# Ganatsekiagon Creek
# Parcel 24 Erosion Threshold Analysis

## TACCGATE Parcel 24 Whitevale East
Pickering, Ontario

Prepared for:
TACCGATE Developments Inc.
600 Applewood Crescent
Vaughan, Ontario

Submitted:
August 7, 2025

GEO Morphix Project No. 24118

| Ver. | Purpose/Change | Authored by | Approved by | Date |
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| 1.0 | Draft Report for client review | Karine Smith, MSc. Jan Franssen, Ph.D. | Paul Villard, Ph.D., P.Geo., CISEC-CAN, EP, CERP | August 1, 2025 |
| 2.0 | Final report | Karine Smith, MSc. Jan Franssen, Ph.D. | Paul Villard, Ph.D., P.Geo., CISEC-CAN, EP, CERP | August 7, 2025 |
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**Disclaimer**

This report presents professional opinions and findings of a scientific and technical nature based on the knowledge and information available at the time of preparation. This document is prepared solely for the Client, and the data, interpretations, suggestions, recommendations, and opinions expressed in the report pertain only to the project being completed for the Client.

**Head Office**
36 Main St. N., PO Box 205
Campbellville, ON, Canada L0P 1B0

**Ottawa Office**
83 Little Bridge St., Unit 12, PO Box 292
Almonte, ON, Canada K0A 1A0

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# 1 Introduction

GEO Morphix Ltd. (GEO Morphix) was retained to complete a geomorphological and erosion threshold assessment for Ganatsekiagon Creek and its tributary in support of the TACCGATE Parcel 24 property in the City of Pickering, Ontario (hereafter referred to as "subject lands". The subject lands are bounded by Peter Matthews Drive to the west, Alexander Knox Road to the north, a tributary to Ganatsekiagon Creek to the east, and Ganatsekiagon Creek to the south (**Appendix A**). The tributary to Ganatsekiagon Creek is located adjacent to the proposed development lands, flowing south towards the main branch of Ganatsekiagon Creek and will be receiving discharge from a stormwater management pond (Pond 25) servicing the development.

It is our understanding that during a pre-con meeting for the Parcel 24 development, Toronto Region Conservation Authority (TRCA) requested that an erosion threshold analysis be completed for the subject lands. An erosion assessment was previously conducted for **Reach G6**, detailed in the Erosion Threshold Analysis Summary provided by GEO Morphix (2024). To supplement the previous analyses, this report provides additional context on the existing conditions within the receiving watercourses, and summarizes an erosion threshold analysis for **Reach GB2**, which will receive runoff from SWM Pond 25.

As part of the existing conditions and erosion threshold assessment, the following tasks were completed:

- Review topographic and geologic maps and previously completed reporting
- Confirm the location and extent of the watercourse reaches delineated in previous studies
- Summarise previously completed field reconnaissance to document reach-scale observations of channel substrate, flow behaviour, geomorphological units, and locations of any valley wall contact and areas of active erosion, as appropriate
- Summarise previously completed detailed geomorphological assessments for the two receiving reaches, the primary objective of which is to determine a critical flow or erosion threshold
- Determine erosion thresholds using an in-house model that predicts the discharge at which the dominant channel material will become entrained

# 2 Physiography and Surficial Geology

Surficial geology and physiography act as constraints to channel development and tendency. These factors determine the nature and quantity of the availability and type of sediment. Secondary variables that affect the channel include land use and riparian vegetation. These factors are explored as they not only offer insight into existing conditions, but also potential changes that could be expected in the future as they relate to a proposed activity.

The subject lands are located entirely within the South Slope physiographic region (Chapman and Putnam, 1984). The South Slope physiographic region is characterized by till moraines in the north and drumlinized till plain to the south, where the subject lands are located. Immediately south of the subject lands, Ganatsekiagon Creek flows through the Iroquois Plains physiographic region, characterized by sand and till plains (Chapman and Putnam, 1984). Published surficial geology mapping indicates that deposits within the subject lands consist of sandy-silt to silty-sand textured till (OGS, 2010). To the south of the subject lands, the main branch of Ganatsekiagon Creek flows through coarse-textured glaciolacustrine deposits consisting of sand, gravel, and some silt and clay (OGS, 2010). Modern alluvial deposits comprised of clay, silt, sand, and gravel also border the main branch of Ganatsekiagon Creek (OGS, 2010).

Surficial geology and hillshade maps of the study site are provided in **Appendix A**, for reference. The hillshade map, derived from a high-resolution bare-earth digital elevation model of the study area, is helpful in visualizing the terrain across the study area.

# 3 Watercourse Characteristics

## 3.1 Reach Delineation

Reaches are homogeneous segments of channel used in geomorphological investigations. Reaches are studied semi-independently as each is expected to function in a manner that is at least slightly different from adjoining reaches. This method allows for a meaningful characterization of a watercourse as the aggregate of reaches, or an understanding of a particular reach, for example, as it relates to a proposed activity. Reaches are typically delineated based on changes in the following:

- Channel planform
- Channel gradient
- Physiography
- Land cover (land use or vegetation)
- Flow, due to tributary inputs
- Soil type and surficial geology
- Historical channel modifications

Reach delineation typically follows the scientifically defensible methodology proposed by Montgomery and Buffington (1997), Richards et al. (1997), and the Toronto and Region Conservation Authority (2004), as well as others. Reaches were previously delineated and confirmed in the field as part of the *Identification of Potential Outfall Locations and Support in Identification of Erosion Concerns Associated with SWM Facilities report (GEO Morphix Ltd., 2015).* General descriptions of all receiving reaches assessed by GEO Morphix; **GB2**, **G7**, **G6**, and **G5** are provided below.

## 3.2 Reach Observations

Field investigations were completed on August 5, 2015, August 7, 2015 and November 24, 2016, and included the following tasks:

- Describe riparian conditions
- Estimate bankfull channel dimensions
- Characterize bed and bank material composition and structure
- Collect observations of erosion, scour, or deposition
- Compile photographs to document the watercourses, riparian areas and/or valley, surrounding land use, and channel disturbances such as crossing structures

The observations and measurements collected during field activities are summarized in **Table 1**. Field descriptions are supplemented and supported with representative photographs, which are included in **Appendix B**. Field observations are provided in **Appendix C**.

**Table 1. Reach characteristics (GEO Morphix Ltd., 2015).**

| Reach Name | Avg. Bankfull Width (m) | Avg. Bankfull Depth (m) | Riffle Substrate | Pool Substrate | Valley Type | Dominant Riparian Condition | Notes |
|---|---|---|---|---|---|---|---|
| G5 | 6.55 | 0.76 | Gravel, cobble, boulder | Sand, gravel, cobble | Partially confined | Dense, mature forest cover | Woody debris jams are large and causing sediment build up (gravel, cobble, sand), sand and gravel deposits on overbank and bars, 2 valley wall contacts observed in reach. |

| Reach Name | Avg. Bankfull Width (m) | Avg. Bankfull Depth (m) | Riffle Substrate | Pool Substrate | Valley Type | Dominant Riparian Condition | Notes |
|---|---|---|---|---|---|---|---|
| G6 | 5.15 | 0.71 | Gravel, cobble | Sand, gravel, cobble | Partially confined | Dense, mature forest cover | Cut-off channels common flow being redirected around debris jams, deposition of sand gravel and cobble common in these areas |
| G7 | 6.92 | 0.75 | Sand, gravel, cobble, boulder | Sand, gravel, cobble | Unconfined | Dense, mature forest cover | Sand, gravel and cobble deposition common on bed and bars |
| GB2 | 4.90 | 0.48 | Sand, gravel, cobble | N/A | Partially confined | Continuous coverage of mature trees | Numerous tributaries drain into reach GB2, Reach opens up at upstream extent to a wetland area with multiple flow paths, terracing, sandy basal scour, meander amplitudes of 23.3 m and 25 m, pool wetted depth of 0.33 m, Undercut of 0.30 m. Water quality clear with no odour. |

**Reach G5** was a sinuous channel situated within a partially confined valley. The riparian zone was comprised of a continuous coverage of mature trees. Riffle-pool morphology was well-established with bed substrate ranging from sand to cobbles within pools, and gravel to boulders within riffles. Bank materials consisted predominantly of silt and sand. Evidence of aggradation including sand and gravel deposits in overbank bars was identified throughout the reach, and two occurrences of valley wall contact were observed. Large woody debris jams were present within the reach, causing sediment buildup.

**Reach G6** was characterized as a sinuous, single-threaded channel flowing through a partially confined valley. The riparian zone was composed of continuous mature trees spanning over 10 times the channel width. Riffle-pool geomorphic units were well-established throughout the reach, with bed substrate consisting of gravel and cobbles within the riffles, and a range of sand to cobble within the pools. Bank materials consisted predominantly of sand and silt. Cut-off channels were common throughout the reach, with flow being redirected around frequent debris jams. Sand and gravel deposits were common around the cut-off channels and woody debris jams. Valley wall contact was observed towards the upstream extent of the reach.

**Reach G7**, located downstream of the confluence with **GB2**, was characterized as an unconfined, single-threaded meandering channel. The riparian zone consisted of a continuous coverage of mature trees. Distinct riffle-pool units were present throughout the reach, with bed substrate ranging from sand to boulders within the riffles, and sand to cobbles within the pools. Bank materials consisted of sandy clay. Bank erosion and undercutting were present along 30-60% of the banks, and bank angles were relatively high, ranging from 60 to 90 degrees. Sand, gravel and cobble deposits were observed along the bed and bars throughout **Reach G7**.

**Reach GB2**, situated within the tributary to Ganatsekiagon Creek, was characterized as a meandering channel flowing through a partially confined valley. The riparian zone consisted of continuous coverage of mature trees spanning over ten channel widths. At the upstream extent of the reach, multiple flow

paths were observed flowing from a wetland area, and several small tributaries flowed into the reach along the assessed extent of **GB2**. Riffle-pool bed morphology was absent from the reach, which was dominated by runs. The bed substrate consisted of gravel to small cobbles, and bank materials consisted of sandy silt. Bank erosion was observed along 60-100% of the banks, and basal scour was observed throughout the reach.

## 3.3 Rapid Assessment Results

Channel instability was objectively quantified by applying the Ontario Ministry of the Environment's (2003) Rapid Geomorphic Assessment (RGA). Observations were quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening, and planimetric adjustment. The index produces values that indicate whether a channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40), or adjusting (score >0.41).

The Rapid Stream Assessment Technique (RSAT) was also employed to provide a broader view of the system as it considers the ecological function of the watercourse (Galli, 1996). Observations were made of channel stability, channel scouring or sediment deposition, instream and riparian habitats, and water quality. The RSAT score ranks the channel as maintaining a poor (<13), fair (13-24), good (25-34), or excellent (35-42) degree of stream health.

Reaches were also classified according to the Downs (1995) Channel Evolution Model. The Downs Model describes the successional stages of a channel because of perturbation, namely hydromodification. Understanding the current stage of the system is beneficial as this allows one to predict how the channel will continue to evolve or respond to an alteration to the system.

These observations and measurements are summarized below and in **Table 2**.

**Table 2. Summary of rapid assessment results.**

| Reach Name | RGA (MOE, 2003) | | | RSAT (Galli, 1996) | | | Downs Classification Model (1995) |
|---|---|---|---|---|---|---|---|
| | Score | Condition | Dominant Systematic Adjustment | Score | Condition | Limiting Feature | |
| G5 | 0.37 | In transition/ stress | Widening | 28 | Good | N/A | "C" - Compound |
| G6 | 0.38 | In transition/ stress | Aggradation | 25 | Good | N/A | "C" - Compound |
| G7 | 0.33 | In transition/ stress | Aggradation/ Widening | 28 | Good | N/A | "U" - Undercutting |
| GB2 | 0.27 | In transition/ stress | Widening | 24 | Fair | N/A | "E" - Enlarging |

**Reach G5** was assigned an RGA score of 0.37, indicating the reach was in transition/stress. The dominant process of systematic adjustment was widening, as evidenced by undercutting and occurrences of valley wall contact. The RSAT resulted in a score of 28, indicating the reach is in good condition and provides an aquatic habitat for local species. The Downs (1995) classification indicated that this reach was widening and aggrading along the bed (C).

**Reach G6** was assigned an RGA score of 0.38, indicating the reach was in transition/stress. The dominant process of systematic adjustment was aggradation, as evidenced by sand and gravel deposits throughout the reach. The RSAT resulted in a score of 25, indicating the reach is in good condition and

provides aquatic habitat benefits. The Downs (1995) classification indicated that **G6** is widening and aggrading along the bed (C).

**Reach G7** was assigned an RGA score of 0.33, with aggradation and widening as the dominant adjustment process, as evidenced by sand deposits and undercutting observed throughout the reach. The RSAT resulted in a score of 28, indicating the reach is in good condition, providing an aquatic habitat. The Downs (1995) classification showed that the reach is undercutting its banks (U).

**Reach GB2** was assigned an RGA score of 0.27, indicating the reach is in transition/stress. The dominant adjustment process was widening, as evidenced by the frequent undercutting of 60-100% of the banks. The RSAT score was 24, indicating the reach is in fair condition, with channel stability as the limiting factor due to the widespread bank erosion. The Downs (1995) classification indicated that the reach is enlarging (E).

## 3.4 Detailed Geomorphological Assessments

Detailed assessments were completed for **GB2**, which will receive direct runoff from SWM Pond 25, and for **G6**, determined as the most erosion-sensitive reach along the main branch of Ganatsekiagon Creek, based on results from the rapid assessments. The assessments were completed on December 13, 2016 (**GB2**) and November 18th, 2015 (**G6**).

Detailed geomorphological assessments provide bankfull channel characteristics to define the erosion threshold, and include the following field activities:

- Long-profile, level survey of the channel centre line
- Detailed cross-sectional surveys at multiple locations along the subject channel reach
- Detailed instream measurements at each cross-section location, including bankfull channel geometry, riparian conditions, bank material, bank height/angle, and bank root density
- Bed material sampling at each cross-section following a modified Wolman's (1954) Pebble Count Technique and/or substrate samples
- Velocity and discharge measurements at select representative cross-sections
- A summary of the detailed assessment results is provided in **Table 3** and **Appendix A**.

The results from **Reach G6** and **GB2** were presented initially in the *Identification of Potential Outfall Locations and Support in Identification of Erosion Concerns Associated with SWM Facilities Report* (GEO Morphix Ltd., 2015). A summary of measured and computed values is presented in **Section 4**, **Table 3** and comprehensive detailed assessment summaries are provided in **Appendix D**.

# 4 Erosion Threshold Assessments

Erosion thresholds are used to determine the magnitude of flow required to potentially entrain and transport bed and/or bank material (Garcia, 2009; Villard and Parish, 2003). As such, they are used to inform erosion mitigation strategies in channels influenced by conceptual flow and stormwater management plans. Erosion thresholds were modelled from detailed field observations of **Reaches GB2** and **G6**. The two reaches were selected for an erosion threshold analysis as they were determined to be the most erosion-sensitive reaches within the potential zone of impact along the receiving watercourses. The erosion threshold is a theoretical value, typically expressed as a critical discharge or shear stress, at which entrainment of sediment would occur based on the physical properties of the bed and bank materials. Due to variability between bed and bank composition and structure, erosion thresholds are determined for both bed and bank materials. The lower of the bed and bank erosion thresholds is adopted, as it provides the more conservative and limiting erosion threshold estimate for the subject reaches.

We note that the contributing area from the subject lands is 5.39 ha, accounting for approximately 2.0% of the total drainage area to **Reach GB2** (268 ha), and approximately 0.8% of the total drainage area to **Reach G6** (705 ha) as defined via the Ontario Watershed Information Tool (OWIT). This indicates that the total runoff contributions from the subject lands will be minor relative to the total catchment runoff to both reaches, and that given appropriate SWM controls the impacts on erosion processes within the watercourse can be expected to be minor. SWM Pond 25 will be designed according to the criteria

outlined in the MESPA, which requires a control release rate of 0.0006 $m^3/s/ha$ (SMD Consultants, 2024). The erosion thresholds defined in the following subsections can be used to provide additional guidance for the stormwater management strategy for Pond 25.

## 4.1 Methodology

Erosion threshold targets are determined using different methods that are dependent on the sediment characteristics of the channel. For example, thresholds for non-cohesive sediments are commonly estimated using a shear stress approach, similar to that of Miller et al. (1977), which is based on a modified Shield's curve. A velocity approach could also be applied (Villard & Parish, 2003). For cohesive materials, a method such as that described by Komar (1987), or empirically derived values such as those compiled by Fischenich (2001), Chow (1959) or Julien (1994), could be applied. Villard and Parish (2003) emphasize the importance of selecting methods that reflect local sediment conditions and integrating them into site-specific geomorphic assessments.

