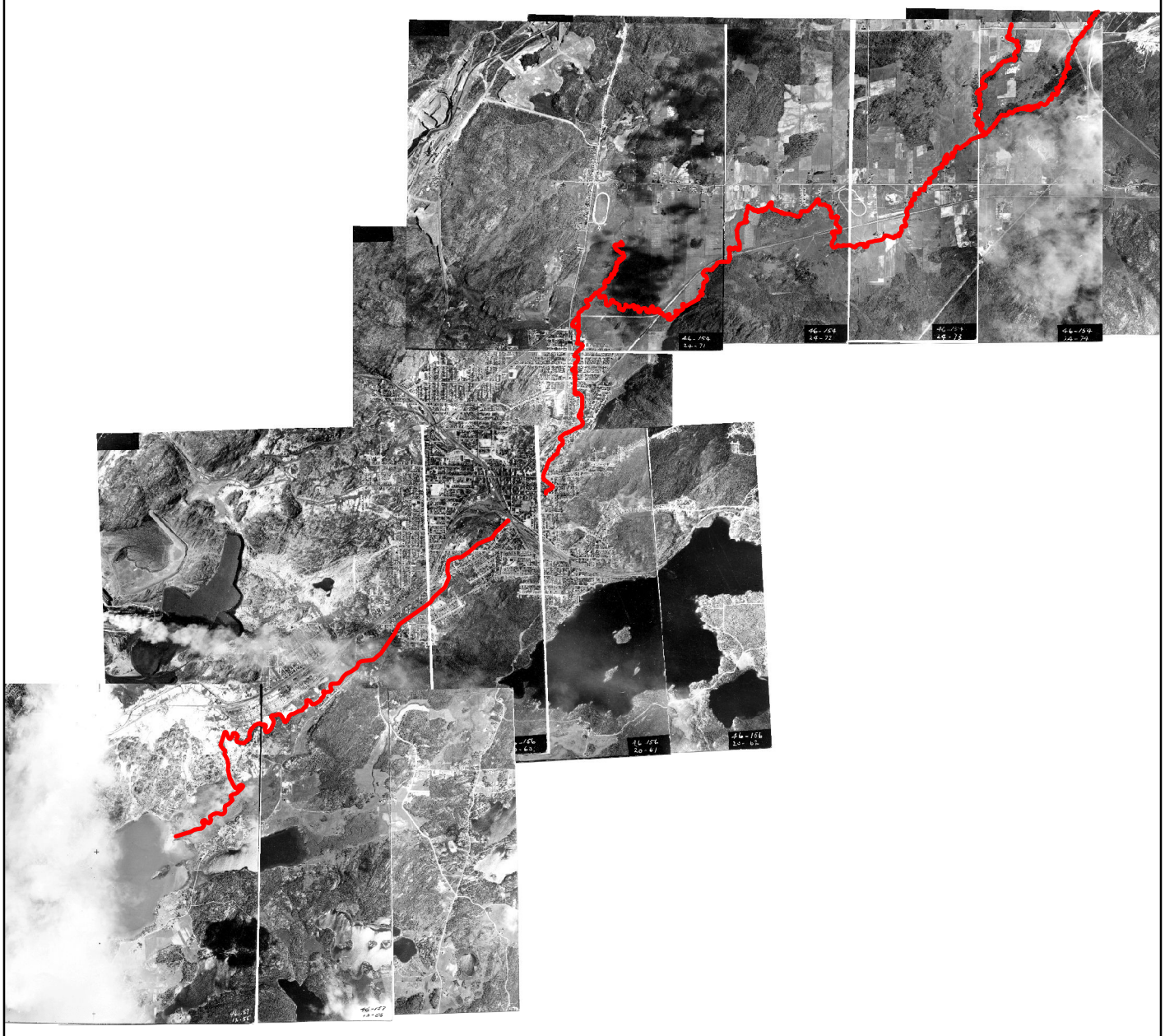
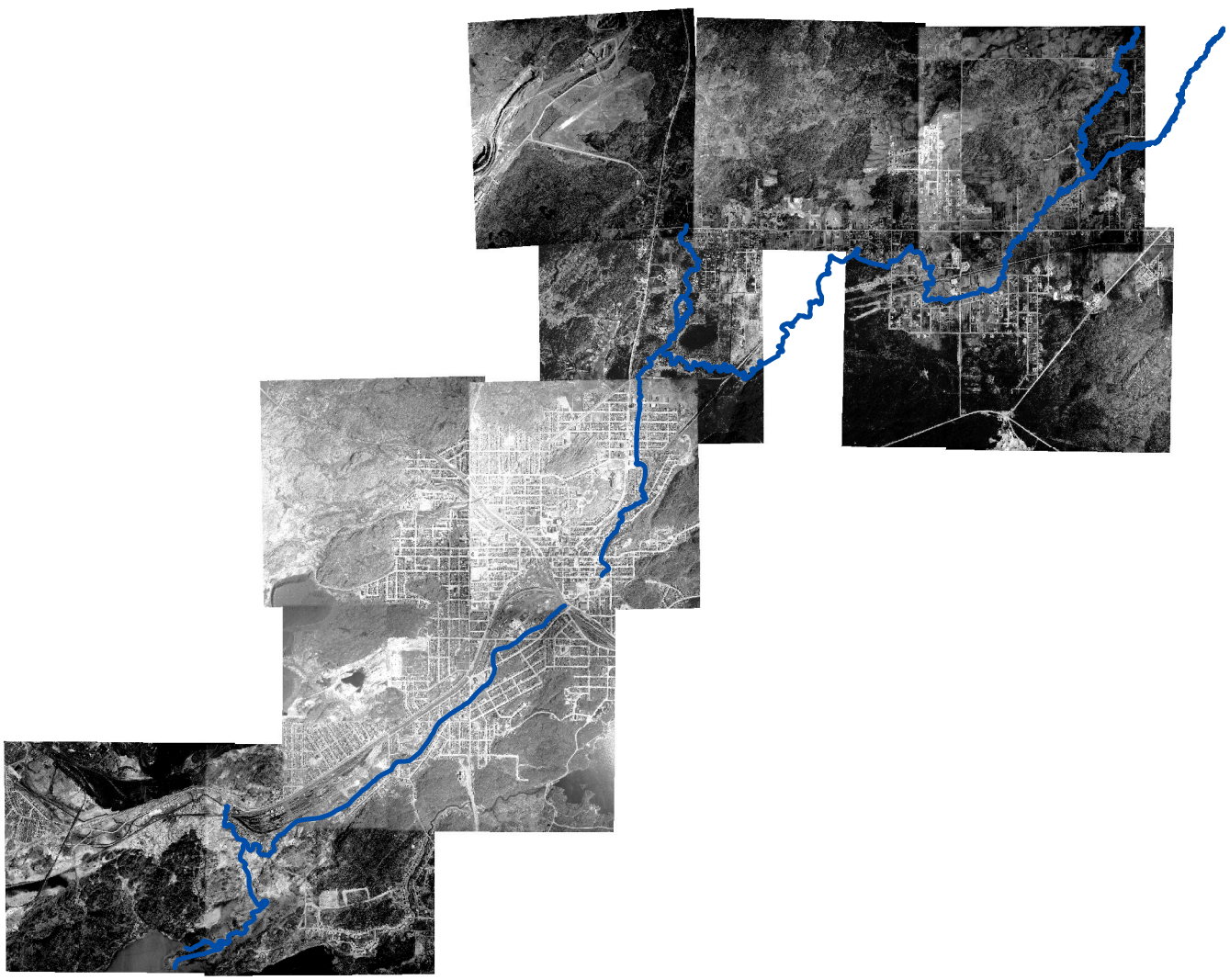
Appendix F1
Historical Aerials

