

**Type** (Table8) 1 Coverage of Reach (%) <5

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

**Density of WD:** ☐ Low ☒ Moderate ☐ High WDJ/50m: 1

### Water Quality

**Odour** (Table 16): 1

**Turbidity** (Table 17): 5

### Channel Characteristics

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

**Entrenchment** (Table 13): 2 **Type of Bank Failure** (Table 14): 2 & 5 **Downs's Classification** (Table 15): E

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Bankfull Width (m)** | 7.4 | 6.5 | 8.2 | **Wetted Width (m)** | 6.0 | 5.0 | 5.85 |
| **Bankfull Depth (m)** | 0.45 | 0.85 | 1.2 | **Wetted Depth (m)** | 0.13 | 0.53 | 0.2 |

**Riffle/Pool Spacing (m)** 8.6 **% Riffles:** <5 **% Pools:** >95 **Meander Amplitude:** not able to measure

**Pool Depth (m)** 31 **Riffle Length (m)** 8.6 **Undercuts (m)** 0.35 **Comments:**

**Velocity (m/s)** 0.833 0.08 0.25 **Wiffle ball / ADV / Estimated** Bank

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

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

**Notes:** erosion scar / slump = 12.5m culvert → sandy, shallow water, less all & way less widgall silt, Bathtub.

reach start → couple islands (shrubs), sandy, undercutting, deposition, beaver activity, woody debris, squishy ground v. soft, major bank slumping, red osier dogwood, major slumping, grasses, big trees down, wood block, water orange-ish, erosion galore, fiddlehead!, beaver dam & tons of cut trees, gets super deep & no riffles, thalweg outside line, some gravel in part, deposition, tons of garbage, oil on shoreline, rock waste (part of culvert), metal/concrete guard in the

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3 distinct sections of creek

start - Lasalle →

Lasalle - train tracks →

after → more grass over eroded edges/undercut

lumpy... & gets deeper, no rocks just silty sand

less beaver presence

Shopping cart bridge

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Geomorphology Earth Science Observations

## General Site Characteristics

**Project Code:** PN16107

| | | | |
|---|---|---|---|
| **Date:** | May 16, 2017 | **Stream/Reach:** | J15 |
| **Weather:** | cloudy, 11°C | **Location:** | New Sudbury |
| **Field Staff:** | AW, AV, SC | **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 |

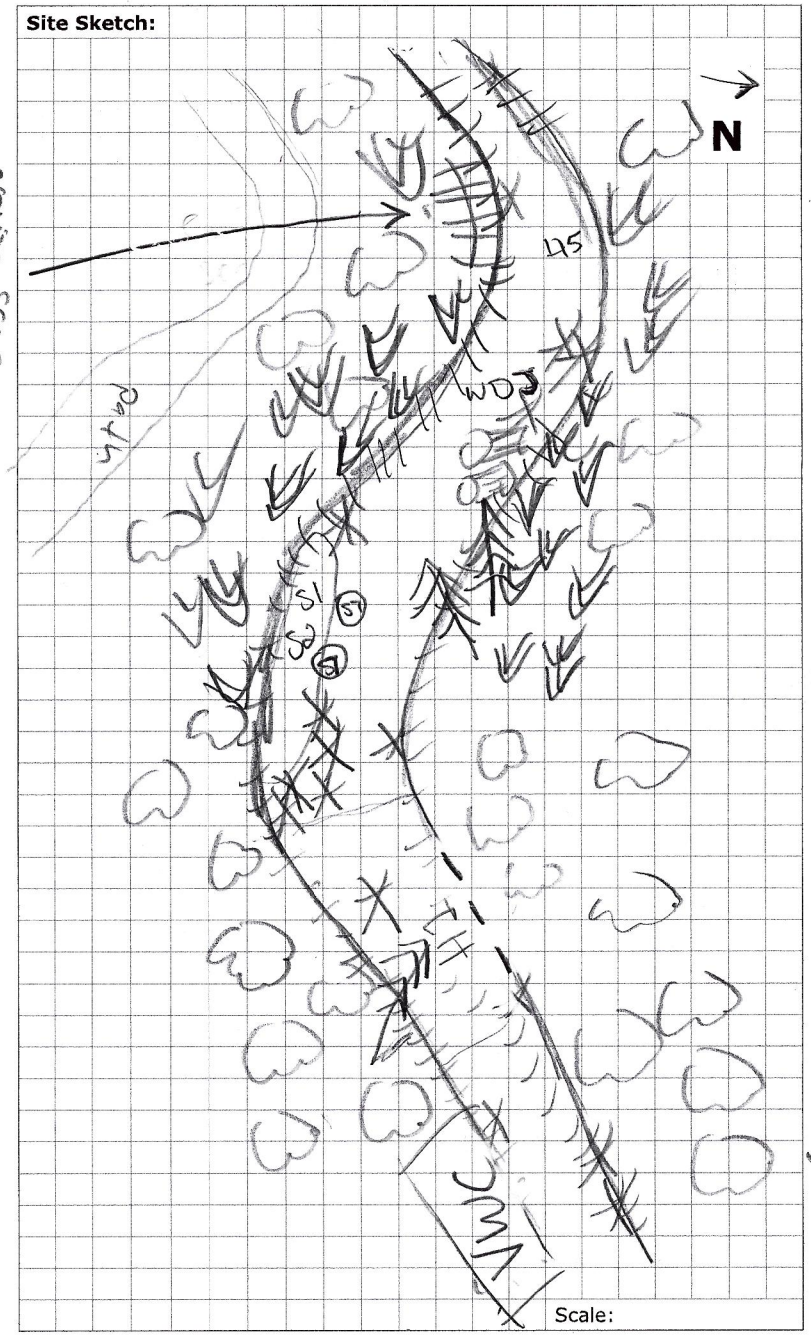
**Substrate**

| | | | |
|---|---|---|---|
| **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: AW Checked by: _____

GEO | MORPHIX

**Rapid Geomorphic Assessment** **Project Code:** PN 16 107

| | | | |
|---|---|---|---|
| **Date:** | MAY 16, 2017 | **Stream/Reach:** | J15 |
| **Weather:** | cloudy | **Location:** | Barry Down Rd |
| **Field Staff:** | AW, AV, SC | **Watershed/Subwatershed:** | JC |

| Process | Geomorphic Indicator No. | Description | Present? Yes | No | Factor Value |
|---|---|---|---|---|---|
| Evidence of Aggradation (AI) | 1 | Lobate bar | | ✓ | 1/7 |
| | 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 = | 1 | 6 | 0.14 |
| 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 | 0.56 |
| 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:

one cut off pool (pix/yrs)

**Stability Index (SI) = (AI+DI+WI+PI)/4 =** 0.24

| 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