An erosion threshold is quantified based on the bed and bank materials and local channel geometry, in the form of a critical discharge (Villard & Parish, 2003; TRCA 2012). Theoretically, above this discharge, entrainment and transport of sediment can occur. To determine this discharge, the velocity, *U*, or Shear Stress, τ, is calculated at various depths for a representative cross-section until the average velocity or shear stress slightly exceeds the critical threshold of the bed material. The velocity is determined using Manning's approach, where Manning's n value is visually estimated through a method described by Acrement and Schneider (1989) or calculated using the Limerino (1970) approach. A Manning's *n* value of 0.045 was used for the assessment, based on the physical characteristics of the subject reach. The velocity is mathematically represented as:

$$U = \frac{1}{n} d^{2/3} S^{1/2} \qquad \text{[Eq. 1.]}$$

where, *d* is depth of water, *S* is channel slope, and *n* is the Manning's roughness.

The shear stress is determined using the depth-slope product, which can be applied to the bed of open channels containing fluid undergoing steady flows. The shear stress is mathematically represented as:

$$\tau_0 = d\rho g S_{bed} \qquad \text{[Eq. 2.]}$$

Where, $\tau_0$ is shear stress, *d* is the water depth, *ρ* is water density, *g* is acceleration due to gravity, and $S_{bed}$ is the channel bed slope.

Because only 75% of bed shear stress applies to channel banks in uniform cross sections (Chow, 1959), the erosion threshold is scaled appropriately for these materials.

## 4.2 Results

**Reach GB2**, located along the tributary to Ganatsekiagon Creek, will receive direct discharge from SWM Pond 25. Based on results from the detailed assessment, bank materials were identified as fairly compact lean clays containing sand and silt. A critical shear stress of 7.18 $N/m^2$ was determined for bank materials, based on the fairly compact lean clay criteria defined by Chow (1959). This yielded a critical discharge for the banks of 0.222 $m^3/s$. Bed materials comprised a range of silt to cobbles, with the dominant material characterized as sandy loam. The critical velocity of 0.53 m/s for sandy loam (Fischenich, 2001) was adopted, yielding a crucial discharge of 0.283 $m^3/s$ for bed materials. As the smaller of the two values, the critical discharge of 0.222 $m^3/s$ for bank materials was adopted as the erosion threshold for **Reach GB2**.

**Reach G6** was determined as the most erosion-sensitive reach within the main branch of Ganatsekiagon Creek downstream of its confluence with the tributary. The dominant bed material was characterized as fine sand to cobbles, with a corresponding critical velocity of 0.47 m/s for the median grain size (Komar, 1987). Based on the critical velocity of 0.47 m/s, the critical discharge for bed materials within **G6** was determined to be 0.380 $m^3/s$. Bank materials were characterized as fairly compact clay, with a corresponding critical shear stress of 8 $N/m^2$. This resulted in a critical discharge for bank materials of

0.270 $m^3/s$. As the limiting factor, the critical discharge for bank materials was adopted as the erosion threshold for **G6**.

Channel parameters and results from the erosion threshold analysis are summarised below in **Table 3**.

### Table 3. Channel parameters and erosion threshold results for Reaches GB2 and G6.

| Channel parameter | GB2 | | G6 GEO Morphix (2015) | |
|---|---|---|---|---|
| **Average bankfull channel width (m)** | 3.01 | | 4.59 | |
| **Average bankfull channel depth (m)** | 0.32 | | 0.52 | |
| **Channel gradient (%)** | 0.49 | | 0.68 | |
| **Sinuosity** | 1.31 | | 1.06 | |
| **$D_{50}$ (mm)** | 0.34 | | 6.60 | |
| **$D_{84}$ (mm)** | 4.75 | | 61.40 | |
| **Manning's n roughness coefficient** | 0.045 | | 0.050 | |
| **Drainage Area (ha)*** | 268.4 | | 704.8 | |
| **Bankfull discharge ($m^3/s$)**** | 0.72 | | 2.56 | |
| **Average bankfull velocity (m/s)**** | 0.73 | | 1.07 | |
| **Erosion Threshold** | **Bed** | **Banks** | **Bed** | **Banks** |
| **Material** | Sandy loam | Fairly compact lean clay | Fine sand to cobbles | Fairly compact clay |
| **Reference** | Fischenich (2001) | Chow (1959) | Komar (1987) $D_{50}$ | Chow (1959) |
| **Critical velocity (m/s)** | 0.53 | - | 0.47 | - |
| **Critical Shear Stress ($N/m^2$)** | - | 7.18 | - | 8.00 |
| **Apparent bed shear stress ($N/m^2$)** | 10.93 | - | 13.50 | - |
| **Apparent velocity (m/s)** | - | 0.38 | - | 0.41 |
| **Critical discharge ($m^3/s$)** | 0.283 | 0.222 | 0.380 | 0.270 |
| **Unitary erosion threshold ($m^3/s/ha$)** | 0.0011 | 0.00083 | 0.00054 | 0.00038 |
| **Limiting erosion threshold ($m^3/s$)** | **0.222** | | **0.270** | |
| **Limiting unitary threshold ($m^3/s/ha$)** | **0.00083** | | **0.00038** | |

*Drainage area determined using the Ontario Watershed Information Tool (OWIT)
**Based on Manning's equation

## 5 Summary

An erosion threshold assessment was conducted in support of future development within the TACCGATE Parcel 24 lands located south of Alexander Knox Road and north of Ganatsekiagon Creek. One stormwater management facility is proposed to discharge east of the subject lands to **Reach GB2**, a tributary to Ganatsekiagon Creek. The tributary ultimately flows to the main branch of Ganatsekiagon Creek, at its confluence with **G7**. Field assessments of the receiving reaches of Ganatsekiagon Creek and its tributary were previously completed in 2015 and 2016, and an erosion threshold of 0.270 $m^3/s$ was defined for the erosion-sensitive **Reach G6** as part of the *Identification of Potential Outfall Locations and Support in Identification of Erosion Concerns Associated with SWM Facilities Report* (GEO Morphix Ltd., 2015). As **Reach GB2** will be receiving direct discharge from Pond 25, an erosion threshold assessment was completed for the reach based on results from the detailed assessment completed in

2015. A critical discharge of 0.222 $m^3/s$ was determined for **Reach GB2**, corresponding to a unitary critical discharge of 0.00083 $m^3/s/ha$.

We note that the contributing area from the subject lands is 5.39 ha, accounting for approximately 2.0% of the total drainage area to **Reach GB2** (268 ha) indicating that the total runoff contributions from the subject lands will be minor relative to the total catchment runoff to both reaches, and that given appropriate SWM controls any impacts on erosion processes within the watercourse can be expected to be minor.

We trust this report meets your requirements. Should you have any questions, please contact the undersigned.

Respectfully submitted,

Paul Villard, Ph.D., P.Geo., CISEC-CAN, EP, CERP
Director, Principal Geomorphologist

Jan Franssen, Ph.D
Senior Watershed Scientist, Technical Lead

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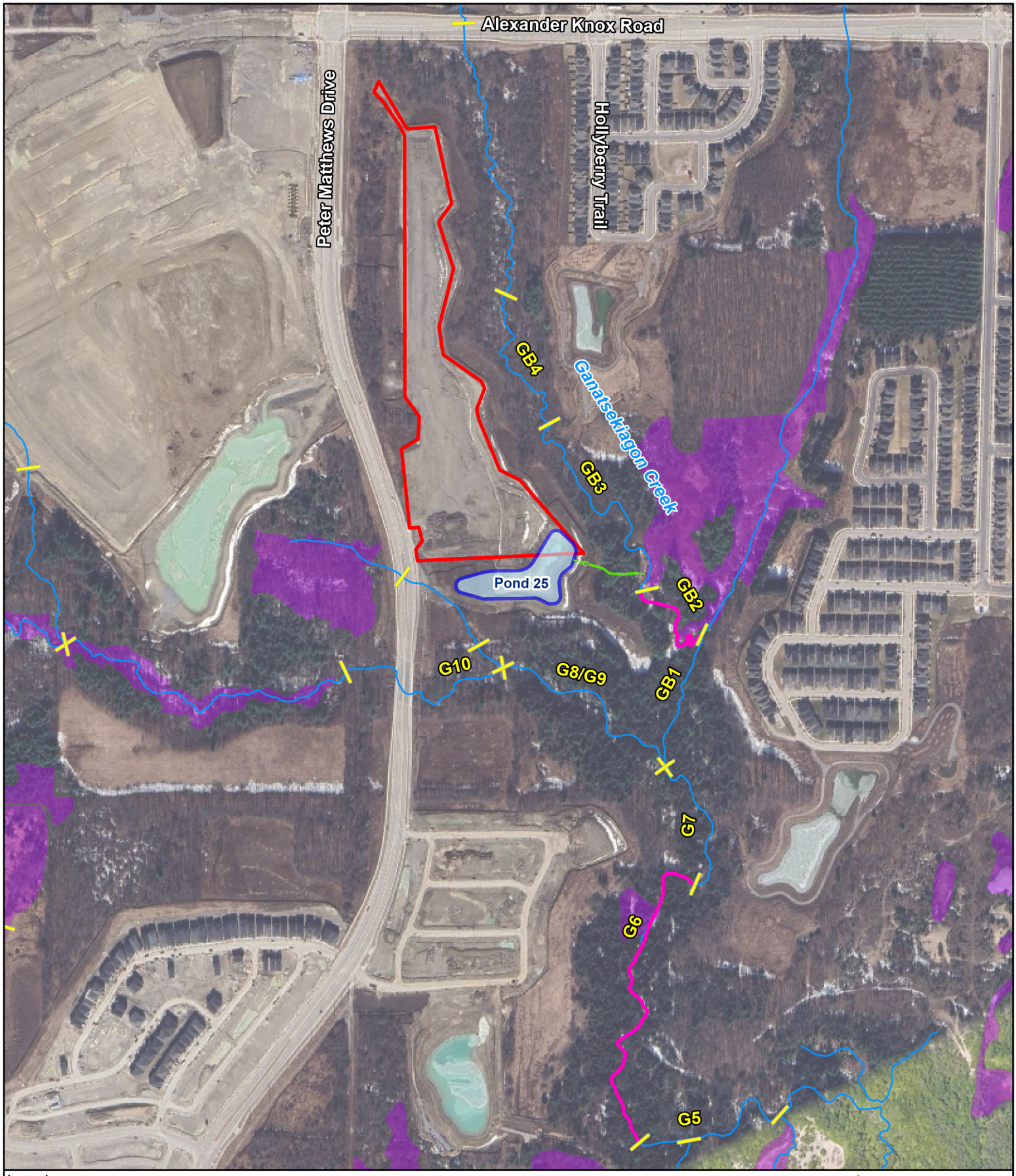
# Appendix A:
# Figures




**Legend**

- Reach Break and ID
- Watercourse
- Detailed Assessment
- Outlet Location
- Approximate Study Area
- SWMP Location
- Not evaluated Wetland

# Study Area

## Ganastekiagon Creek

Pickering, Ontario

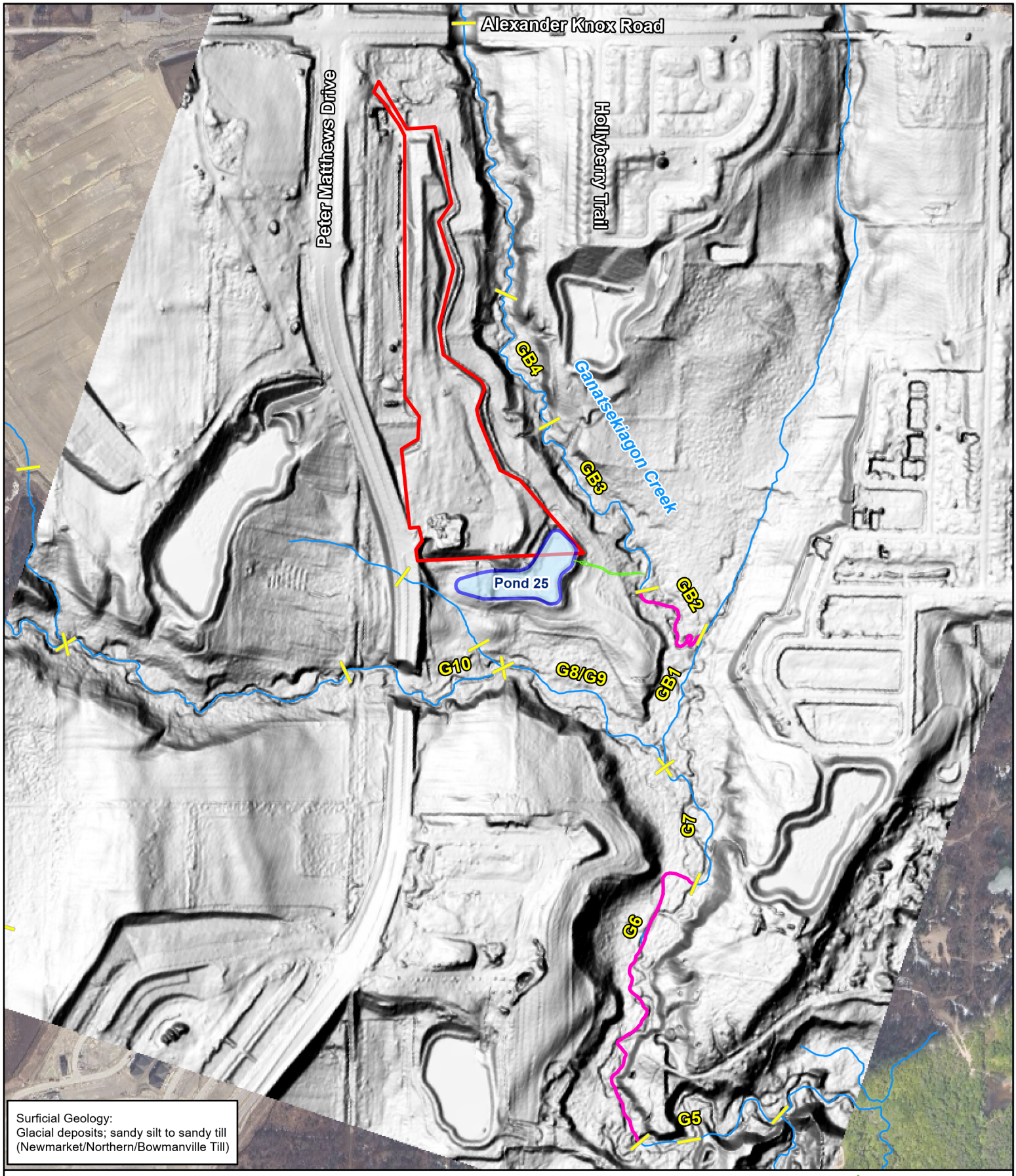
GEO MORPHIX™

N

0 75 150

Metres

Imagery: Google Earth Pro, 2023. Wetland, Watercourse: MNFR,2020-2024. Reach Break, Approximate Study Area: GEO Morphix Ltd., 2016/2025. SWMP and Outlet Location: SMD Consultant, 2024. 1 m Contour: Region of Waterloo, 2021. Print Date: August 2025. PN24118. Drawn By: L.D., G.U.




**Legend**

- Reach Break and ID
- Watercourse
- Detailed Assessment
- Outlet Location
- Approximate Study Area
- SWMP Location

# Study Area - Hillshade

Ganastekiagon Creek

Pickering, Ontario

GEO MORPHIX™

N

0 75 150

Metres

Imagery: Google Earth Pro, 2023. Hillshade: MNRF, 2023. Watercourse: MNFR,2020-2024. Reach Break, Approximate Study Area: GEO Morphix Ltd., 2016/2025. SWMP and Outlet Location: SMD Consultant, 2024. 1 m Contour: Region of Waterloo, 2021. Print Date: August 2025. PN24118. Drawn By: L.D., G.U.