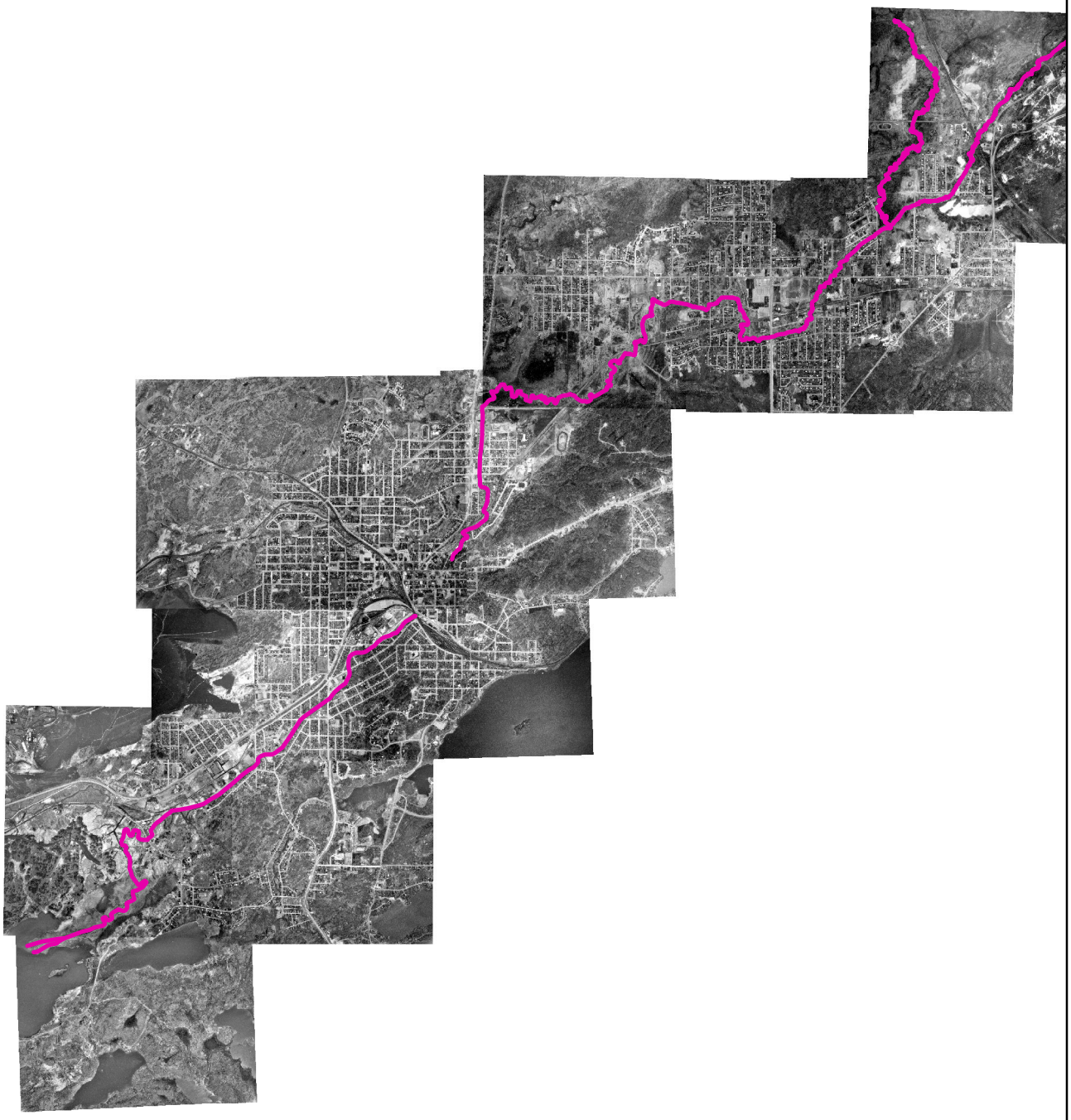
Delineation of Junction Creek 1946



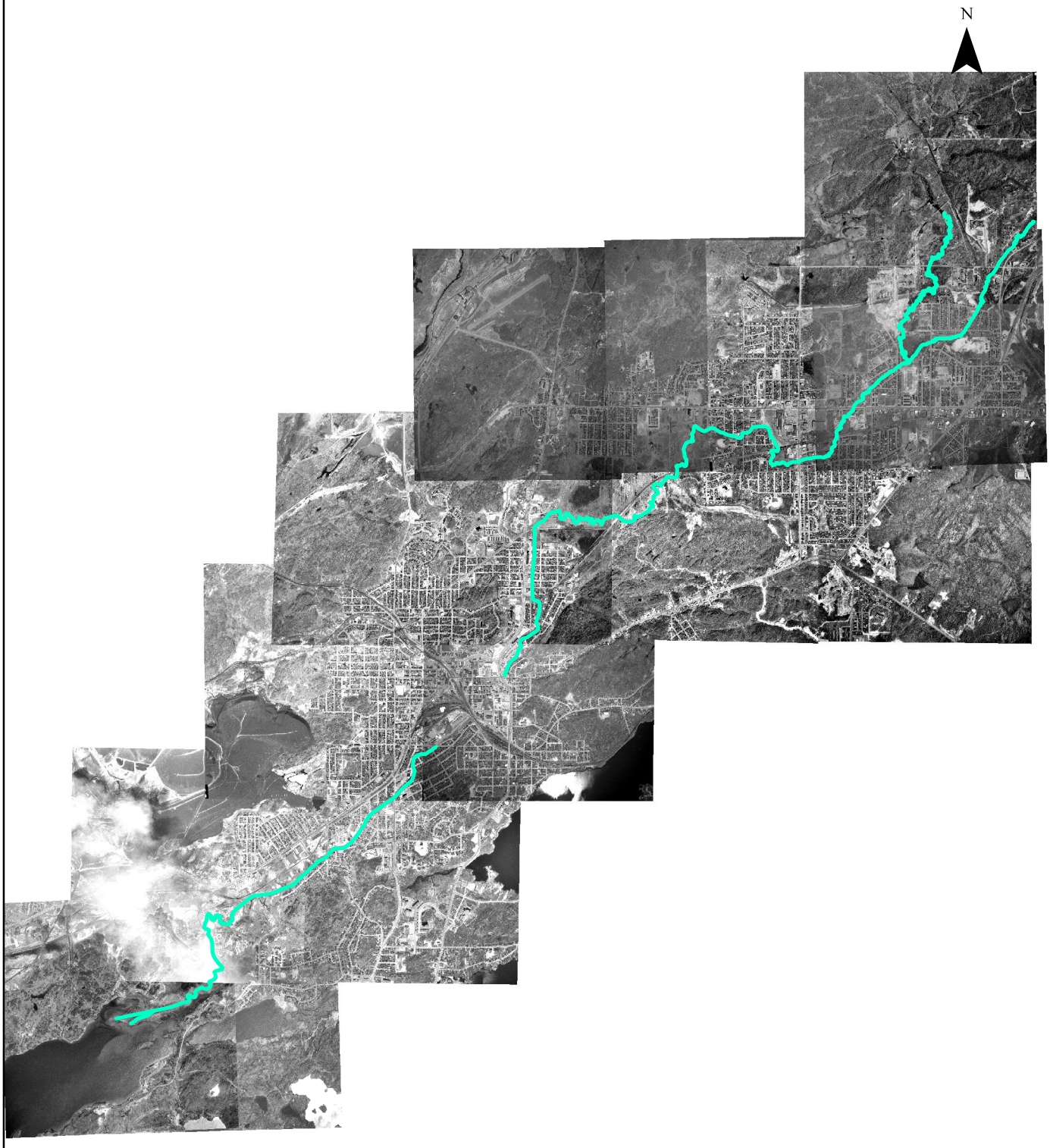
Delineation of Junction Creek 1956



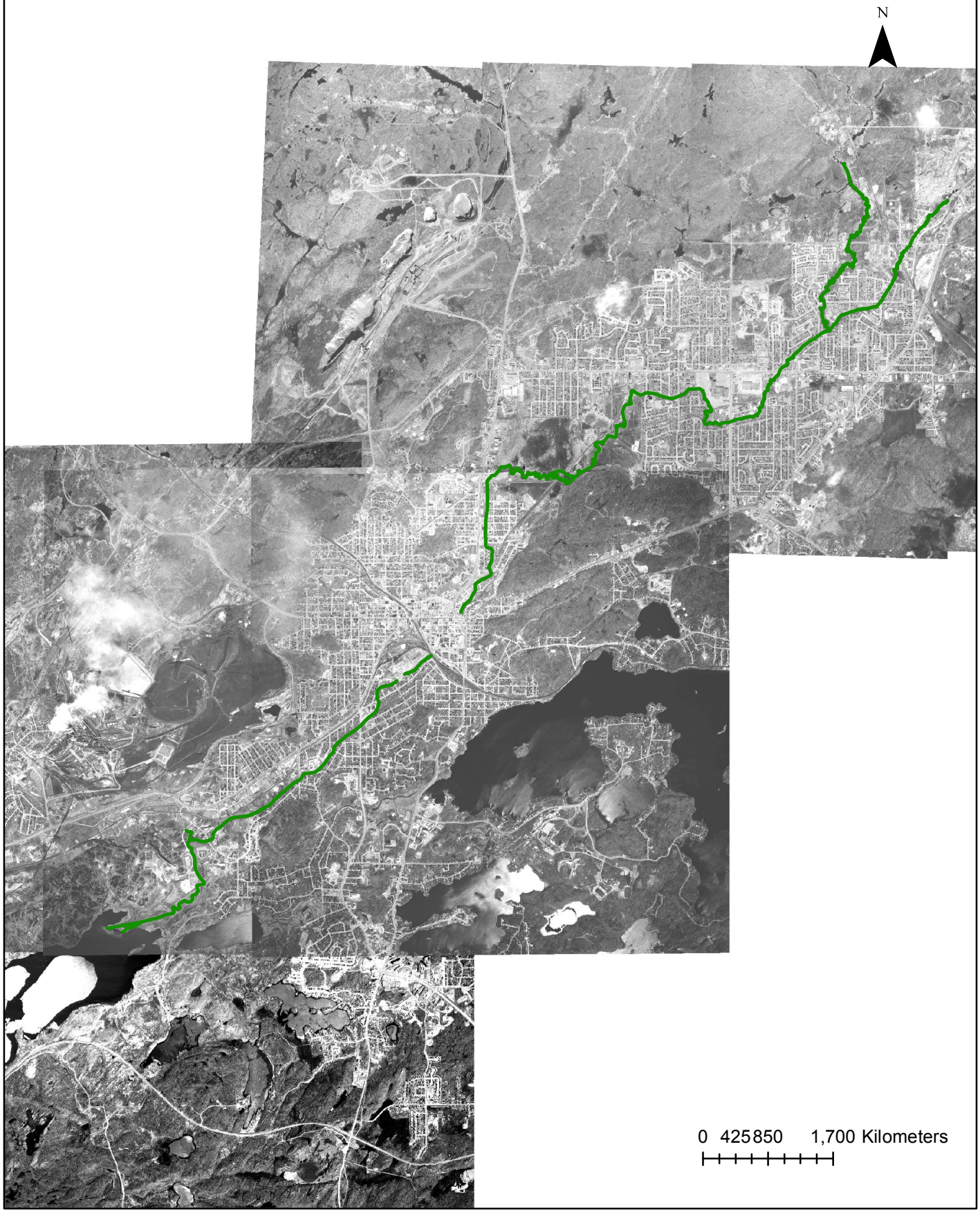
Delineation of Junction Creek 1969



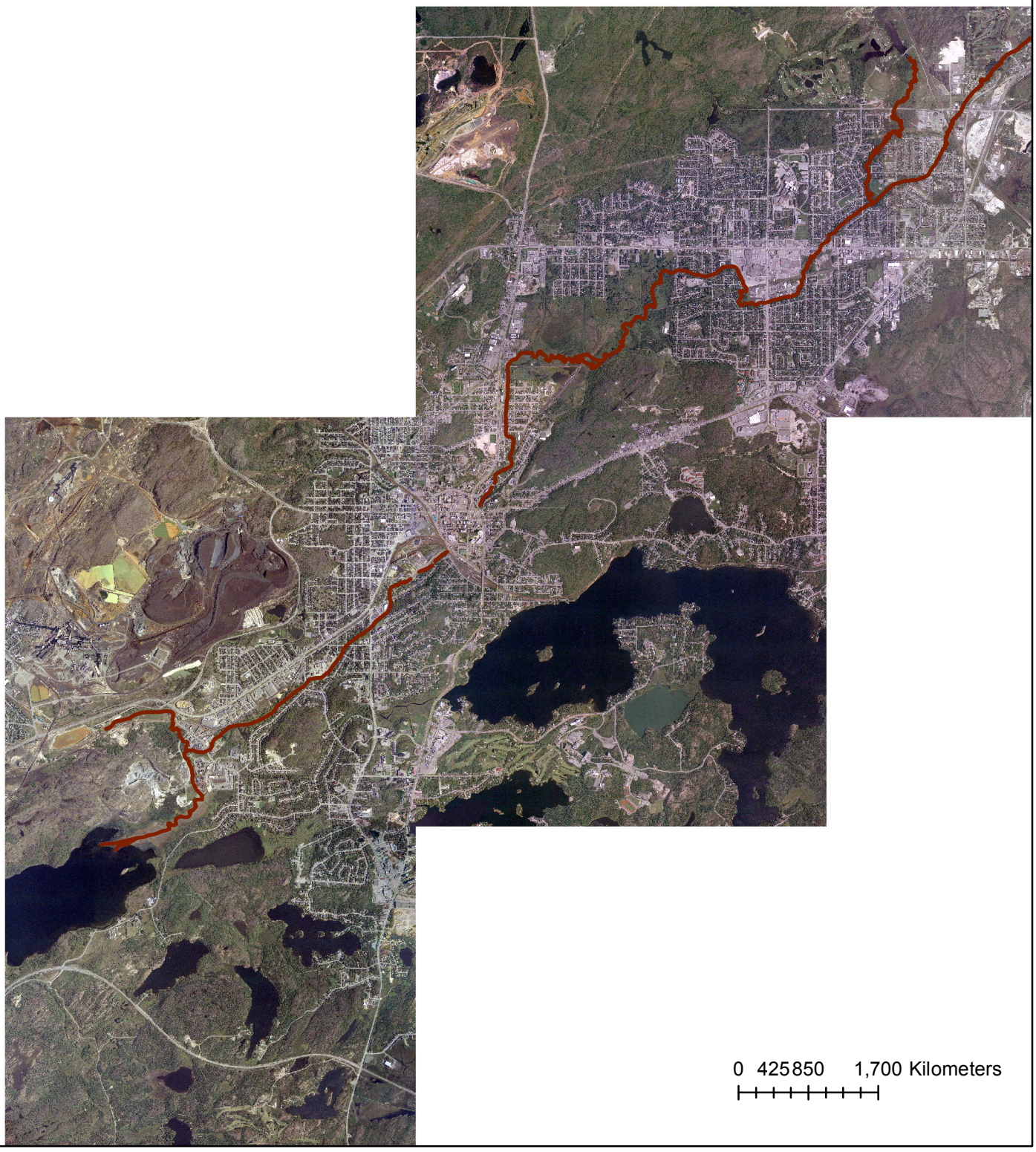
Delineation of Junction Creek 1975



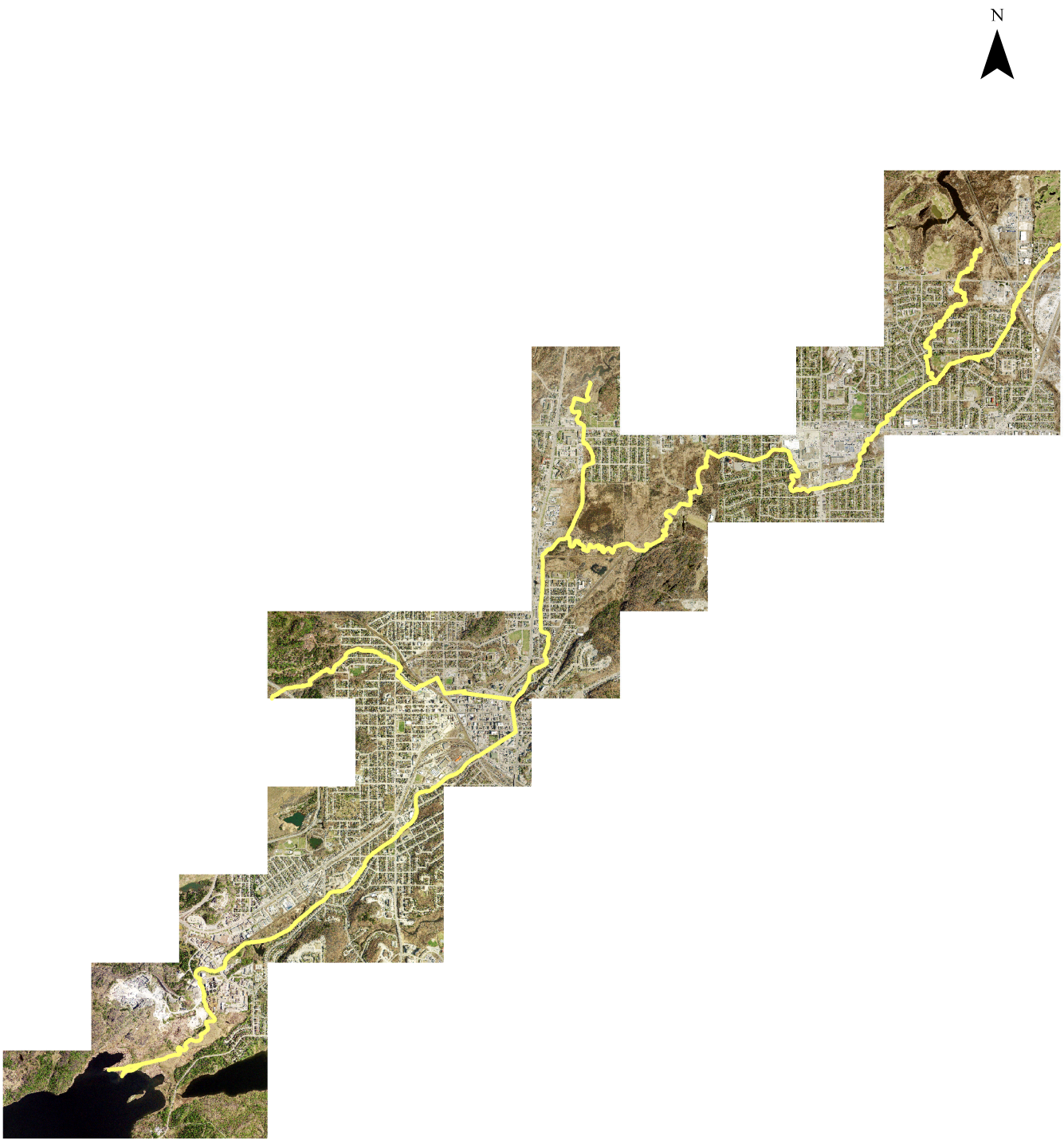
Delineation of Junction Creek 1991



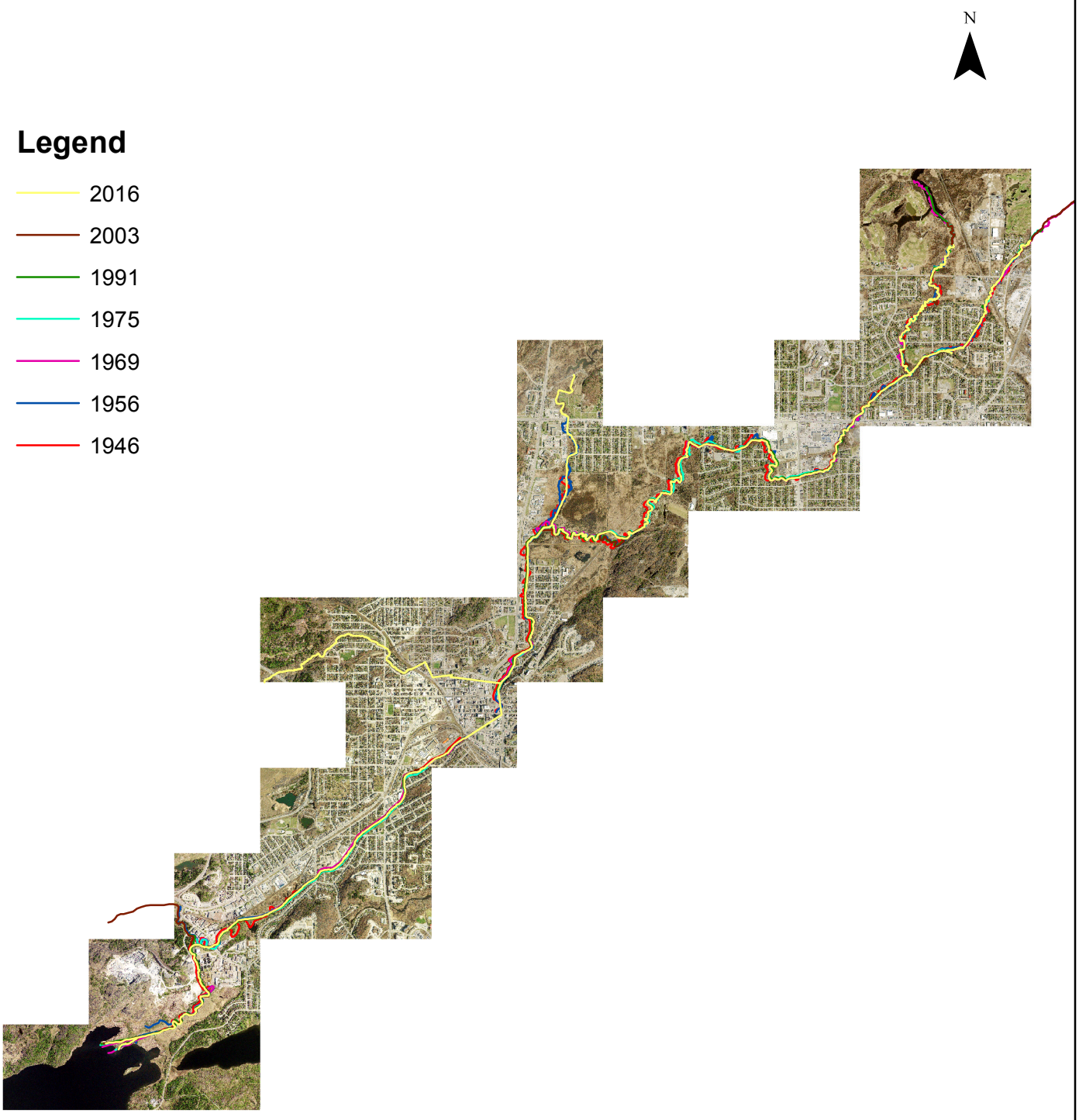
Delineation of Junction Creek 2003