# Appendix B:
# Site Photographs

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|---|---|
| **Photo 1**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G5** |  |
| | Photo taken facing upstream. **Reach G5** was characterized as partially confined, with a riparian zone consisting of a continuous coverage of mature trees. |
| **Photo 2**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G5** |  |
| | Photo taken facing downstream. Woody debris jams were common throughout the reach, resulting in accumulation and deposition of sand and gravel. |

| | |
|---|---|
| **Photo 3**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G5** |  |
| Photo taken facing downstream. An occurrence of valley wall contact was identified in **Reach G5**. | |
| **Photo 4**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G5** |  |
| Photo taken facing downstream. Bed substrate ranged from sand to cobbles and small boulders. | |

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| **Photo 5**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G6** |  |
| | Photo taken facing upstream. **Reach G6** flowed through a partially confined valley, with a wide and continuous riparian zone consisting of mature trees. |
| **Photo 6**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G6** |  |
| | Photo taken facing upstream. Debris jams were common throughout the reach, resulting in deposits of sand and gravel. |

| | |
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| **Photo 7**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G6** |  |
| Photo taken facing upstream. Bed substrate consisted of sand, gravel and cobbles. | |
| **Photo 8**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G6** |  |
| Photo take facing the left bank. Undercutting was identified along the banks, and exposed roots were present throughout. | |

| | |
|---|---|
| **Photo 9**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G7** |  |
| | Photo taken facing downstream. **Reach G7** flowed through an unconfined valley with a wide, continuous riparian zone of mature trees. |
| **Photo 10**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G7** |  |
| | Photo taken facing the right bank. Large woody debris was found in moderate densities throughout the reach. |

| | |
|---|---|
| **Photo 11**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G7** |  |
| | Photo taken facing the left bank. Undercutting of up to 40 cm was observed along 30-60% of the banks. |
| **Photo 12**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach G7** |  |
| | Photo taken facing downstream. Sand, gravel and cobble deposits were commonly observed along the bed. |

| | |
|---|---|
| **Photo 13**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach GB2** |  |
| | Photo taken facing downstream. Reach GB2 was a moderately entrenched flowing through a partially confined valley with a continuous riparian zone consisting of mature trees. |
| **Photo 14**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach GB2** |  |
| | Photo taken facing upstream. Undercutting was prevalent within **Reach GB2**, observed along 60-100% of the banks. Bank angles were steep along the outside of meander bends. |

| | |
|---|---|
| **Photo 15**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach GB2** |  |
| | Photo taken facing downstream. Leaning/fallen trees and woody debris were observed throughout **Reach GB2**. |
| **Photo 16**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach GB2** |  |
| | Photo taken facing downstream. Watercress was present within the stream at several locations through GB2. |

| | |
|---|---|
| **Photo 17**<br>Seaton Parcel 24, TACC Developments, Pickering, Ontario<br>**Reach GB2** |  |
| | Bank substrate consisted primarily of fairly compact lean clay, while bed materials were composed of sandy loam underlying sand and gravel deposits. |

# Appendix C:
# Field Sheets

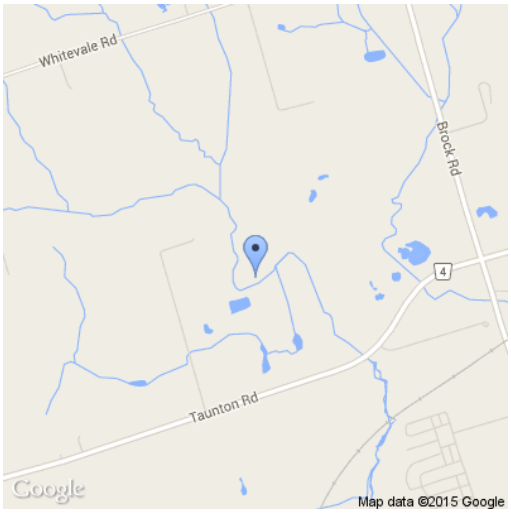
GEO Morphix Ltd.
348 Bronte Street South, Unit 2
Milton, Ontario L9T 5B6
T 416.920.0926
e balance@geomorphix.com

**Project Number:** PN15048

## Reach Characteristics

| | | | |
|---|---|---|---|
| Date: | 2015-08-05 | Reach: | G5 |
| Field Staff: | JK/ER | Watercourse: | Ganatsekegion Creek |
| Weather: | sunny and 25°C | Watershed: | Ganatsekegion Creek |

## Location




lat=43.88621811343929, long=-79.10636732267828, alt=132.53258481668647, accuracy=24.0

## General Characteristics

| | |
|---|---|
| **Land Use:** | Forest |
| **Valley Type:** | Partially Confined |
| **Channel Type:** | 8 - Sinuous mixed load |
| **Flow Type:** | Perennial |
| **Groundwater:** | yes<br>iron staining |

## Riparian Vegetation

| | |
|---|---|
| **Dominant Vegetation Type:** | Trees |
| **Dominant Species:** | Cedar forest/unknown |

| | |
|---|---|
| **Riparian Coverage:** | Continuous |
| **Width of Riparian Zone:** | > 10 Channel Widths |
| **Riparian Age Class:** | Mature (>30 years) |
| **Extent of Encroachment into channel:** | None |

## Aquatic/Instream Vegetation

| | |
|---|---|
| **Type of Instream Vegetation:** | Attached Algae |
| **Coverage of Reach (%):** | 1 |
| **Presence of Woody Debris:** | Present in Cutbank,Present in Channel |
| **Density of Woody Debris:** | Moderate |
| **Number of WDJs per 50 m:** | 1 |
| **Notes:** | Woody debris jams are large and causing sediment build up (gravel, cobble, sand) |

## Channel Characteristics

| | |
|---|---|
| **Type of Sinuosity:** | Irregular Meanders |
| **Degree of Sinuosity:** | Meandering (1.31 - 3.0) |
| **Gradient:** | Moderate |
| **Number of Channels:** | Single |
| **Entrenchment:** | Low (>2.2) |
| **Bank Failures (Brierley and Fryirs, 2005):** | Fall/Sloughing (Mass Failure) |
| **Downs Model of Channel Evolution (1995):** | Compound - aggradation of channel bed with erosion of channel banks |
| **Riffle Substrate:** | Gravel,Cobble,Boulder |
| **Pool Substrate:** | Sand,Gravel,Cobble |
| **Bank Material:** | Clay,Sand |
| **Bank Angle:** | 60 - 90 |
| **Extent of Bank Erosion:** | 60 - 100% |
| **Notes:** | VWC approx 15m wide, 15-20m high, another 15x4<br>Sand and gravel deposits on overbank and bars |

## Channel Measurements

### Cross Section #1: Run

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 5.8 | **Wetted Width (m):** | 4.15 |
| **Bankfull Depth (m):** | 0.87 | **Wetted Depth (m):** | 0.14 |
| **Velocity (m/s):** | 0.11 | **Measurement Type:** | Wiffle Ball |

### Cross Section #2: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 4.5 | **Wetted Width (m):** | 3.4 |
| **Bankfull Depth (m):** | 1.12 | **Wetted Depth (m):** | 0.52 |
| **Velocity (m/s):** | N/A | **Measurement Type:** | No flow |

### Cross Section #3: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 7.2 | **Wetted Width (m):** | 3.7 |
| **Bankfull Depth (m):** | 0.58 | **Wetted Depth (m):** | 0.29 |
| **Velocity (m/s):** | N/A | **Measurement Type:** | No flow |

### Additional Measurements

| | |
|---|---|
| **Riffle-pool Spacing (m):** | 8 |
| **% Riffles:** | 50 |
| **% Pools:** | 50 |
| **Meander Amplitude (m):** | 25.3 |
| **Pool Depth (m):** | 0.315, 0.52, 0.6 |
| **Riffle Length (m):** | 3-5 |
| **Undercuts (m):** | N/A |

**Notes:** Water flowing through riffles, stagnant in pools

## Water Quality

| | |
|---|---|
| **Odour:** | None |
| **Turbidity:** | Clear |

GEO Morphix Ltd.
348 Bronte Street South, Unit 2
Milton, Ontario L9T 5B6
T 416.920.0926
e balance@geomorphix.com

**Project Number:** PN15048

## Reach Characteristics

| | | | |
|---|---|---|---|
| Date: | 2015-08-05 | Reach: | G6 |
| Field Staff: | JK / ER | Watercourse: | Ganatsekegion Creek |
| Weather: | sunny and 25°C | Watershed: | Ganatsekegion Creek |

## Location


lat=43.88560120643035, long=-79.10740028757195, alt=107.02091551024549, accuracy=48.0

## General Characteristics

| | |
|---|---|
| **Land Use:** | Forest |
| **Valley Type:** | Partially Confined |
| **Channel Type:** | 9 - Meandering mixed load |
| **Flow Type:** | Perennial |
| **Groundwater:** | yes<br>iron staining |
| **Notes:** | VWC 8x10m |

## Riparian Vegetation

| | |
|---|---|
| **Dominant Vegetation Type:** | Trees |
| **Dominant Species:** | Unknown |
| **Riparian Coverage:** | Continuous |
| **Width of Riparian Zone:** | > 10 Channel Widths |
| **Riparian Age Class:** | Mature (>30 years) |
| **Extent of Encroachment into channel:** | None |

## Aquatic/Instream Vegetation

| | |
|---|---|
| **Type of Instream Vegetation:** | None |
| **Coverage of Reach (%):** | 0 |
| **Presence of Woody Debris:** | Present in Cutbank,Present in Channel |
| **Density of Woody Debris:** | Moderate |
| **Number of WDJs per 50 m:** | 2 |

## Channel Characteristics

| | |
|---|---|
| **Type of Sinuosity:** | Irregular Meanders |
| **Degree of Sinuosity:** | Meandering (1.31 - 3.0) |
| **Gradient:** | Moderate |
| **Number of Channels:** | Single |
| **Entrenchment:** | Low (>2.2) |
| **Bank Failures (Brierley and Fryirs, 2005):** | Fall/Sloughing (Mass Failure) |
| **Downs Model of Channel Evolution (1995):** | Compound - aggradation of channel bed with erosion of channel banks |
| **Riffle Substrate:** | Gravel,Cobble |
| **Pool Substrate:** | Silt,Sand,Gravel,Cobble |
| **Bank Material:** | Silt,Sand |
| **Bank Angle:** | 60 - 90 |
| **Extent of Bank Erosion:** | 60 - 100% |
| **Notes:** | cutoff channels common flow being redirected around debris jams, deposition of sand gravel and cobble common in these areas |

## Channel Measurements

### Cross Section #1: Riffle

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 6.8 | **Wetted Width (m):** | 3.45 |
| **Bankfull Depth (m):** | 0.58 | **Wetted Depth (m):** | 0.055 |
| **Velocity (m/s):** | 0.34 | **Measurement Type:** | Wiffle ball |

### Cross Section #2: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 6 | **Wetted Width (m):** | 3.3 |
| **Bankfull Depth (m):** | 0.85 | **Wetted Depth (m):** | 0.28 |
| **Velocity (m/s):** | 0.06 | **Measurement Type:** | Wiffle Ball |

### Cross Section #3: Run

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 2.9 | **Wetted Width (m):** | 1.9 |
| **Bankfull Depth (m):** | 0.6 | **Wetted Depth (m):** | 0.105 |
| **Velocity (m/s):** | 0.09 | **Measurement Type:** | Wiffle Ball |

### Cross Section #4: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 4.9 | **Wetted Width (m):** | 3.65 |
| **Bankfull Depth (m):** | 0.8 | **Wetted Depth (m):** | 0.32 |
| **Velocity (m/s):** | N/A | **Measurement Type:** | No flow |

### Additional Measurements

| | |
|---|---|
| **Riffle-pool Spacing (m):** | 15 |
| **% Riffles:** | 50 |
| **% Pools:** | 50 |
| **Meander Amplitude (m):** | N/A |
| **Pool Depth (m):** | 0.32 |
| **Riffle Length (m):** | 3-5 |
| **Undercuts (m):** | N/A |

## Water Quality

| | |
|---|---|
| **Odour:** | None |
| **Turbidity:** | Clear |

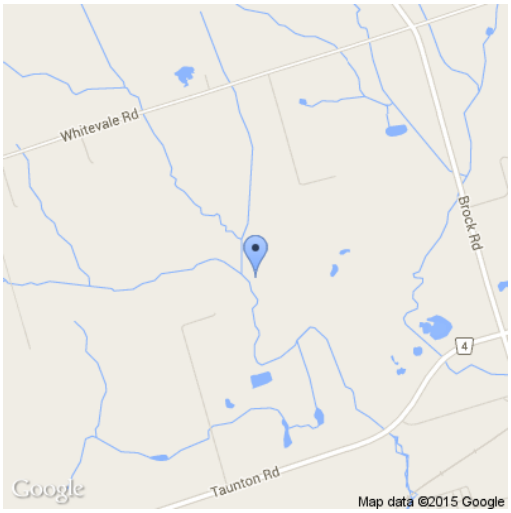
GEO Morphix Ltd.
348 Bronte Street South, Unit 2
Milton, Ontario L9T 5B6
T 416.920.0926
e balance@geomorphix.com

**Project Number:** PN15048

## Reach Characteristics

| | | | |
|---|---|---|---|
| Date: | 2015-08-07 | Reach: | G7 |
| Field Staff: | JK/ER | Watercourse: | Ganatsekiagon Creek |
| Weather: | 25 degrees sunny | Watershed: | Ganatsekiagon |

## Location




lat=43.88983066388575, long=-79.10778980953006, alt=120.13139547309393, accuracy=12.0

## General Characteristics

| | |
|---|---|
| **Land Use:** | Forest |
| **Valley Type:** | Unconfined |
| **Channel Type:** | 9 - Meandering mixed load |
| **Flow Type:** | Perennial |
| **Groundwater:** | yes<br>iron staining, small seep |

## Riparian Vegetation

| | |
|---|---|
| **Dominant Vegetation Type:** | Trees |
| **Dominant Species:** | Unknown |

| | |
|---|---|
| **Riparian Coverage:** | Continuous |
| **Width of Riparian Zone:** | > 10 Channel Widths |
| **Riparian Age Class:** | Mature (>30 years) |
| **Extent of Encroachment into channel:** | None |

## Aquatic/Instream Vegetation

| | |
|---|---|
| **Type of Instream Vegetation:** | Attached Algae |
| **Coverage of Reach (%):** | 20 |
| **Presence of Woody Debris:** | Present in Cutbank,Present in Channel |
| **Density of Woody Debris:** | Moderate |
| **Number of WDJs per 50 m:** | 2 |

## Channel Characteristics

| | |
|---|---|
| **Type of Sinuosity:** | Irregular Meanders |
| **Degree of Sinuosity:** | Meandering (1.31 - 3.0) |
| **Gradient:** | Moderate |
| **Number of Channels:** | Single |
| **Entrenchment:** | Low (>2.2) |
| **Bank Failures (Brierley and Fryirs, 2005):** | Undercutting (Hydraulic Action) |
| **Downs Model of Channel Evolution (1995):** | Undercutting - active bed and outer bank erosion |
| **Riffle Substrate:** | Sand,Gravel,Cobble,Boulder |
| **Pool Substrate:** | Sand,Gravel,Cobble |
| **Bank Material:** | Clay,Sand |
| **Bank Angle:** | 60 - 90,Undercut |
| **Extent of Bank Erosion:** | 30 - 60% |
| **Notes:** | sand gravel and cobble deposition common on bed<br>gravel and cobble deposition on bars |

## Channel Measurements

### Cross Section #1: Run

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 6.7 | **Wetted Width (m):** | 3.35 |
| **Bankfull Depth (m):** | 0.82 | **Wetted Depth (m):** | 0.12 |
| **Velocity (m/s):** | 0.05 | **Measurement Type:** | Wiffle Ball |

### Cross Section #2: Riffle

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 7.7 | **Wetted Width (m):** | 2.5 |
| **Bankfull Depth (m):** | 0.75 | **Wetted Depth (m):** | 0.03 |
| **Velocity (m/s):** | 0.21 | **Measurement Type:** | Wiffle Ball |

### Cross Section #3: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 6.4 | **Wetted Width (m):** | 4.73 |
| **Bankfull Depth (m):** | 0.75 | **Wetted Depth (m):** | 0.245 |
| **Velocity (m/s):** | N/A | **Measurement Type:** | No flow |

### Cross Section #4: Riffle

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 4.9 | **Wetted Width (m):** | 1.05 |
| **Bankfull Depth (m):** | 0.58 | **Wetted Depth (m):** | 0.065 |
| **Velocity (m/s):** | 0.16 | **Measurement Type:** | Wiffle Ball |

### Cross Section #5: Pool

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 8.9 | **Wetted Width (m):** | 2.55 |
| **Bankfull Depth (m):** | 0.85 | **Wetted Depth (m):** | 0.225 |
| **Velocity (m/s):** | N/A | **Measurement Type:** | No flow |

### Additional Measurements

| | |
|---|---|
| **Riffle-pool Spacing (m):** | 15 |
| **% Riffles:** | 50 |
| **% Pools:** | 50 |
| **Meander Amplitude (m):** | N/a |
| **Pool Depth (m):** | 0.46, 0.225 |
| **Riffle Length (m):** | 1-3 |
| **Undercuts (m):** | 0.20, 0.64, 0.20, 0.75 |

## Water Quality

| | |
|---|---|
| **Odour:** | None |
| **Turbidity:** | Clear |

GEO MORPHIX
Geomorphology Earth Science Observations

## General Site Characteristics

**Project Code:** PN1606

| | | | |
|---|---|---|---|
| **Date:** | 24/11/2016 | **Stream/Reach:** | GB2 ~~GB2~~ |
| **Weather:** | Cloudy ~4°C | **Location:** | Pickering |
| **Field Staff:** | AM, PP | **Watershed/Subwatershed:** | Ganatsekiagon |