Delineation of Junction Creek 2016



Delineation of Junction Creek 1946-2016



Appendix F2
Photographic Record

Photo 1 Reach J7	
	Photograph taken facing upstream. Point bars established on inside meander bends and bank failures on outside of bends.
Photo 2 Reach J7	
	Photograph taken facing left bank. Rotational sliding and slumping common along banks.

Photo 3 Reach J8	
	Photograph taken facing downstream. Undercutting and bank failures were observed, leaning trees common.
Photo 4 Reach J8	
	Photograph taken facing left bank. Rotational sliding and slumping of bank, leaning tree and woody debris in channel.

Photo 5 Reach J9	
	Photograph taken facing downstream. Woody debris in channel, leaning trees were observed.
Photo 6 Reach J9	
	Photograph taken facing left bank. Undercutting of banks, root exposure, and pipe outlets common along reach.

Photo 7 Reach J10	
	Photograph taken facing upstream. Undercutting, slumping, and pipe outlets common. Rip rap observed.
Photo 8 Reach J10	
	Photograph taken facing left bank. Bank failure present and trash line observed at property edge.

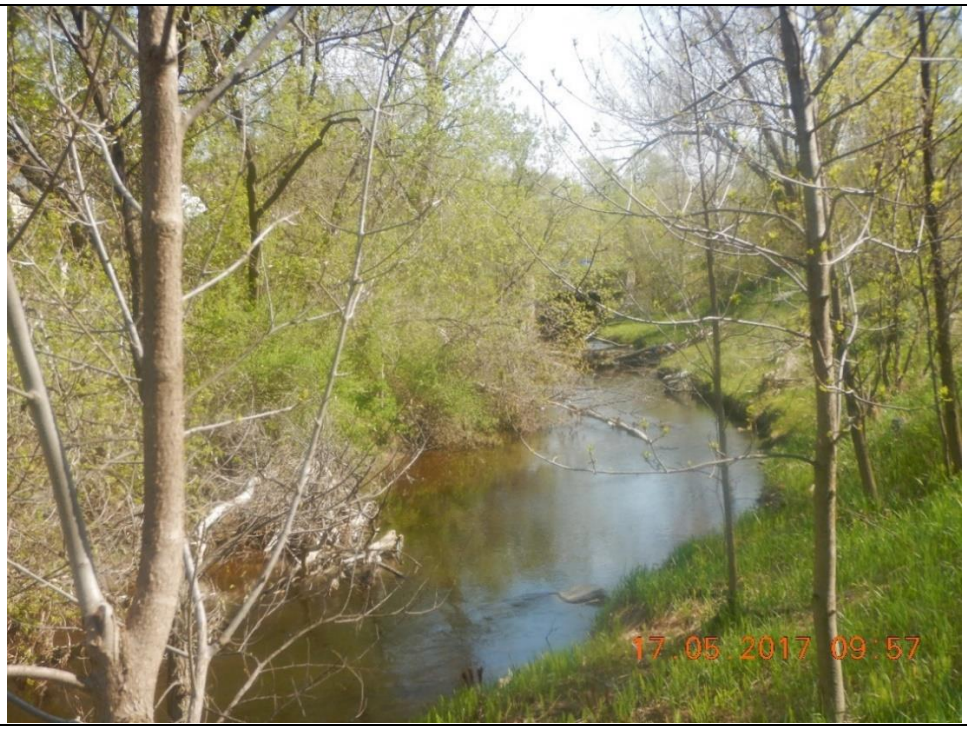
Photo 9 Reach J11	
	Photograph taken facing upstream. Undercutting, leaning trees, pipe outlets, and large woody debris were all common.
Photo 10 Reach J11	
	Photograph taken facing right bank. Fracture lines and bank failure were noted.