**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

)( - chute

**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 |

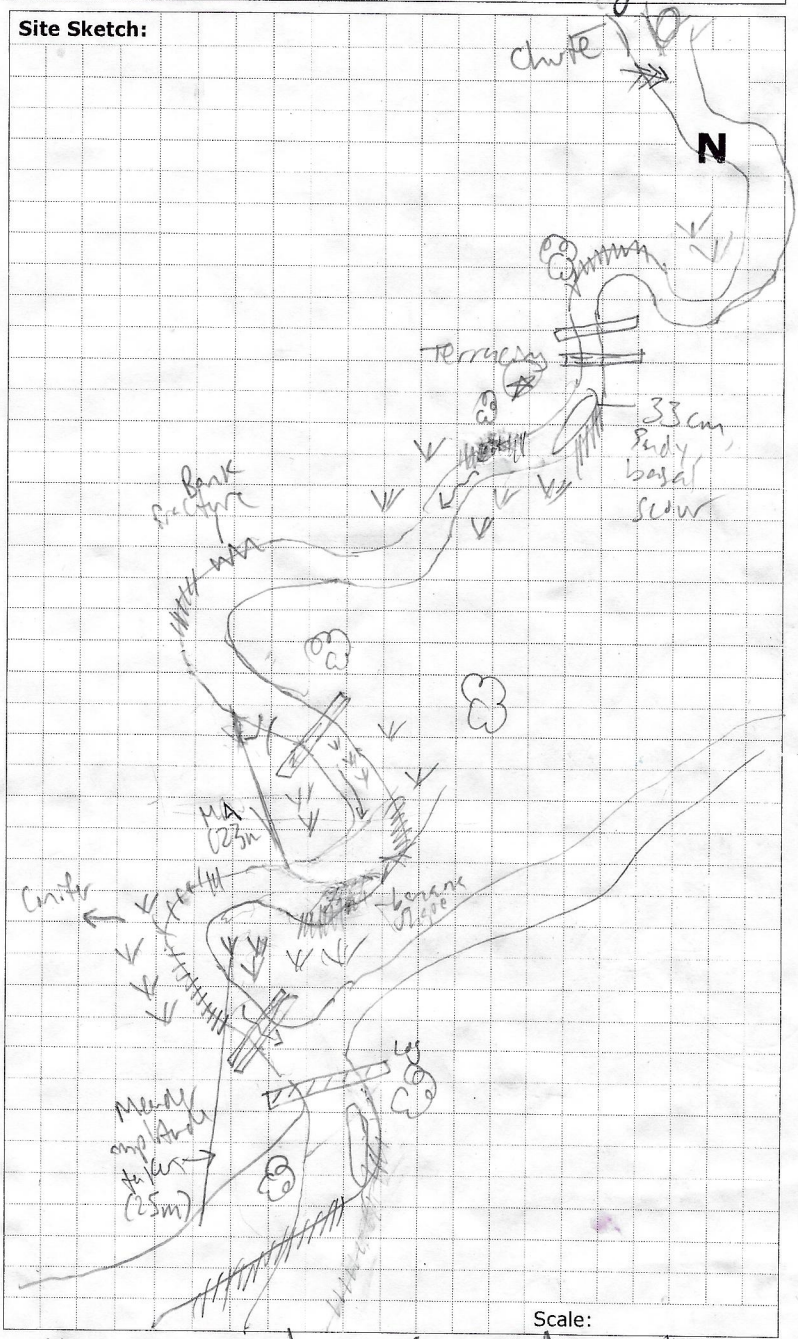
**Substrate**

| | | | |
|---|---|---|---|
| **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: watercress present in-stream

watercress

Completed by: AM Checked by: _____

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Geomorphology Earth Science Observations

## General Site Characteristics

**Project Code:** PN16106

| | | | |
|---|---|---|---|
| **Date:** | 16-23-11 | **Stream/Reach:** | GB-2 cont |
| **Weather:** | Cloudy 4°C | **Location:** | Pickering |
| **Field Staff:** | PP-AM | **Watershed/Subwatershed:** | Gnats Keigon |

**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 |

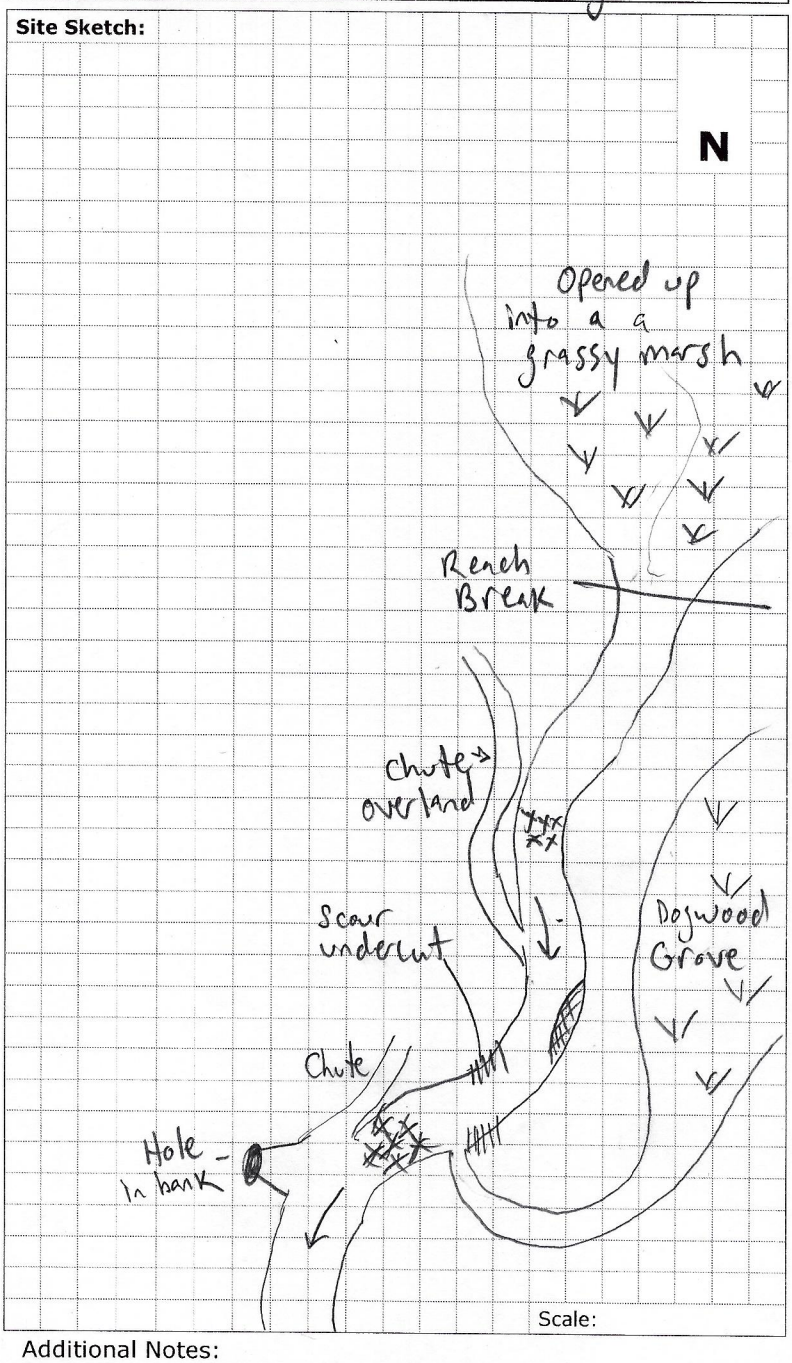
**Substrate**

| | | | |
|---|---|---|---|
| **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: AM Checked by: _____

GEO | MORPHIX

## Rapid Geomorphic Assessment

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-23-11 | **Stream/Reach:** | GB-2 |
| **Weather:** | Drizzle, ~4°C | **Location:** | Pickering |
| **Field Staff:** | AM PP | **Watershed/Subwatershed:** | Ganatsekiagon |

| Process | No. | Geomorphic Indicator: Description | Present? Yes | Present? 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 | | | |
| | 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 | 1/5 |
| | 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 | | 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 | 4 | 0.2 |
| Evidence of Widening (WI) | 1 | Fallen / leaning trees / fence posts / etc. | X | | 3/7 |
| | 2 | Occurrence of large organic debris | X | | |
| | 3 | Exposed tree roots | X | | |
| | 4 | Basal scour on inside meander bends | | X | |
| | 5 | Basal scour on both sides of channel through riffle | | 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. | | N/A | |
| | 9 | Fracture lines along top of bank | | X | |
| | 10 | Exposed building foundation | | N/A | |
| | | Sum of indices = | 3 | 4 | 0.43 |
| 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 = | 2 | 5 | 0.29 |

Additional notes:

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

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

Completed by: AM Checked by: _____

## Rapid Stream Assessment Technique

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-11-24 | **Stream/Reach:** | GB-2 |
| **Weather:** | Drizzle ~4°C | **Location:** | Pickerty |
| **Field Staff:** | AMPP | **Watershed/Subwatershed:** | Ganatsekiagon |

| 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: | 16-11-24 | Reach: | GB-2 | Project Code: | 16106 |
|---|---|---|---|---|---|

| 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) = 24 | Poor (<13) | Fair (13-24) | Good (25-34) | Excellent (>35) |
|---|---|---|---|---|

Completed by: AM Checked by: _____

GEO Morphix Ltd.
348 Bronte Street South, Unit 2
Milton, Ontario L9T 5B6
T 416.920.0926
e balance@geomorphix.com

**Project Number:** PN16106

## Reach Characteristics

| | | | |
|---|---|---|---|
| Date: | 2016-11-24 | Reach: | GB2 |
| Field Staff: | PP AM | Watercourse: | Ganatsekiagon Creek |
| Weather: | Rain 1°C | Watershed: | Ganatsekiagon Creek |

## Location


lat=43.89192891756497, long=-79.10872024247819, alt=111.14798429051129, accuracy=16.0

## General Characteristics

| | |
|---|---|
| **Land Use:** | Forest |
| **Valley Type:** | Partially Confined |
| **Channel Type:** | 13 - Meandering suspended load |
| **Flow Type:** | Perennial |
| **Groundwater:** | yes<br>Iron staining, watercress |
| **Notes:** | At upstream end Reach opens up to wetland area with multiple flow paths. Numerous tributaries draining into GB2 |

## Riparian Vegetation

| | |
|---|---|
| **Dominant Vegetation Type:** | Trees |
| **Dominant Species:** | Cedar |
| **Riparian Coverage:** | Continuous |
| **Width of Riparian Zone:** | > 10 Channel Widths |
| **Riparian Age Class:** | Mature (>30 years) |
| **Extent of Encroachment into channel:** | None |
| **Notes:** | |

## Aquatic/Instream Vegetation

| | |
|---|---|
| **Type of Instream Vegetation:** | Rooted Emergent |
| **Coverage of Reach (%):** | |
| **Presence of Woody Debris:** | Present in Cutbank,Present in Channel |
| **Density of Woody Debris:** | High |
| **Number of WDJs per 50 m:** | 5+ |
| **Notes:** | Watercress present |

## Channel Characteristics

| | |
|---|---|
| **Type of Sinuosity:** | Irregular Meanders |
| **Degree of Sinuosity:** | Meandering (1.31 - 3.0) |
| **Gradient:** | Low |
| **Number of Channels:** | Single |
| **Entrenchment:** | Moderate (1.4 - 2.2) |
| **Bank Failures (Brierley and Fryirs, 2005):** | Undercutting (Hydraulic Action) |
| **Downs Model of Channel Evolution (1995):** | E - Enlarging - Consistent increase in channel width/depth |
| **Riffle Substrate:** | Gravel,Cobble |
| **Pool Substrate:** | Sand,Gravel |
| **Bank Material:** | Silt,Sand |
| **Bank Angle:** | 30 - 60,60 - 90 |
| **Extent of Bank Erosion:** | 60 - 100% |

**Notes:**

## Channel Measurements

### Cross Section #1:

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 3.4 | **Wetted Width (m):** | 1.15 |
| **Bankfull Depth (m):** | 0.62, 0.41, 0.49 | **Wetted Depth (m):** | 0.12, 0.15, 0.11 |
| **Velocity (m/s):** | | **Measurement Type:** | |

### Cross Section #1:

| | | | |
|---|---|---|---|
| **Bankfull Width (m):** | 6.4 | **Wetted Width (m):** | 0.56 |
| **Bankfull Depth (m):** | 0.35, 0.51, 0.48 | **Wetted Depth (m):** | 0.09, 0.11, .06 |
| **Velocity (m/s):** | | **Measurement Type:** | |

### Additional Measurements

| | |
|---|---|
| **Is riffle-pool development absent?** | no |
| **Riffle-pool Spacing (m):** | |
| **% Riffles:** | |
| **% Pools:** | |
| **Meander Amplitude (m):** | 23.3, 25 |
| **Pool Depth (m):** | 0.33 |
| **Riffle Length (m):** | |
| **Undercuts (m):** | .30 |

**Notes:**

## Water Quality

| | |
|---|---|
| **Odour:** | None |
| **Turbidity:** | Clear |
| **Notes:** | |

## General Site Characteristics

**Project Code/Phase:** PN15089

| | | | |
|---|---|---|---|
| Date: | Nov 18, 2015 | Stream/Reach: | G6 |
| Weather: | 10°C, overcast | Location: | Pickering |
| Field Staff: | CH/ER | Watershed/Subwatershed: | Ganatsekiagan |

**Features**

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Island/bar
- Eroded bank
- Undercut bank
- XXXXXX Rip rap/stabilization
- Instream log/tree
- Fence
- Culvert
- Swamp
- Grasses
- Tree

**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 |

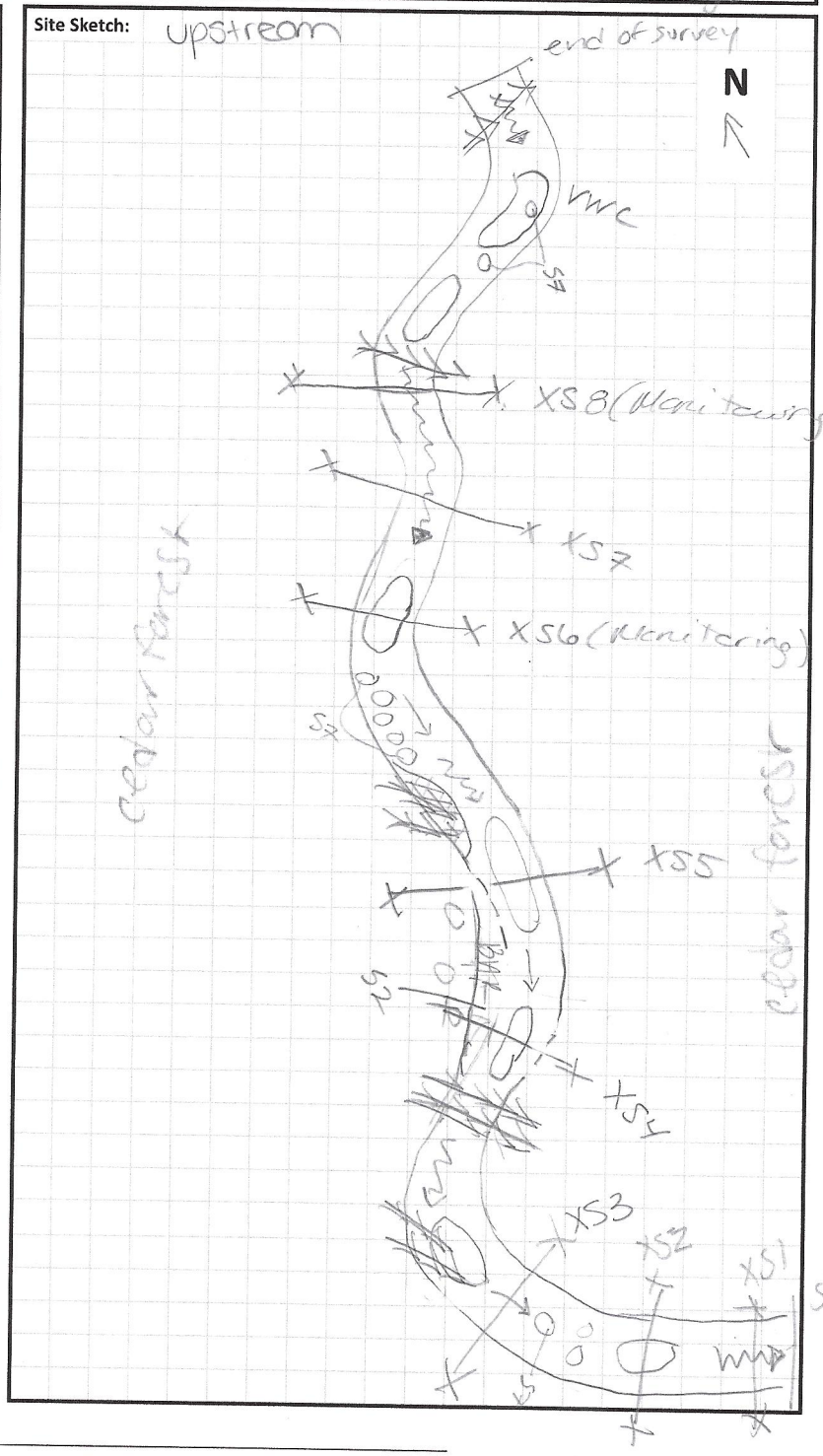
**Substrate**

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

**Other**

| | | | |
|---|---|---|---|
| BM | Benchmark | TR | Terrace |
| FC | Flood chute | BOS | Bottom of slope |
| FP | Floodplain | TOS | Top of slope |
| GC | Grade control | VWC | Valley wall contact |
| KP | Knick point | WDJ | Woody debris jam |

**Site Sketch:**




Additional notes:

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Completed by: ER Checked by: _____

## Detailed Assessment (Level)

Date: Nov 18, 2015 Recorder/Crew: CHJER

Weather: 10°C, sunny Weather in last 24 hrs: Sun, 10°C

Sub-Reach: G6 Subwatershed: Canatsekiggon creek

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| Top | Middle | Bottom | Angle | Water | XS | Survey Notes |
|---|---|---|---|---|---|---|
| 3183 | 3015 | 2866 | 156 | 2905 | | |
| 3145 | 2998 | 2848 | 155 | 2900 | 1 | |
| *2475 | 2330 | 2185 | 152 | X | LB | |
| 2755 | 2595 | 2435 | 161.5 | X | RB | |
| 3083 | 2940 | 2797 | 155 | 2908 | | |
| 3022 | 2891 | 2760 | 157 | 2833 | | Top of riffle |
| 3115 | 2988 | 2861 | 159.5 | 2831 | | |
| 3151 | 3031 | 2925 | 161 | 2816 | | |
| 3261 | 3150 | 3039 | 163 | 2829 | 2 | mid pool |
| 2555 | 2445 | 2335 | 154 | X | LB | |
| 2490 | 2375 | 2255 | 168 | X | RB * | |
| 3243 | 3137 | 3032 | 165 | 2842 | | log |
| 2999 | 2899 | 2799 | 163.5 | 2805 | | u/s of log |
| 3049 | 2959 | 2871 | 161 | 2802 | | |
| 2998 | 2918 | 2840 | 160 | 2809 | | |
| 3037 | 2969 | 2900 | 162.5 | 2803 | 3 | |
| 2340 | 2275 | 2209 | 152 | X | LB | |
| 2132 | 2059 | 1985 | 174 | X | RB | |
| 3130 | 3072 | 3014 | 163.5 | 2818 | | |
| 3049 | 3004 | 2960 | 168 | 2815 | | mid pool |
| 3002 | 2966 | 2931 | 166 | 2812 | | |
| 3028 | 2999 | 2967 | 153 | 2822 | | |
| 3031 | 3002 | 2975 | 139.5 | 2817 | | |
| 2966 | 2935 | 2904 | 121.5 | 2832 | | both riffle |
| 2892 | 2861 | 2830 | 112 | 2800 | | |
| 2836 | 2805 | 2772 | 102 | 2740 | | top riffle |
| 2856 | 2824 | 2790 | 90 | 2727 | | |
| 2916 | 2878 | 2841 | 77.5 | 2735 | | |
| 2512 | 2389 | 2268 | 42 | X | FS | TP |
| 2279 | 2208 | 2137 | 210.5 | X | BS | TP ~3m from previous |
| 2912 | 2762 | 2612 | 210 | 2520 | | woody |
| 2703 | 2565 | 2427 | 210 | 2395 | | debris |
| 2687 | 2552 | 2417 | 209 | 2368 | | |
| 2669 | 2555 | 2441 | 207 | 2398 | | |
| 2942 | 2830 | 2725 | 206 | 2382 | | |
| 2762 | 2666 | 2571 | 206 | 2403 | 4 | |
| 2055 | 1965 | 1875 | 199 | X | LB | |
| 1943 | 1847 | 1751 | 215.5 | X | RB | |
| 2650 | 2570 | 2490 | 203 | 2384 | | |
| 2626 | 2554 | 2481 | 204 | 2380 | | |
| 2612 | 2550 | 2485 | 206 | 2385 | | |
| 2736 | 2680 | 2632 | 213 | 2398 | | |
| 2847 | 2802 | 2745 | 218 | 2394 | 5 | |
| 1974* | 1931* | 1890 | 208 | X | LB * | |
| 1526 | 1474 | 1424 | 228 | X | RB | |
| 2822 | 2785 | 2749 | 224.5 | 2385 | | |
| 2612 | 2584 | 2555 | 231 | 2392 | | |

## Detailed Assessment (Level)

Date: NOV 18, 2015 Recorder/Crew: CH/ER

Weather: 10°C, sunny Weather in last 24 hrs: SUN 10°C

Sub-Reach: GL6 Subwatershed: Ganatsekiagon

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| Top | Middle | Bottom | Angle | Water | XS | Survey Notes |
|---|---|---|---|---|---|---|
| 2496 | 2472 | 2450 | 241.5 | 2305 | | |
| 2445 | 2428 | 2413 | 268.5 | 2302 | | |
| 2411 | 2398 | 2384 | 308.5 | 2288 | | T.O. Riffle |
| 2472 | 2453 | 2435 | 341 | 2295 | | |
| 2566 | 2540 | 2512 | 0 | 2278 | | |
| 2644 | 2612 | 2579 | 10.5 | 2300 | 6 | |
| 1814 | 1787 | 1762 | 22 | X | LB | |
| 1689 | 1647 | 1605 | 355.5 | X | RB | |
| 2565 | 2525 | 2493 | 16 | 2274 | | |
| 2490 | 2447 | 2406 | 19 | 2296 | | Bot riffle |
| 2436 | 2393 | 2349 | 25.5 | 2292 | | |
| 2447 | 2400 | 2352 | 34 | 2275 | | |
| 2492 | 2432 | 2375 | 42.5 | 2278 | | |
| 2506 | 2438 | 2372 | 44 | 2285 | 7 | |
| 1519 | 1455 | 1391 | 51 | X | LB | |
| 1652 | 1579 | 1506 | 34 | X | RB | |
| 2459 | 2385 | 2311 | 45.5 | 2294 | | |
| 2441 | 2360 | 2278 | 49.5 | 2235 | | |
| 2386 | 2300 | 2212 | 50.5 | 2212 | 8 | |
| 1780 | 1693 | 1609 | 55 | X | LB | |
| 1779 | 1686 | 1597 | 42 | X | RB | |
| 2338 | 2232 | 2138 | 50 | 2164 | | |
| 1919 | 1808 | 1697 | 51 | X | BS | TP ~2m from previous |
| 2573 | 2489 | 2404 | 230 | X | FS | TP ↓ |
| 2950 | 2861 | 2771 | 234 | 2783 | | |
| 2876 | 2794 | 2712 | 236 | 2745 | | |
| 2933 | 2860 | 2786 | 238.5 | 2712 | | |
| 2882 | 2816 | 2751 | 338.5 | 2700 | | Top of riffle |
| 2875 | 2819 | 2762 | 335 | 2692 | | |
| 3055 | 3005 | 2956 | 228.5 | 2732 | | |
| 3305 | 3262 | 3220 | 222 | 2703 | | mid pool |
| 3204 | 3168 | 3133 | 217 | 2700 | | |
| 3041 | 3008 | 2975 | 192.5 | 2690 | | |
| 3125 | 3089 | 3055 | 175 | 2698 | | |
| 2896 | 2863 | 2832 | 164 | 2692 | | |
| 2870 | 2839 | 2808 | 153 | 2690 | | |
| 2954 | 2924 | 2898 | 141 | 2698 | | |
| 2838 | 2812 | 2786 | 129 | 2696 | | B. Riffle |
| 2738 | 2713 | 2686 | 115.5 | 2602 | | |
| 2687 | 2661 | 2634 | 108 | 2605 | | T. Riffle |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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## Cross-Section Characteristics

**PN:** pn15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS1 G6 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Ganatsekiagon Creek |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1086 | | | 16.7 | 1188 |
| 8.8 | 1078 | | | 17.0 | 1176 |
| 9.1 | 1099 | | | 17.3 | 1194 |
| 9.4 | 1151 | | | 17.6 | 1147 |
| 9.7 | 1143 | | | 17.9 | 1088 |
| 10.0 | 1145 | | | 18.2 | 1102 |
| 10.3 | 1226 | | | 18.5 | 1075 |
| 10.6 | 1355 | BF | | | |
| 10.75 | 1833 | Bed | | | |
| 10.75 | 1810 | WL | | | |
| 11.0 | 1918 | | Depth | Vel | |
| 11.2 | 1940 | | (m) | (m/s) | |
| 11.4 | 1934 | | 0.12 | 0.062 | |
| 11.6 | 1902 | | 0.12 | 0.128 | |
| 11.8 | 1892 | | 0.09 | 0.191 | |
| 12.0 | 1876 | | 0.07 | 0.123 | |
| 12.2 | 1872 | | 0.07 | 0.226 | |
| 12.4 | 1876 | | 0.07 | 0.204 | |
| 12.6 | 1876 | | | | |
| 12.8 | 1852 | | | | |
| 13.1 | 1809 | WE | | | |
| 13.3 | 1776 | | | | |
| 13.5 | 1763 | | | | |
| 13.7 | 1752 | | | | |
| 13.9 | 1761 | | | | |
| 14.1 | 1742 | | | | |
| 14.3 | 1708 | | | | |
| 14.5 | 1646 | | | | |
| 14.7 | 1562 | | | | |
| 14.9 | 1518 | | | | |
| 15.1 | 1479 | | | | |
| 15.3 | 1462 | | | | |
| 15.5 | 1454 | | | | |
| 15.7 | 1414 | | | | |
| 15.9 | 1372 | | | | |
| 16.1 | 1319 | | | | |
| 16.4 | 1262 | | | | |

### Cross-sectional Morphology

☑ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 4.0 | 11. 0.2 | 21. 3.0 | 31. 6.5 |
| 2. 1.0 | 12. 9.0 | 22. 1.0 | 32. 5.5 |
| 3. 2.0 | 13. 7.5 | 23. 0.5 | 33. 7.0 |
| 4. 2.0 | 14. 2.5 | 24. 0.5 | 34. 0.5 |
| 5. 1.0 | 15. 1.5 | 25. 4.5 | 35. 3.5 |
| 6. 1.1 | 16. 2.0 | 26. 3.5 | 36. 1.5 |
| 7. 0.5 | 17. 1.0 | 27. 9.0 | 37. 2.5 |
| 8. 0.5 | 18. 22.0 | 28. 7.0 | 38. 2.5 |
| 9. 1.1 | 19. 3.0 | 29. 4.0 | 39. 0.5 |
| 10. 0.2 | 20. 1.5 | 30. 3.0 | 40. 1.0 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 5 %

Subpavement: gravel

**Sorting:** ☑ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:**

☐ Estimated see m/s
☑ Measured about m/s

**Discharge:**

☐ Estimated _____ m/s
☑ Measured 0.018 m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☑ ADV
☐ Other

Completed by: ER Checked By: _____

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Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** ph15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS2 / G6 |
| **Weather:** | 10°C, overcast | **Location:** | sideline 22 Pickering Gandatsetiagon Crk |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1121 | | 16.2 | 1569 | |
| 8.8 | 1093 | | 16.4 | 1508 | |
| 9.1 | 1145 | | 16.6 | 1446 | |
| 9.4 | 1184 | | 16.8 | 1384 | |
| 9.7 | 1226 | | 17.0 | 1198 | BF * |
| 10.0 | 1297 | | 17.2 | 1162 | |
| 10.3 | 1259 | | 17.5 | 1088 | |
| 10.6 | 1252 | | 17.8 | 1065 | |
| 10.9 | 1279 | | 18.1 | 1048 | |
| 11.1 | 1327 | BF | 18.4 | 1023 | |
| 11.2 | 1558 | | 18.6 | 1015 | |
| 11.4 | 1602 | | | | |
| 11.6 | 1607 | | | | |
| 11.8 | 1582 | | | | |
| 12.0 | 1575 | | | | |
| 12.1 | 1649 | | | | |
| 12.3 | 1686 | | Depth | Vel | |
| 12.55 | 1715 | WE | (m) | (m/s) | |
| 12.8 | 1777 | | | | |
| 13.0 | 1805 | | | | |
| 13.2 | 1809 | | | | |
| 13.4 | 1831 | | | | |
| 13.6 | 1839 | | | | |
| 13.8 | 1903 | | 0.12 | BW | |
| 14.0 | 1923 | | | BW | |
| 14.2 | 1948 | | 0.22 | BW | |
| | 1984 | | | BW | |
| | 2028 | | 0.30 | 0.011 | |
| | 2019 | | 0.30 | 0.077 | |
| 15.0 | 1992 | | 0.27 | 0.119 | |
| 15.2 | 1958 | | 0.23 | 0.094 | |
| 15.4 | 1927 | | 0.20 | 0.083 | |
| 15.6 | 1872 | Bed | | | |
| 15.6 | 1710 | WL | | | |
| 15.6 | 1669 | Bank | | | |
| 15.8 | 1654 | | | | |
| 16.0 | 1612 | | | | |

### Cross-sectional Morphology

☐ Riffle ☑ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Sand | 11. | 4.0 | 21. | 6.2 | 31. | 1.5 |
| 2. | | 12. | 2.0 | 22. | 5.0 | 32. | 1.5 |
| 3. | | 13. | 1.0 | 23. | 3.0 | 33. | 4.5 |
| 4. | | 14. | 3.0 | 24. | 3.5 | 34. | 0.5 |
| 5. | | 15. | 0.2 | 25. | 4.0 | 35. | 0.2 |
| 6. | | 16. | Sand | 26. | 3.0 | 36. | 0.6 |
| 7. | | 17. | | 27. | 1.0 | 37. | 6.2 |
| 8. | | 18. | | 28. | 1.0 | 38. | 0.3 |
| 9. | | 19. | | 29. | 0.5 | 39. | 2.0 |
| 10. | | 20. | | 30. | 1.0 | 40. | 1.0 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 60 %

Subpavement: Sand

**Sorting:** ☐ Well ☐ Moderate ☑ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:**

☐ Estimated see m/s
☑ Measured above m/s

**Discharge:**

☐ Estimated _____ m/s
☑ Measured 0.0223 m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☑ ADV
☐ Other

Completed by: ER Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** pn15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS3 / G6 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Greenstein Crk |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1584 | | 16.3 | 1371 | |
| 8.8 | 1588 | | 16.6 | 1363 | |
| 9.1 | 1571 | | 16.9 | 1312 | |
| | 1566 | | 17.2 | 1305 | |
| | 1533 | | 17.5 | 1300 | |
| 10.0 | 1544 | | 17.8 | 1276 | |
| | 1641 | | | | |
| | 1689 | | | | |
| 10.9 | 1746 | BF | | | |
| 11.1 | 1831 | | | | |
| 11.3 | 2021 | | | | |
| 11.35 | 2125 | WE | | | |
| 11.4 | 2198 | | | | |
| | 2196 | | | | |
| | 2218 | | | | |
| 12.0 | 2246 | | | | |
| | 2259 | | | | |
| | 2311 | | | | |
| | 2351 | | | | |
| | 2345 | | | | |
| 13.0 | 2299 | | | | |
| | 2311 | | | | |
| | 2344 | | | | |
| | 2306 | | | | |
| | 2266 | | | | |
| 14.0 | 2208 | | | | |
| | 2188 | | | | |
| | 2181 | | | | |
| | 2175 | | | | |
| | 2170 | | | | |
| 15.0 | 2165 | | | | |
| 15.1 | 2114 | WE | | | |
| 15.3 | 1807 | | | | |
| 15.5 | 1742 | | | | |
| 15.6 | 1605 | BF | | | |
| 15.8 | 1565 | | | | |
| 16.0 | 1496 | | | | |

### Cross-sectional Morphology

☐ Riffle ☐ Pool ☑ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 99.0 | 11. Sand | 21. Sand | 31. 7.0 |
| 2. 4.5 | 12. | 22. | 32. 5.0 |
| 3. 2.0 | 13. | 23. | 33. 9.0 |
| 4. 3.5 | 14. | 24. | 34. 7.0 |
| 5. 1.0 | 15. | 25. ✓ | 35. 2.0 |
| 6. 1.0 | 16. | 26. 1.0 | 36. 3.0 |
| 7. 2.5 | 17. | 27. 0.5 | 37. 6.0 |
| 8. 3.0 | 18. | 28. 0.2 | 38. 5.5 |
| 9. 0.2 | 19. | 29. 10.0 | 39. 1.5 |
| 10. 0.5 | 20. ✓ | 30. 7.5 | 40. 1.5 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 30 %