Photo 11 Reach J13	
	Photograph taken facing downstream. Fracture lines and undercutting present along banks.
Photo 12 Reach J13	
	Photograph taken facing upstream. Established beaver dam at mid reach. Could not proceed downstream because of access.

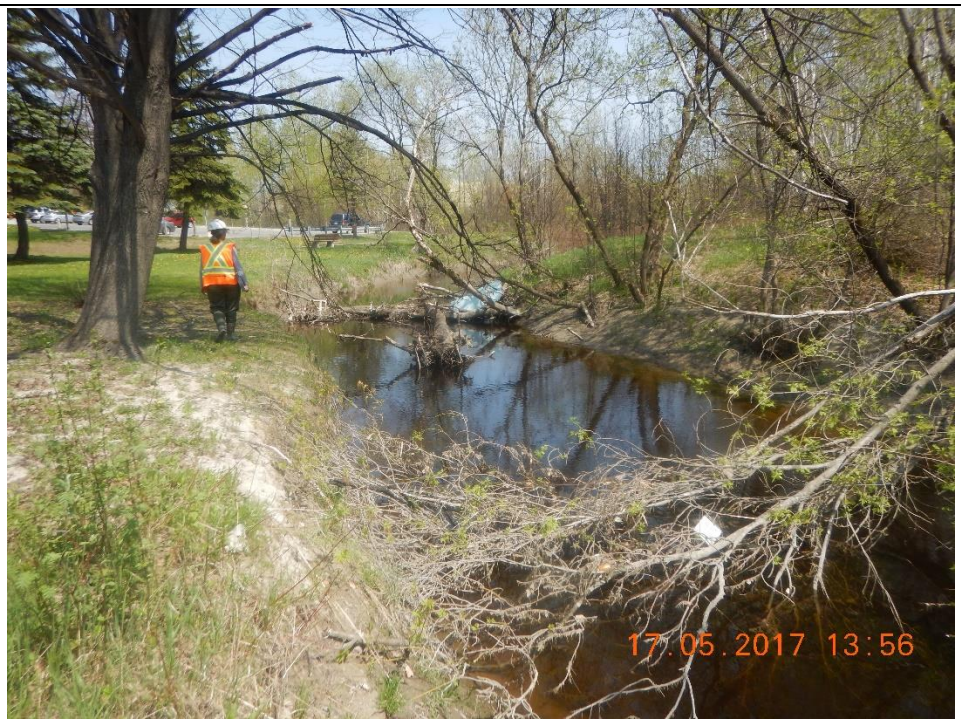
Photo 13 Reach J14	
	Photograph taken facing upstream. Exposed tree roots and rip rap observed. Pipe outlets undercutting banks were common.
Photo 14 Reach J14	
	Photograph taken facing downstream. Leaning trees and large woody debris common throughout reach.

Photo 15 Reach J15	
	Photograph taken facing upstream. Bank undercutting, slumping, and large woody debris common.
Photo 16 Reach J15	
	Photograph taken facing left bank. Large erosion scar observed.

Photo 17 Reach J16	
	Photograph taken facing downstream. Slumping and bank erosion common. Woody debris observed in channel.
Photo 18 Reach J16	
	Photograph taken facing downstream/ right bank. Leaning trees and bank failure common. Exposed tree roots observed.

Photo 19 Reach J17	
	Photo taken facing downstream to the left. Mild undercutting and rooted emergent vegetation observed.
Photo 20 Reach 17	
	Photo taken facing downstream. Mild bank erosion and large woody debris observed.

Photo 21 Reach TJ-14	
	Photograph taken facing upstream. Extensive backwatering from established beaver dams observed in lower half of reach.
Photo 22 Reach TJ-14	
	Photograph taken facing downstream. Backwatering and leaning trees observed along top portion of reach.

Photo 23 Reach TJ-14-1	
	Photograph taken facing downstream. Large cobbles and boulders in riffles, rooted emergent vegetation observed.
Photo 24 Reach TJ-14-1	
	Photograph taken facing upstream. Extensive backwatering observed upstream of large beaver dam.

Photo 25 Reach TJ17	
	Photograph taken facing downstream/ left bank. Undercutting and slumping, leaning trees, large woody debris in channel common.
Photo 26 Reach TJ17	
	Photograph taken facing downstream toward right bank. Pipe outlets common throughout reach. Failure and erosion of right bank observed.

Appendix F3
Field Sheets

GEO MORPHIX
Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107

Date:	May 17, 2017 / May 18, 2017	**Stream/Reach:**	J7
Weather:	sunny 27°C / sunny 23°C	**Location:**	Kelly Lake Rd
Field staff:	ALW, AV, SC / FBJ, EG, AL	**Watershed/Subwatershed:**	Junction Crk
UTM (Upstream)		**UTM (Downstream)**	

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

Riparian Vegetation

Dominant Type: (Table 6): 2+3
Species: _____
Scattered trees.

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, 3 | Coverage of Reach (%):

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

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

WDJ/50m: None

Water Quality

Odour (Table 16): 1

Turbidity (Table 17): 2

Channel Characteristics

Sinuosity (Type) (Table 9): 2
Sinuosity (Degree) (Table 10): 3
Gradient (Table 11): 1
Number of Channels (Table 12): 1
Entrenchment (Table 13): 1
Type of Bank Failure (Table 14): 1, 3, 6
Downs's Classification (Table 15): M

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

	U/S	D/S			U/S	D/S	
Bankfull Width (m)	10.3	22.0	/	**Wetted Width (m)**	9.7	20.0	/
Bankfull Depth (m)	1.26	1.7 w/o LWD	/	**Wetted Depth (m)**	0.4	too deep	/

Riffle/Pool Spacing (m): NA | **% Riffles:** NA | **% Pools:** NA | **Meander Amplitude:** unable to measure

Pool Depth (m): NA | **Riffle Length (m):** NA | **Undercuts (m):**

Velocity (m/s): 0.076 U/S | 0.57 D/S | / | Wiffle ball / ADV / Estimated

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

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

Comments: overbank deposits, leaning + fallen trees, re-worked pt bars

Notes: exposed till, streak marks, No R-Ps developing short section entrenched @ U/S extent

Completed by: FBJ / AKl **Checked by:** CH

May 17 @ U/S portion where access allowed.

GEO | MORPHIX

Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 18, 2017	**Stream/Reach:**	J7
Weather:	sun! ~ 23°C	**Location:**	Kelly Lake Rd
Field Staff:	AW, AV, SC / FBJ, EG, AL	**Watershed/Subwatershed:**	Junction Crk

Process	No.	Geomorphic Indicator: Description	Present? Yes	Present? No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar		✓	2/6
	2	Coarse materials in riffles embedded	NA		
	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	4	0.33
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		1/6
	2	Exposed sanitary / storm sewer / pipeline / etc.		✓	
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools downstream of culverts / storm sewer outlets	NA		
	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	5	0.17
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	✓		2/7
	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	NA		
	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 =	2	5	0.29
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 = 0.23

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

Completed by: _____ Checked by: CJT

Rapid Stream Assessment Technique

Project Code: PN16107

Date:	May 18, 2017	**Stream/Reach:**	J7
Weather:	sun/23°C	**Location:**	Kelly Lake Rd.
Field Staff:	AW, AN, SC / KBJ, AI, EG,	**Watershed/Subwatershed:**	Junction Crk

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**

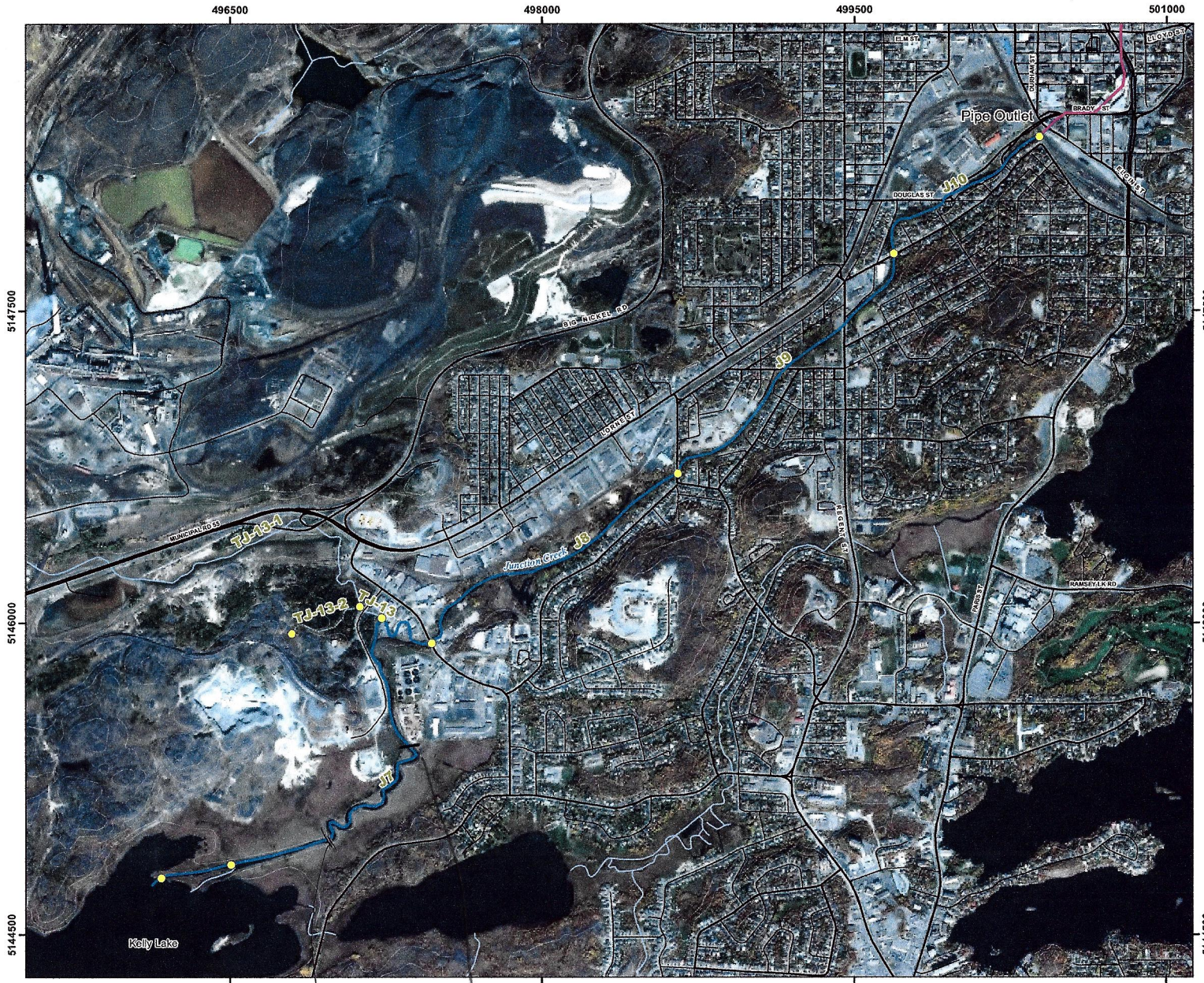
Channel Scouring/ Sediment Deposition	• > 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60-85% embedded for large mainstem areas)	• 25-49% embedded (35-59% embedded for large mainstem areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas) NA
	• 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 18, 2017	Reach:	J7	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) = 23	Poor (<13)	Fair (13-24)	Good (25-34)	Excellent (>35)

Completed by: _____ Checked by: CH

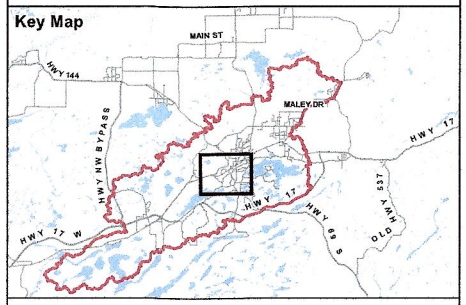


Map 1a

Junction Creek Subwatershed Study

Large Reach Break Map Set

Key Map



Legend

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

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Project: 1844A
Date: May 12, 2017

NAD83 - UTM Zone 17
Size: 11x17"
1:18,000

0 250 500 750 Meters

N

GEO | MORPHIX
Geomorphology Earth Science Observations

Reach Characteristics

Project Code/Phase: PN16107.