Subpavement: sand

**Sorting:** ☐ Well ☐ Moderate ☑ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:** N/M

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Discharge:**

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☐ ADV
☐ Other

Completed by: EP Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** PN15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS4 / GG |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Ganatsekiagon Crk |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1065 | | 16.1 | 1652 | |
| 8.8 | 1086 | | | 1635 | |
| 9.1 | 1100 | | 16.7 | 1614 | |
| | 1172 | | | 1596 | |
| | 1206 | | | 1477 | |
| 10.0 | 1256 | | | 1535 | |
| 10.2 | 1308 | | | 1515 | |
| 10.4 | 1455 | BF* | 18.2 | 1462 | |
| 10.5 | 1672 | | | 1345 | |
| 10.7 | 1813 | | | 1257 | |
| 10.9 | 1938 | | 19.1 | 1207 | |
| 11.1 | 2080 | | | 1192 | |
| 11.25 | 2168 | WE | | 1196 | |
| 11.3 | 2311 | | 20.0 | 1203 | |
| 11.5 | 2395 | | | | |
| | 2449 | | | | |
| 11.9 | 2438 | | | | |
| | 2422 | | | | |
| | 2425 | | | | |
| 12.5 | 2407 | | | | |
| | 2433 | | | | |
| | 2450 | | | | |
| 13.1 | 2408 | | | | |
| | 2362 | | | | |
| | 2336 | | | | |
| | 2306 | | | | |
| | 2249 | | | | |
| 14.1 | 2220 | | | | |
| 14.35 | 2172 | WE | | | |
| 14.6 | 2168 | | | | |
| 14.8 | 2144 | | | | |
| 15.0 | 2123 | | | | |
| 15.2 | 2083 | | | | |
| | 2016 | | | | |
| 15.55 | 1988 | | | | |
| 15.6 | 1798 | | | | |
| 15.8 | 1709 | BF | | | |

### Cross-sectional Morphology

☐ Riffle ☑ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. Sand | 11. Sand | 21. Sand | 31. 28.0 |
| 2. | 12. | 22. | 32. 14.0 |
| 3. | 13. | 23. | 33. 7.0 |
| 4. | 14. | 24. | 34. 10.0 |
| 5. | 15. | 25. | 35. 13.0 |
| 6. | 16. | 26. | 36. 1.0 |
| 7. | 17. | 27. | 37. 3.0 |
| 8. | 18. | 28. | 38. 1.0 |
| 9. | 19. | 29. | 39. 1.5 |
| 10. ↓ | 20. ↓ | 30. ↓ | 40. 0.5 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 60 %

Subpavement: Sand

**Sorting:** ☐ Well ☐ Moderate ☑ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:** N/M

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☐ ADV
☐ Other

**Discharge:**

☐ Estimated _____ m/s
☐ Measured _____ m/s

Completed by: ER Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** PN15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS5 / G6 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Ganatsekiagon Creek |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1445 | | | 16.2 | 0988 |
| 8.7 | 1482 | | | 16.4 | 0994 |
| 9.0 | 1542 | | | | |
| 9.3 | 1567 | | | | |
| 9.6 | 1624 | | | | |
| 9.9 | 1677 | | | | |
| 10.2 | 1691 | | | | |
| 10.5 | 1693 | | | | |
| 10.8 | 1717 | | | | |
| 11.1 | 1770 | | | | |
| 11.35 | 1865 | BF * | | | |
| 11.5 | 2260 | WL | | | |
| 11.5 | 2400 | Bed | | | |
| 11.7 | 2545 | | | | |
| | 2596 | | | | |
| 12.1 | 2622 | | | | |
| 12.3 | 2646 | | | | |
| | 2653 | | | | |
| | 2640 | | | | |
| | 2642 | | | | |
| 13.1 | 2622 | | | | |
| | 2551 | | | | |
| | 2500 | | | | |
| | 2463 | | | | |
| | 2408 | | | | |
| 14.1 | 2326 | | | | |
| | 2320 | | | | |
| | 2293 | | | | |
| | 2335 | | | | |
| 14.9 | 2342 | Bed | | | |
| 14.9 | 2257 | WL | | | |
| 14.95 | 1396 | BF | | | |
| 15.2 | 1288 | | | | |
| 15.4 | 1195 | | | | |
| 15.6 | 1154 | | | | |
| 15.8 | 1111 | | | | |
| 16.0 | 1016 | | | | |

### Cross-sectional Morphology

☐ Riffle ☑ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. Sand | 11. Sand | 21. 2.5 | 31. 0.5 |
| 2. | 12. | 22. 1.0 | 32. 0.2 |
| 3. | 13. | 23. 2.0 | 33. 0.2 |
| 4. | 14. | 24. 2.0 | 34. 0.2 |
| 5. | 15. | 25. 1.0 | 35. 0.2 |
| 6. | 16. | 26. 0.9 | 36. 0.2 |
| 7. | 17. | 27. 1.5 | 37. 0.5 |
| 8. | 18. | 28. 1.5 | 38. 0.5 |
| 9. | 19. | 29. 1.0 | 39. 0.6 |
| 10. ↓ | 20. ↓ | 30. 1.0 | 40. 11.0 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: 60 %

Subpavement: Sand

**Sorting:** ☐ Well ☐ Moderate ☑ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:** N/M

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☐ ADV
☐ Other

**Discharge:**

☐ Estimated _____ m/s
☐ Measured _____ m/s

Completed by: ER Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** PN15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS6 (Monitoring)/G6 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Ganatsekiagon Creek |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1628 | rebar | | | |
| | 1655 | | | | |
| | 1660 | | | | |
| | 1667 | | | | |
| | 1701 | | | | |
| 9.6 | 1785 | BF | | | |
| 9.8 | 2042 | | | | |
| 9.9 | 2290 | W/E | | | |
| 10.2 | 2435 | | | | |
| 10.4 | 2525 | | Depth (m) | Vel (m/s) | |
| 10.6 | 2587 | | | | |
| | 2621 | | | | |
| 11.0 | 2588 | | | | |
| | 2549 | | 0.26 | 0.026 | |
| | 2542 | | 0.24 | 0.058 | |
| | 2474 | | 0.25 | 0.069 | |
| | 2529 | | 0.23 | 0.088 | |
| 12.0 | 2524 | | 0.24 | 0.097 | |
| 12.2 | 2526 | | 0.22 | 0.014 | |
| 12.6 | 2508 | | 0.22 | | |
| | 2495 | | | | |
| 13.1 | 2430 | W/E (Bed) | | | |
| 13.1 | 2286 | WL | | | |
| 13.3 | 1938 | | | | |
| | 1824 | | | | |
| | 1743 | | | | |
| | 1649 | | | | |
| 14.1 | 1572 | | | | |
| 14.3 | 1553 | | | | |
| 14.6 | 1516 | | | | |
| | 1531 | | | | |
| 15.2 | 1535 | | | | |
| | 1507 | | | | |
| | 1419 | | | | |
| 16.1 | 1328 | | | | |
| 16.45 | 1206 | rebar | | | |
| | | | | | |

U/S, LB, RB, D/S

### Cross-sectional Morphology

☐ Riffle ☑ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. Sand | 11. Sand | 21. Sand | 31. 10.0 |
| 2. | 12. | 22. | 32. 4.0 |
| 3. | 13. | 23. | 33. 3.0 |
| 4. | 14. | 24. | 34. 4.0 |
| 5. | 15. | 25. ↓ | 35. 1.0 |
| 6. | 16. | 26. 19.0 | 36. 1.0 |
| 7. | 17. | 27. 7.5 | 37. 1.5 |
| 8. | 18. | 28. 5.0 | 38. 2.0 |
| 9. | 19. | 29. 7.0 | 39. 23.0 |
| 10. ↓ | 20. ↓ | 30. 11.0 | 40. 16.0 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 50 %

Subpavement: Sand

**Sorting:** ☐ Well ☐ Moderate ☑ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:**

☐ Estimated Sa m/s
☐ Measured above m/s

**Discharge:**

☐ Estimated _____ m/s
☐ Measured 0.0186 m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☑ ADV
☐ Other

Completed by: ER Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** PN5089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | XS7, G6 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Carruthers Creek |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1728 | | | 15.7 | 2034 |
| 8.8 | 1750 | | | 16.0 | 2017 |
| 9.0 | 1751 | | | 16.3 | 1987 |
| | 1772 | | | 16.6 | 1942 |
| | 1799 | | | | |
| | 1836 | | | | |
| | 1866 | | | | |
| 10.0 | 1938 | | | | |
| | 2054 | | | | |
| 10.3 | 2125 | BF* | | | |
| 10.35 | 2335 | | | | |
| 10.6 | 2520 | | | | |
| | 2610 | | | | |
| 11.0 | 2700 | | | | |
| | 2722 | | | | |
| | 2761 | | | | |
| 11.45 | 2887 | WE | | | |
| 11.5 | 3000 | | | | |
| 11.7 | 3041 | | | | |
| | 2984 | | | | |
| 12.1 | 2961 | | | | |
| | 2994 | | | | |
| | 2971 | | | | |
| | 2968 | | | | |
| | 2920 | boulder | | | |
| 13.1 | 2936 | | | | |
| 13.3 | 2898 | WE | | | |
| 13.5 | 2833 | | | | |
| | 2701 | | | | |
| | 2571 | | | | |
| 14.1 | 2474 | | | | |
| | 2380 | | | | |
| | 2268 | BF | | | |
| | 2203 | | | | |
| | 2109 | | | | |
| 15.1 | 2104 | | | | |
| 15.4 | 2045 | | | | |

### Cross-sectional Morphology

☑ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Sand | 11. | Sand | 21. | 15.5 | 31. | 0.5 |
| 2. | | 12. | | 22. | 17.0 | 32. | 3.5 |
| 3. | | 13. | | 23. | 9.0 | 33. | 3.0 |
| 4. | | 14. | | 24. | 8.5 | 34. | 2.0 |
| 5. | | 15. | ↓ | 25. | 14.0 | 35. | 12.0 |
| 6. | | 16. | 12.0 | 26. | 2.0 | 36. | 11.0 |
| 7. | | 17. | 7.5 | 27. | 4.5 | 37. | 1.0 |
| 8. | | 18. | 8.0 | 28. | 13.0 | 38. | 1.5 |
| 9. | | 19. | 4.0 | 29. | 5.5 | 39. | 5.0 |
| 10. | ↓ | 20. | 7.0 | 30. | 3.5 | 40. | 3.5 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 30 %

Subpavement: Sand

**Sorting:** ☐ Well ☑ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:** N/M

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Discharge:**

☐ Estimated _____ m/s
☐ Measured _____ m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☐ ADV
☐ Other

Completed by: ER Checked By: _____

GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**PN:** pn15089

| | | | |
|---|---|---|---|
| **Date:** | Nov 18, 2015 | **Stream/Reach:** | G6, XS 8 |
| **Weather:** | 10°C, overcast | **Location:** | Sideline 22, Pickering |
| **Field Staff:** | CH/ER | **Watershed/Subwatershed:** | Ganatsekiagon Creek |

| | | | | | Notes |
|---|---|---|---|---|---|
| 8.5 | 1656 | rebar | | | |
| 8.7 | 1649 | | | | |
| | 1672 | | | | |
| 9.1 | 1679 | | | | |
| | 1723 | | | | |
| | 1780 | | | | |
| | 1826 | | | | |
| | 1878 | | | | |
| 10.1 | 1942 | | | | |
| | 2014 | | | | |
| | 2088 | | | | |
| | 2146 | | | | |
| | 2194 | | | | |
| 11.1 | 2321 | BF * | | | |
| 11.2 | 2627 | | | | |
| 11.4 | 2829 | WE | Depth (m) | Vel (m/s) | |
| 11.5 | 2924 | | | | |
| 11.7 | 2942 | | 0.08 | 0.036 | |
| | 2941 | | 0.09 | 0.088 | |
| 12.2 | 2912 | | 0.08 | 0.189 | |
| 12.4 | 2918 | | 0.08 | 0.089 | |
| 12.6 | 2902 | | 0.06 | 0.036 | |
| | 2985 | | | | |
| 13.0 | 2882 | | | | |
| | 2870 | | | | |
| | 2859 | | | | |
| 13.6 | 2845 | | | | |
| 13.7 | 2822 | WE | | | |
| 13.8 | 2738 | | | | |
| 14.0 | 2731 | | | | |
| | 2659 | | | | |
| | 2557 | | | | |
| | 2495 | | | | |
| 14.8 | 2321 | BF | | | |
| | 2304 | | | | |
| 15.2 | 2275 | | | | |
| | 2138 | | | | |

| | | | |
|---|---|---|---|
| 15.6 | 2061 | 16.8 | 1852 |
| 15.8 | 2006 | 17.0 | 1851 |
| 16.0 | 1950 | 17.2 | 1817 |
| 16.2 | 1932 | 17.4 | 1769 |
| 16.4 | 1879 | 17.62 | 1749 |
| 16.6 | 1882 | | |

### Cross-sectional Morphology

☑ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☐ Bed ☐ Bank ☐ Subpavement ☐ Water ☑ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 9.7 | 11. 0.1 | 21. 1.5 | 31. 0.4 |
| 2. 9.0 | 12. 0.1 | 22. 2.5 | 32. 1.5 |
| 3. 15.0 | 13. CS | 23. 3.0 | 33. 3.0 |
| 4. 8.0 | 14. CS | 24. 1.5 | 34. 7.0 |
| 5. 2.8 | 15. 1.0 | 25. 2.0 | 35. 3.0 |
| 6. 3.5 | 16. 0.4 | 26. 9.0 | 36. 10.0 |
| 7. 4.6 | 17. 0.3 | 27. 10.0 | 37. 9.0 |
| 8. 0.6 | 18. 0.6 | 28. 3.3 | 38. 5.0 |
| 9. 0.2 | 19. 0.4 | 29. 1.3 | 39. 9.5 |
| 10. 0.2 | 20. 2.0 | 30. 2.2 | 40. 11.0 |

**Particle Shape:**

☐ Platy ☑ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☑ Sub-Rounded
☐ Rounded

Embededness: 10 %

Subpavement: gravel

**Sorting:** ☑ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☑ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

### Velocity and Discharge

**Velocity:**

☐ Estimated too m/s
☐ Measured above m/s

**Discharge:**

☐ Estimated _____ m/s
☐ Measured 00093 m/s

**Method:**

☐ Wiffle ball
☐ Current Meter
☑ ADV
☐ Other

Completed by: ER Checked By: _____

U/S/RB/LB/DS

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Geomorphology Earth Science Observations

## General Site Characteristics

**Project Code:** PN16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Stream/Reach:** | GB2 |
| **Weather:** | Overcast -8 | **Location:** | Pickering |
| **Field Staff:** | PP + BM2 | **Watershed/Subwatershed:** | Garatteckiagon |

**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 |

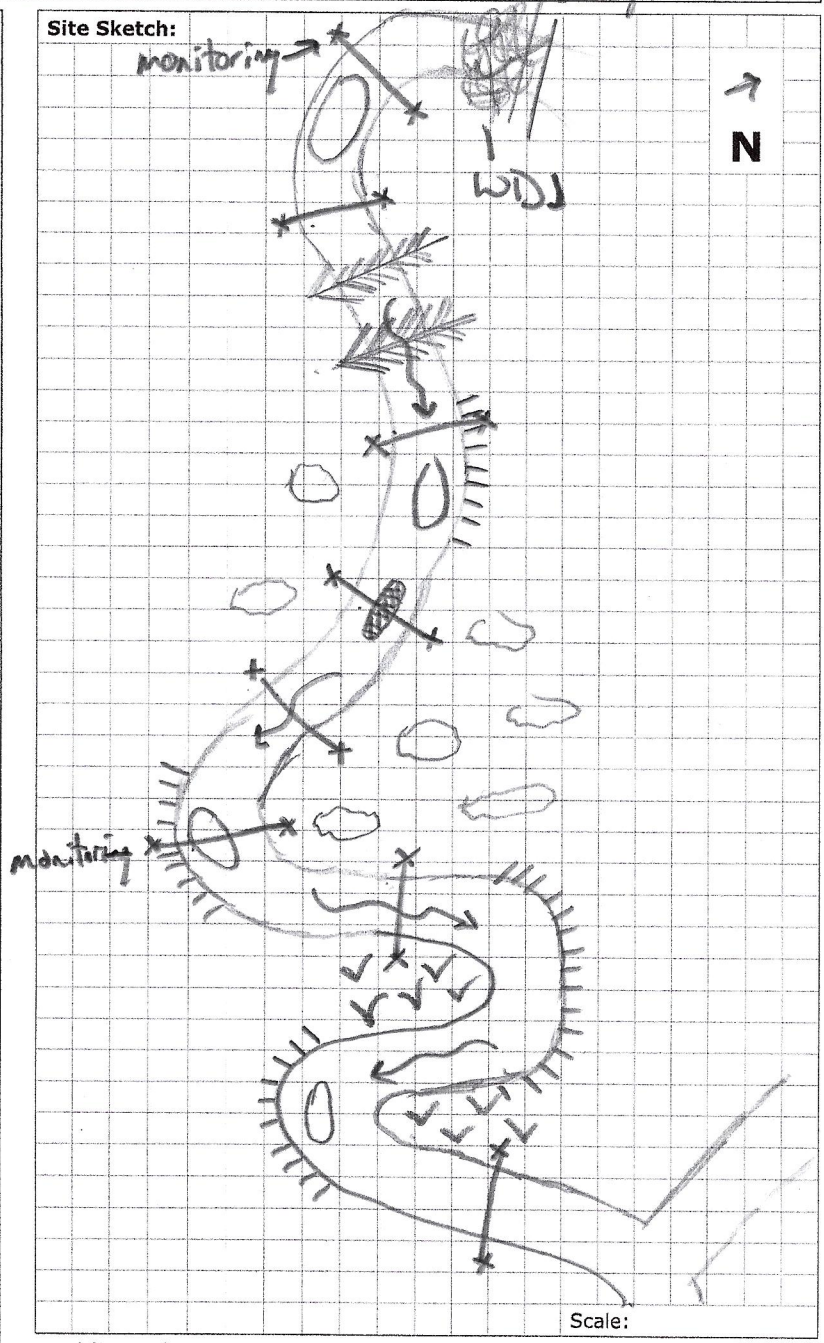
**Substrate**

| | | | |
|---|---|---|---|
| **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: PP Checked by: _____