Date:	May 15, 2017	**Stream/Reach:**	J8
Weather:	Sunny	**Location:**	Kelly Lake Rd culvert
Field staff:	SC, AV, PP, GM, AL, PB	**Watershed/Subwatershed:**	Junction Creek
UTM (Upstream)		**UTM (Downstream)**	497476 5145937

Land Use (Table 1): 4,5,7 | **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: deciduous and coniferous

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): 2,6 | Coverage of Reach (%): 30

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): 1
Sinuosity (Degree) (Table 10): 2
Gradient (Table 11): 1
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	☑	☑	☑	☑	☐	☑ fill	☐
Bank Material	☑	☑	☐	☐	☐	☑	☐

Bankfull Width (m)	15.2	26.2	17.8	**Wetted Width (m)**	8.2	13.2	10.2
Bankfull Depth (m)	1.7	2.4	1.3	**Wetted Depth (m)**	0.62	1.5	>0.3

Riffle/Pool Spacing (m): 76 | **% Riffles:** 10 | **% Pools:** 90 | **Meander Amplitude:** NA

Pool Depth (m): 0.65 | **Riffle Length (m):** 13.15 | **Undercuts (m):** 0.3

Velocity (m/s): 0.2 | 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%

Comments: Straight, streak marks.

Notes:
Some of every bank failure type
Waste rock
12. 2 erosion iron
17. 7 erosion scar
DEAD TREES
beaver dam
orange stained water on opposite side of trail

Completed by: _____ Checked by: CH

Note: Wetted depth recorded for 3rd point is depth on the shoulder. The depth in the middle is deeper but we were unable to measure due to the ground being too soft.

GEO MORPHIX

General Site Characteristics

Project Code: PN16107

Date:	May 15, 2017	**Stream/Reach:**	J8
Weather:	sun + 15°C	**Location:**	Kelly Lake Rd
Field Staff:	SC, AV, PP, GM, AL, PB	**Watershed/Subwatershed:**	Junction Crk

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

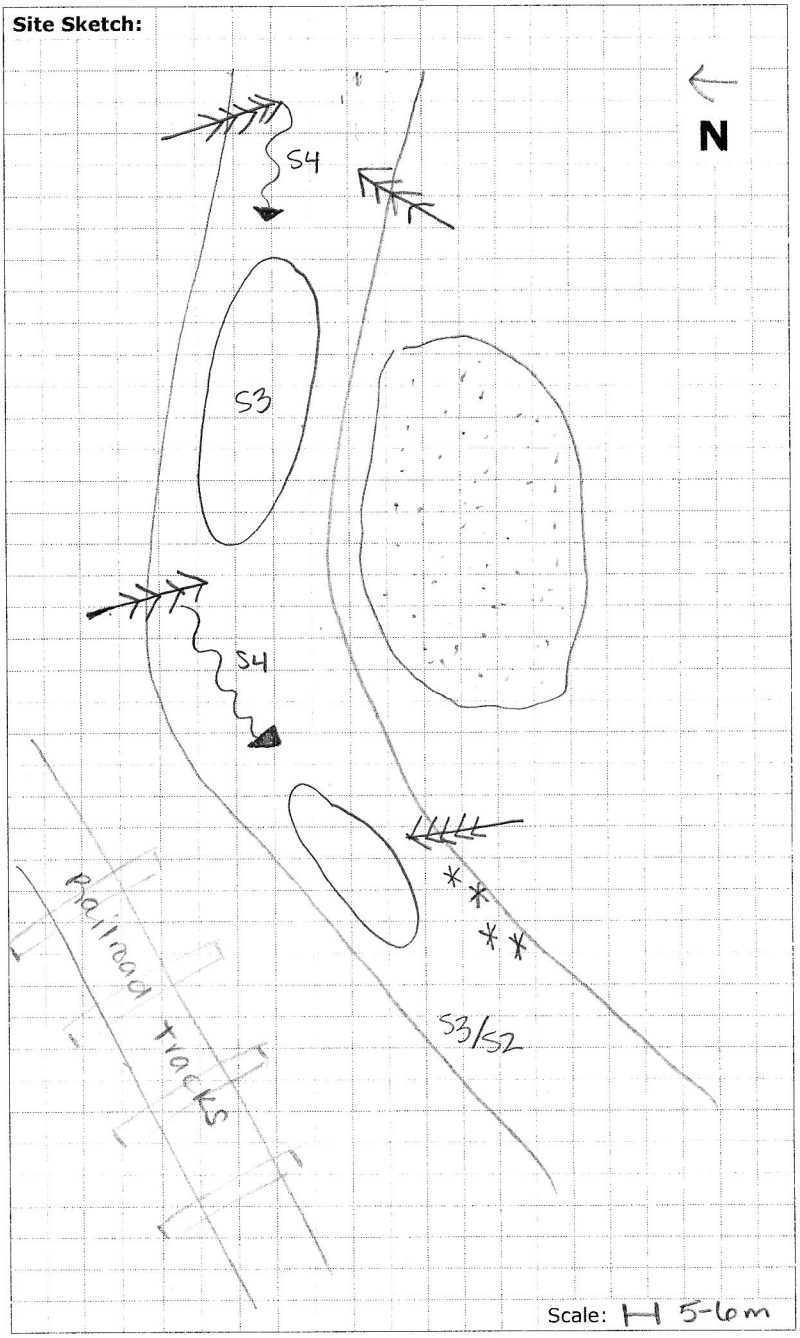
Substrate

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:

Only 2 riffles in the whole reach

Completed by: _____ Checked by: AH

GEO | MORPHIX

Rapid Geomorphic Assessment **Project Code:** PN16107

Date:	May 15, 2017	**Stream/Reach:**	J8
Weather:	Sunny	**Location:**	Kelly Lake Rd.
Field Staff:	SC, AV, PP, GM, AL, PB	**Watershed/Subwatershed:**	Junction Rd

Process	No.	Geomorphic Indicator: Description	Present? Yes	Present? No	Factor Value
Evidence of Aggradation (AI)	1	Lobate bar	X		2/7
	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 =	2	5	0.28
Evidence of Degradation (DI)	1	Exposed bridge footing(s)		X	1/8
	2	Exposed sanitary / storm sewer / pipeline / etc.		X	
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	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	7	0.125
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		3/9
	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.		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	NA		
		Sum of indices =	3	6	0.33
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 = 0.18

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: PN16167

Date:	May 15, 2017	**Stream/Reach:**	JS
Weather:	Sunny	**Location:**	Kelly Lake Rd
Field Staff:	SC, AU, PP, GM, AL, PB	**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**

NA

Date:	May 15 2017	Reach:	J8	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) = 23	Poor (<13)	Fair (13-24)	Good (25-34)	Excellent (>35)

Completed by: _____ Checked by: CH