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Geomorphology Earth Science Observations

## Detailed Assessment (Level)

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 12-12-16 | **Reach:** | GB2 |
| **Weather:** | Snow -3 | **Location:** | Pickering |
| **Field Staff:** | PP + BM2 | **Watershed/Subwatershed:** | Ganaskigiagon |

| Top | Middle | Bottom | Angle | Water | XS | Notes |
|---|---|---|---|---|---|---|
| 3078 | 2944 | 2810 | 76.5 | 2878 | | Run |
| 3067 | 2931 | 2797 | 79 | 2837 | | |
| 3076 | 2936 | 2800 | 91.5 | 2803 | | |
| 3081 | 2948 | 2814 | 83.5 | 2809 | | |
| 3074 | 2949 | 2810 | 85 | 2811 | | |
| 3072 | 2937 | 2809 | 87 | 2805 | | |
| 3069 | 2939 | 2813 | 88.5 | 2805 | | |
| 3044 | 2916 | 2792 | 89.5 | 2795 | XS1 | Bed |
| 2350 | 2220 | 2094 | 90.5 | | XS1 | LBBF |
| 2584 | 2468 | 2353 | 86 | | XS1 | RBBF |
| 3043 | 2918 | 2796 | 91 | 2791 | | |
| 3012 | 2893 | 2773 | 92 | 2795 | | |
| 3070 | 2956 | 2848 | 94 | 2785 | | |
| 3051 | 2942 | 2836 | 94 | 2782 | | |
| 2994 | 2890 | 2782 | 93 | 2787 | | |
| 2951 | 2851 | 2751 | 90 | 2777 | | |
| 3029 | 2931 | 2833 | 88 | 2772 | | |
| 2998 | 2906 | 2804 | 84.5 | 2765 | | |
| 2982 | 2882 | 2781 | 83 | 2757 | | |
| 3006 | 2900 | 2794 | 82.5 | 2749 | | |
| 2997 | 2887 | 2780 | 79 | 2746 | | |
| 3016 | 2901 | 2790 | 77.5 | 2739 | | |
| 2999 | 2881 | 2765 | 75.5 | 2731 | | |
| 2977 | 2858 | 2740 | 73 | 2733 | | |
| 2970 | 2851 | 2732 | 71 | 2726 | | |
| 2985 | 2864 | 2750 | 68.5 | 2720 | | |
| 2982 | 2866 | 2750 | 67 | 2725 | | |
| 2970 | 2853 | 2736 | 64 | 2718 | | |
| 2980 | 2834 | 2723 | 61.5 | 2728 | | |
| 2990 | 2873 | 2763 | 60 | 2715 | | |
| 2928 | 2825 | 2723 | 60 | 2713 | | |
| 2920 | 2826 | 2721 | 60.5 | 2706 | | |
| 2980 | 2883 | 2790 | 62 | 2711 | | |
| 2990 | 2900 | 2813 | 63.5 | 2710 | | |
| 2887 | 2802 | 2717 | 65.5 | 2912 | XS2 | Bed |
| 2364 | 2271 | 2185 | 71.5 | | XS2 | LBBF |
| 2318 | 2239 | 2162 | 52.5 | | XS2 | RBBF |

**Survey Direction**
- ☐ Upstream to Downstream
- ☒ Downstream to Upstream

**Cross-sections**
No. of Cross-sections: 3
Monitoring Cross-sections:
- ☐ None
- ☒ Yes (2)

If yes, which ones: 3 & ____

**Rain in last 24 hours**
- ☒ None
- ☐ Yes: Amount _____ mm

**Valley Type:** Confined / Partially / Unconfined
**Channel Zone:** Headwater / Transfer / Deposition
**Land Use:** forest
**Aquatic Vegetation:** water cress
**Coverage of Reach:** 20 %
**Riparian Vegetation:** herbaceous
**Extent of Riparian Cover:** Fragment / None / Continuous
**Riparian Cover (channel widths):** 1-4 / 4-10 / >10
**Age Class of Riparian Vegetation:** Immature (<5 yrs) / Established (5-30 yrs) / Mature (>30 yrs)
**Extent of Encroachment:** None / Minimal / Moderate / Heavy / Extreme
**Density of Woody Debris:** Low / Moderate / High
☐ **Overall Photographs Taken**
**Blockage(s) in Channel:** Infrastructure / Dam / LWD

Completed by: PP Checked By: _____

Page ____ of ____

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Geomorphology Earth Science Observations

**Detailed Assessment (Level)** **Project Code:**

| | | | |
|---|---|---|---|
| **Date:** | | **Reach:** | |
| **Weather:** | | **Location:** | |
| **Field Staff:** | | **Watershed/Subwatershed:** | |

| Top | Middle | Bottom | Angle | Water | XS | Notes |
|---|---|---|---|---|---|---|
| 2883 | 2801 | 2720 | 67 | 2708 | | |
| 2875 | 2798 | 2724 | 69.5 | 2709 | | |
| 2960 | 2788 | 2713 | 72 | 2693 | | |
| 2949 | 2877 | 2808 | 77 | 2690 | | |
| 2885 | 2819 | 2756 | 79.5 | 2690 | | |
| 2896 | 2830 | 2767 | 84 | 2692 | | |
| 2939 | 2876 | 2814 | 88 | 2699 | | |
| 2996 | 2912 | 2852 | 91.5 | 2692 | | |
| 2952 | 2888 | 2828 | 92 | 2682 | | |
| 2875 | 2812 | 2752 | 101 | 2696 | | |
| 2841 | 2732 | 2733 | 104 | 2690 | | |
| 2833 | 2768 | 2712 | 107 | 2692 | | |
| 2830 | 2778 | 2725 | 110 | 2684 | | |
| 2791 | 2739 | 2693 | 112 | 2689 | | |
| 2820 | 2776 | 2732 | 114 | 2679 | | |
| 2903 | 2864 | 2824 | 116 | 2697 | | |
| 2938 | 2904 | 2872 | 118 | 2685 | | |
| 2861 | 2829 | 2802 | 121 | 2677 | XS3-MRB | |
| 2256 | 2225 | 2198 | 130 | | XS3-MRB | |
| 2235 | 2208 | 2179 | 103 | | XS3-MRB | |
| 2874 | 2849 | 2824 | 124 | 2685 | | |
| 2936 | 2919 | 2898 | 126 | 2679 | | |
| 2865 | 2850 | 2834 | 115 | 2684 | | |
| 2830 | 2817 | 2804 | 96 | 2876 | | |
| 2788 | 2774 | 2760 | 77 | 2674 | | |
| 2730 | 2712 | 2696 | 60 | 2664 | | |
| 2775 | 2703 | 2682 | 49 | 2640 | | |
| 2665 | 2640 | 2616 | 40 | 2611 | | |
| 2729 | 2701 | 2673 | 32 | 2598 | | |
| 2727 | 2696 | 2663 | 24 | 2595 | | |
| 2662 | 2629 | 2599 | 11 | 2594 | | |
| 2658 | 2619 | 2583 | 09 | 2571 | | |
| 2646 | 2604 | 2562 | 05 | 2530 | | |
| 2615 | 2567 | 2519 | 02 | 2535 | | |
| 2630 | 2578 | 2525 | 01.5 | 2534 | | |
| 2751 | 2733 | 2716 | 58.5 | 2656 | XS4 | Bed |
| 1906 | 1892 | 1883 | 37 | | XS4 | LB |
| 2253 | 2223 | 2194 | 61 | | XS4 | RB |

**Survey Direction**

- ☐ Upstream to Downstream
- ☐ Downstream to Upstream

**Cross-sections**

No. of Cross-sections: _____

Monitoring Cross-sections:

- ☐ None
- ☐ Yes

If yes, which ones: _____ & _____

**Rain in last 24 hours**

- ☐ None
- ☐ Yes: Amount _____ mm

**Valley Type:**
Confined Partially Unconfined

**Channel Zone:**
Headwater Transfer Deposition

**Land Use:** _____

**Aquatic Vegetation:** _____

**Coverage of Reach:** _____%

**Riparian Vegetation:** _____

**Extent of Riparian Cover:**
Fragment None Continuous

**Riparian Cover (channel widths):**
1-4 4-10 >10

**Age Class of Riparian Vegetation:**
Immature (<5 yrs) Established (5-30 yrs) Mature (>30 yrs)

**Extent of Encroachment:**
None Minimal Moderate Heavy Extreme

**Density of Woody Debris:**
Low Moderate High

☐ **Overall Photographs Taken**

**Blockage(s) in Channel:**
Infrastructure Dam LWD

Completed by: _____ Checked By: _____

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Geomorphology Earth Science Observations

## Detailed Assessment (Level)

**Project Code:**

| | | | |
|---|---|---|---|
| **Date:** | | **Reach:** | |
| **Weather:** | | **Location:** | |
| **Field Staff:** | | **Watershed/Subwatershed:** | |

| Top | Middle | Bottom | Angle | Water | XS | Notes |
|---|---|---|---|---|---|---|
| 2572 | 2516 | 2460 | 05 | 2506 | XS5 | |
| 1872 | 1817 | | 22 | | XS5-LB | |
| 1735 | 1677 | 1618 | 352 | | XS5-RB | |
| 2576 | 2514 | 2453 | 03 | 2488 | | |
| 2711 | 2638 | 2570 | 06 | 2472 | | |
| 2768 | 2692 | 2619 | 06 | 2481 | | |
| 2829 | 2750 | 2669 | 06 | 2481 | | |
| 2927 | 2841 | 2758 | 04 | 2483 | | |
| 2770 | 2681 | 2594 | 01 | 2471 | | |
| 2665 | 2572 | 2483 | 350 | 2469 | | |
| 2652 | 2561 | 2472 | 358 | 2463 | | |
| 2672 | 2573 | 2481 | 358 | 2464 | | |
| 2549 | 2440 | 2333 | 351 | 2414 | | 2.5m US (free in water) |
| 2658 | 2542 | 2432 | 351 | 2399 | | |
| 2494 | 2379 | 2265 | 348 | 2339 | | |
| 2448 | 2318 | 2194 | 348 | 2275 | | |
| 2415 | 2281 | 2150 | 347 | 2218 | | |
| 2520 | 2381 | 2247 | 346 | 2219 | | |
| | | | | | | 2m US (free in water) |
| | | | | | | |
| 1532 | 1400 | 1270 | 341 | | | Turning Pt. 1 |
| 1615 | 1556 | 1499 | 156 | | | Turning Pt. 2 |
| 2638 | 2591 | 2545 | 145 | 2374 | | |
| 2613 | 2570 | 2526 | 149 | 2376 | XS7 | Bed |
| 2284 | 2246 | 2208 | 143 | | XS7 | LB |
| 1875 | 1829 | 1777 | 159 | | XS7 | RB |
| 2590 | 2552 | 2514 | 155.5 | 2379 | | |
| 2568 | 2535 | 2503 | 168.5 | 2377 | | |
| 2490 | 2461 | 2434 | 156 | 2377 | | |
| 2464 | 2440 | 2414 | 151 | 2377 | XS8 | Bed |
| 2069 | 2034 | 2001 | 135.5 | | XS8 | LB |
| 1597 | 1576 | 1554 | 167 | | XS8 | RB |
| 2496 | 2479 | 2451 | 139 | 2372 | | |
| 2573 | 2547 | 2528 | 125 | 2491 | | |
| 2838 | 2742 | 2663 | 3 | 2473 | XS6 | Bed |
| 1707 | 1626 | 1548 | 344 | | XS6 | LB |
| 1652 | 1559 | 1466 | 348 | | XS6 | RB |

**Survey Direction**

- ☐ Upstream to Downstream
- ☐ Downstream to Upstream

**Cross-sections**

No. of Cross-sections: _____

Monitoring Cross-sections:

- ☐ None
- ☐ Yes

If yes, which ones: _____ & _____

**Rain in last 24 hours**

- ☐ None
- ☐ Yes: Amount _____ mm

**Valley Type:**
Confined Partially Unconfined

**Channel Zone:**
Headwater Transfer Deposition

**Land Use:** _____

**Aquatic Vegetation:** _____

**Coverage of Reach:** _____%

**Riparian Vegetation:** _____

**Extent of Riparian Cover:**
Fragment None Continuous

**Riparian Cover (channel widths):**
1-4 4-10 >10

**Age Class of Riparian Vegetation:**
Immature (<5 yrs) Established (5-30 yrs) Mature (>30 yrs)

**Extent of Encroachment:**
None Minimal Moderate Heavy Extreme

**Density of Woody Debris:**
Low Moderate High

☐ **Overall Photographs Taken**

**Blockage(s) in Channel:**
Infrastructure Dam LWD

Completed by: _____ Checked By: _____

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## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB2 / XS1 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 24.77 | | | | |
| 0.3 | 24.92 | | | | |
| 0.6 | 26.45 | | | | |
| 0.9 | 27.34 | | | | |
| 1.2 | 2733 | | | | |
| 1.5 | 2706 | | | | |
| 1.8 | 2758 | | | | |
| 2.05 | 2875 | WE | | | |
| 2.20 | 2890 | | | | |
| 2.40 | 2916 | | | | |
| 2.60 | 2922 | | | | |
| 2.80 | 2943 | | | | |
| 3.0 | 2954 | | | | |
| 3.20 | 2927 | Bed WE | | | |
| 3.20 | 2860 | WL | | | |
| 3.30 | 2811 | | | | |
| 3.4 | 2253 | | | | |
| 3.7 | 2140 | Top Bank | | | |
| 4.0 | 2062 | | | | |
| 4.3 | 2118 | | | | |
| 4.6 | 2111 | T | | | |
| 4.9 | 2148 | | | | |

### Cross-sectional Morphology

☐ Riffle ☐ Pool ☒ Run ☐ Other

### Substrate

**Sample:** Sediment sample collected

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. ____ | 11. ____ | 21. ____ | 31. ____ |
| 2. ____ | 12. ____ | 22. ____ | 32. ____ |
| 3. ____ | 13. ____ | 23. ____ | 33. ____ |
| 4. ____ | 14. ____ | 24. ____ | 34. ____ |
| 5. ____ | 15. ____ | 25. ____ | 35. ____ |
| 6. ____ | 16. ____ | 26. ____ | 36. ____ |
| 7. ____ | 17. ____ | 27. ____ | 37. ____ |
| 8. ____ | 18. ____ | 28. ____ | 38. ____ |
| 9. ____ | 19. ____ | 29. ____ | 39. ____ |
| 10. ____ | 20. ____ | 30. ____ | 40. ____ |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☒ Observed ☐ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.147 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ $m^3/s$
☐ Measured _____ $m^3/s$

1/3

Completed by: PP Checked by: _____

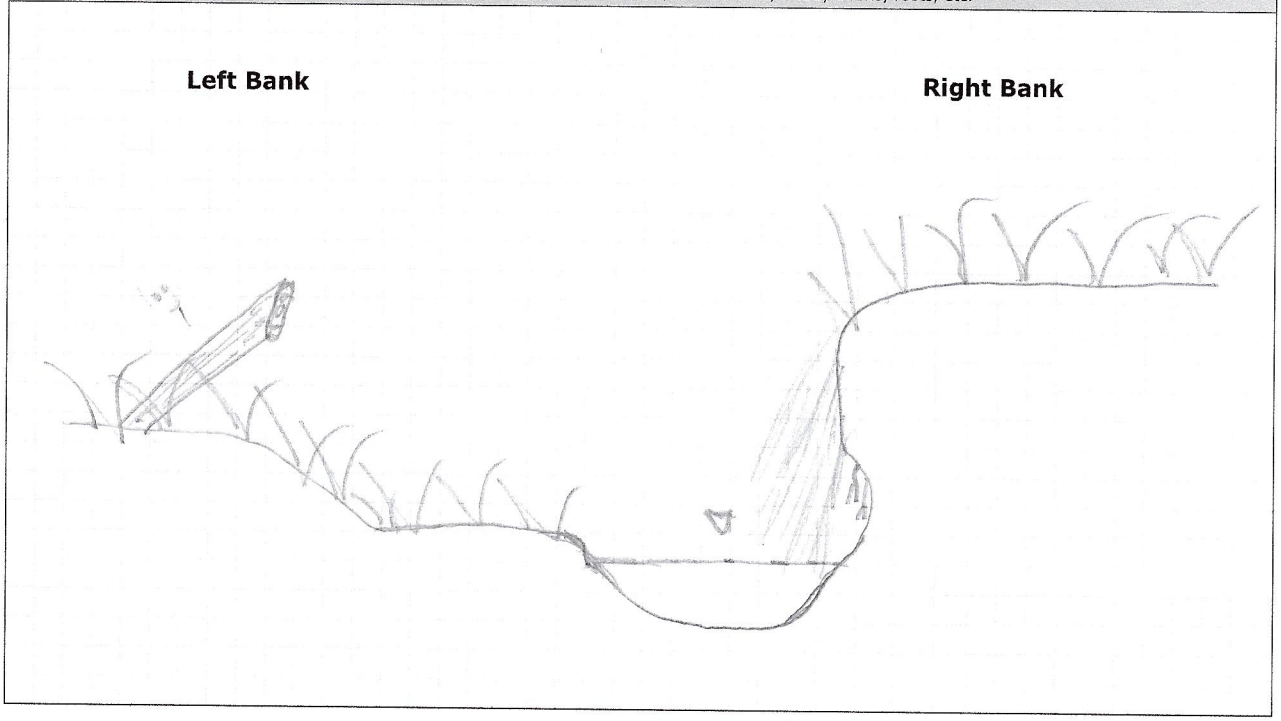
GEO MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | XS1 - GB2 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 0.41 | m | |
| Bank Angle: | 30 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | \ | m | |
| Penetrometer: | \ | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Right Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 0.86 | m | |
| Bank Angle: | 90 | ° | |
| Root Depth: | 0.11 | m | |
| Root Density: | 15 | % | |
| Undercut: | 0.25 | m | |
| Erosion Pin: | \ | m | |
| Penetrometer: | \ | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Additional Notes

US LB
DS RB

**Photo Order:**

Completed by: PP Checked by: _____

Page ____ of ____

GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB-2 XS 2 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 2244 | | | | |
| 1.0 | 2391 | | | | |
| 2.0 | 2400 | | | | |
| 2.5 | 2420 | | | | |
| 2.9 | 2415 | | | | |
| 3.1 | 2457 | | | | |
| 3.4 | 2500 | | | | |
| 3.7 | 2572 | | | | |
| 3.85 | 2650 | | | | |
| 3.9 | 2760 | WE/WL | | | |
| 4.0 | 2796 | | | | |
| 4.1 | 2815 | | | | |
| 4.2 | 2822 | | | | |
| 4.3 | 2824 | | | | |
| 4.46 | 2764 | WE WL | | | |
| 4.60 | ~~2707~~ | | | | |
| 4.8 | 2637 | | | | |
| 5.0 | 2613 | | | | |
| 5.3 | 2607 | | | | |
| 5.6 | 2543 | | | | |
| 5.9 | 2404 | | | | |
| 6.2 | 2354 | | | | |
| 6.4 | 2290 | RB BF | | | |
| 6.8 | 2286 | | | | |
| 7.20 | 2291 | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### Cross-sectional Morphology

☒ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:** Sample collected

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. _____ | 11. _____ | 21. _____ | 31. _____ |
| 2. _____ | 12. _____ | 22. _____ | 32. _____ |
| 3. _____ | 13. _____ | 23. _____ | 33. _____ |
| 4. _____ | 14. _____ | 24. _____ | 34. _____ |
| 5. _____ | 15. _____ | 25. _____ | 35. _____ |
| 6. _____ | 16. _____ | 26. _____ | 36. _____ |
| 7. _____ | 17. _____ | 27. _____ | 37. _____ |
| 8. _____ | 18. _____ | 28. _____ | 38. _____ |
| 9. _____ | 19. _____ | 29. _____ | 39. _____ |
| 10. _____ | 20. _____ | 30. _____ | 40. _____ |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.28 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ $m^3/s$
☐ Measured _____ $m^3/s$

Completed by: PP Checked by: _____

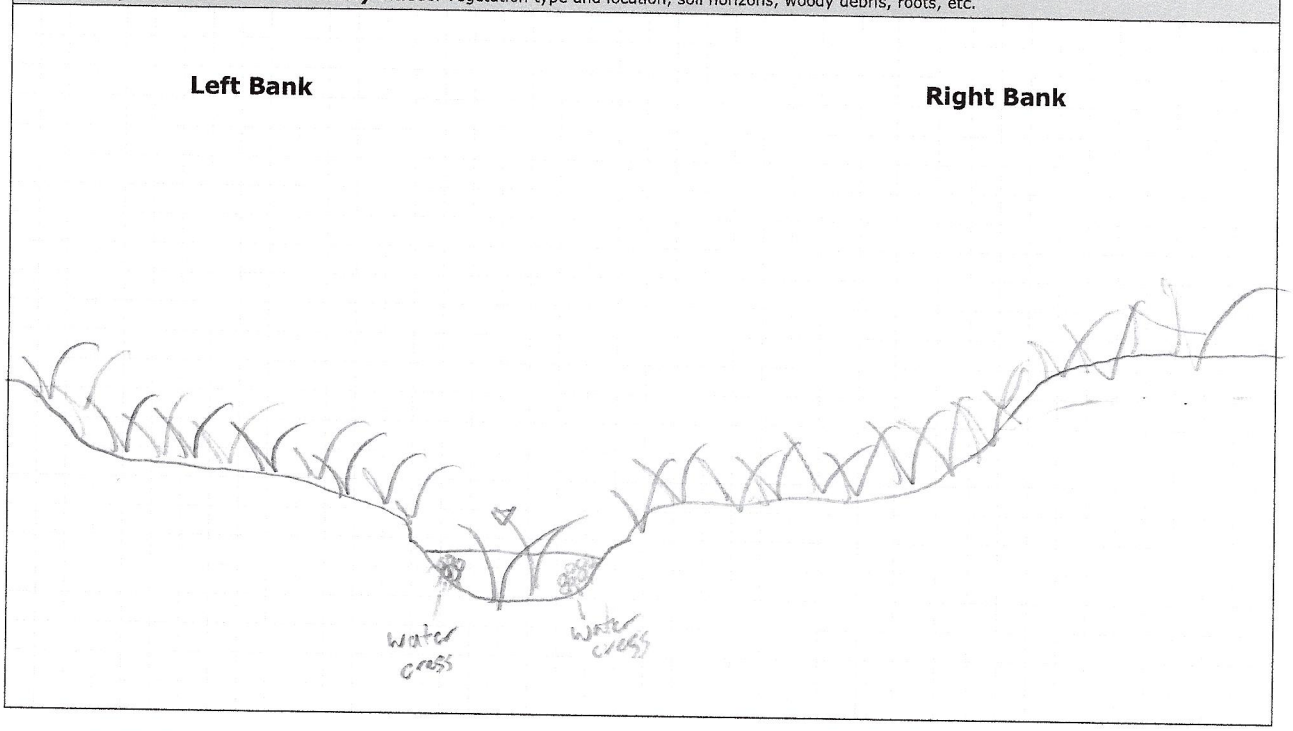
GEO MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB2 / XS2 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 35 | m | |
| Bank Angle: | 30 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | NA | m | |
| Erosion Pin: | \ | m | |
| Penetrometer: | | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Right Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | | m | |
| Bank Angle: | 40 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | N/A | m | |
| Penetrometer: | \ | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Additional Notes

US LB

DS RB

**Photo Order:**

Completed by: _____ Checked by: _____

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GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 1C106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB2-XS3M |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 2198 | Pin | | | |
| 0.4 | 2146 | | | | |
| 0.8 | 2173 | | | | |
| 1.2 | 2192 | | | | |
| 1.5 | 2225 | | | | |
| 1.8 | 2321 | | | | |
| 1.95 | 2350 | | | | |
| 2.05 | 2537 | height of Erosion Pin | | | |
| 2.2 | 2615 | | | | |
| 2.4 | 2711 | WE WL | | | |
| 2.6 | 2756 | | | | |
| 2.8 | 2818 | | | | |
| 3.0 | 2873 | | | | |
| 3.2 | 2903 | | | | |
| 3.4 | 2910 | | | | |
| 3.6 | 2879 | WE Bed | | | |
| 3.6 | 2710 | WL | | | |
| 3.7 | 2443 | | | | |
| 3.9 | 2267 | | | | |
| 4.1 | 2297 | | | | |
| 4.4 | 2136 | | | | |
| 4.7 | 1970 | | | | |
| 5.0 | 1891 | RB BF | | | |
| 5.4 | 1912 | | | | |
| 5.8 | 1922 | | | | |
| 6.1 | 1931 | | | | |
| 6.38 | 1908 | Pin | | | |

### Cross-sectional Morphology

☐ Riffle ☒ Pool ☐ Run ☐ Other

### Substrate

**Sample:** Sediment sample Collected.

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. _____ | 11. _____ | 21. _____ | 31. _____ |
| 2. _____ | 12. _____ | 22. _____ | 32. _____ |
| 3. _____ | 13. _____ | 23. _____ | 33. _____ |
| 4. _____ | 14. _____ | 24. _____ | 34. _____ |
| 5. _____ | 15. _____ | 25. _____ | 35. _____ |
| 6. _____ | 16. _____ | 26. _____ | 36. _____ |
| 7. _____ | 17. _____ | 27. _____ | 37. _____ |
| 8. _____ | 18. _____ | 28. _____ | 38. _____ |
| 9. _____ | 19. _____ | 29. _____ | 39. _____ |
| 10. _____ | 20. _____ | 30. _____ | 40. _____ |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.0 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ m³/s
☐ Measured _____ m³/s

Completed by: PP Checked by: _____

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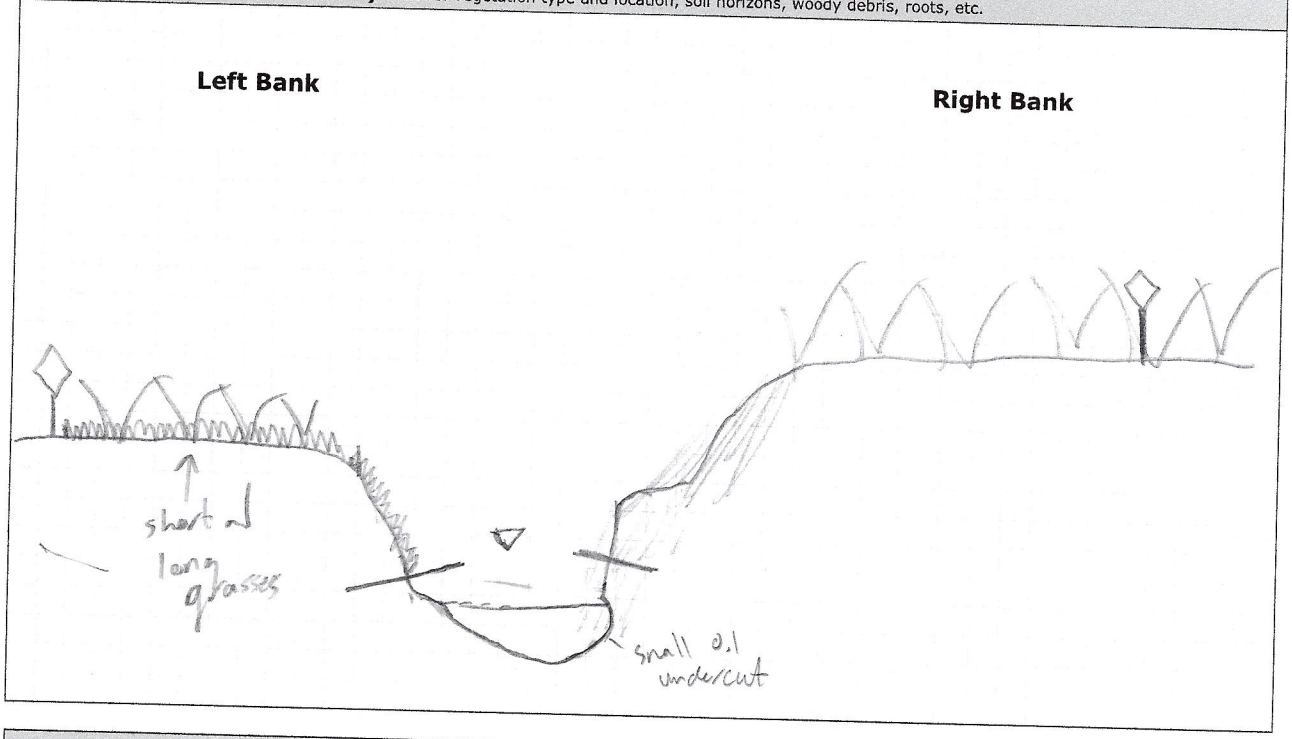
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB-2 / XS3M |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

☐ Bedrock ☐ Gravel
☐ Till ☐ Small Cobble
☒ Clay ☐ Large Cobble
☒ Silt ☐ Small Boulder
☒ Sand ☐ Large Boulder

| | | |
|---|---|---|
| Bank Height: | 0.52 | m |
| Bank Angle: | 70 | ° |
| Root Depth: | N/A | m |
| Root Density: | N/A | % |
| Undercut: | N/A | m |
| Erosion Pin: | 0.2 | m |
| Penetrometer: | | kg/cm² |

Foot Used: ☐ Yes ☐ No

### Right Bank Materials

☐ Bedrock ☐ Gravel
☐ Till ☐ Small Cobble
☒ Clay ☐ Large Cobble
☒ Silt ☐ Small Boulder
☒ Sand ☐ Large Boulder

| | | |
|---|---|---|
| Bank Height: | 0.98 | m |
| Bank Angle: | 60-90 | ° |
| Root Depth: | N/A | m |
| Root Density: | N/A | % |
| Undercut: | 0.1 | m |
| Erosion Pin: | 0.2 | m |
| Penetrometer: | | kg/cm² |

Foot Used: ☐ Yes ☐ No

### Additional Notes

US LB
DS RB

**Photo Order:**

Completed by: _____ Checked by: _____

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GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB2 – XS4 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 2217 | | | | |
| 0.3 | 2259 | | | | |
| 0.6 | 2299 | | | | |
| 0.9 | 2456 | | | | |
| 1.2 | 2431 | | | | |
| 1.5 | 2494 | | | | |
| 1.7 | 2677 | WE/WL | | | |
| 1.9 | 2746 | | | | |
| 2.10 | 2753 | | | | |
| 2.30 | 2763 | | | | |
| 2.50 | 2740 | | | | |
| 2.70 | 2726 | | | | |
| 2.9 | 2747 | | | | |
| 3.21 | 2686 | WE/WL | | | |
| 3.30 | 2577 | | | | |
| 3.50 | 2444 | | | | |
| 3.60 | 2403 | | | | |
| 3.70 | 2152 | | | | |
| 4.1 | 1886 | | | | |
| 4.5 | 1741 | RB/BFL | | | |
| 4.9 | 1647 | | | | |
| 5.3 | 1633 | | | | |
| 5.6 | 1619 | | | | |

### Cross-sectional Morphology

☒ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 8 | 11. 4.5 | 21. Silt | 31. Sand |
| 2. 7 | 12. 6.5 | 22. | 32. |
| 3. 11 | 13. 6 | 23. | 33. |
| 4. 6.5 | 14. 2 | 24. | 34. |
| 5. 5 | 15. 3 | 25. | 35. |
| 6. 3 | 16. 2.5 | 26. | 36. |
| 7. 5 | 17. 4 | 27. | 37. |
| 8. 8 | 18. 4.5 | 28. | 38. |
| 9. 12 | 19. 5 | 29. | 39. |
| 10. 6 | 20. 2 | 30. | 40. |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☒ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☒ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.10 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ $m^3/s$
☐ Measured _____ $m^3/s$

Completed by: PP Checked by: _____

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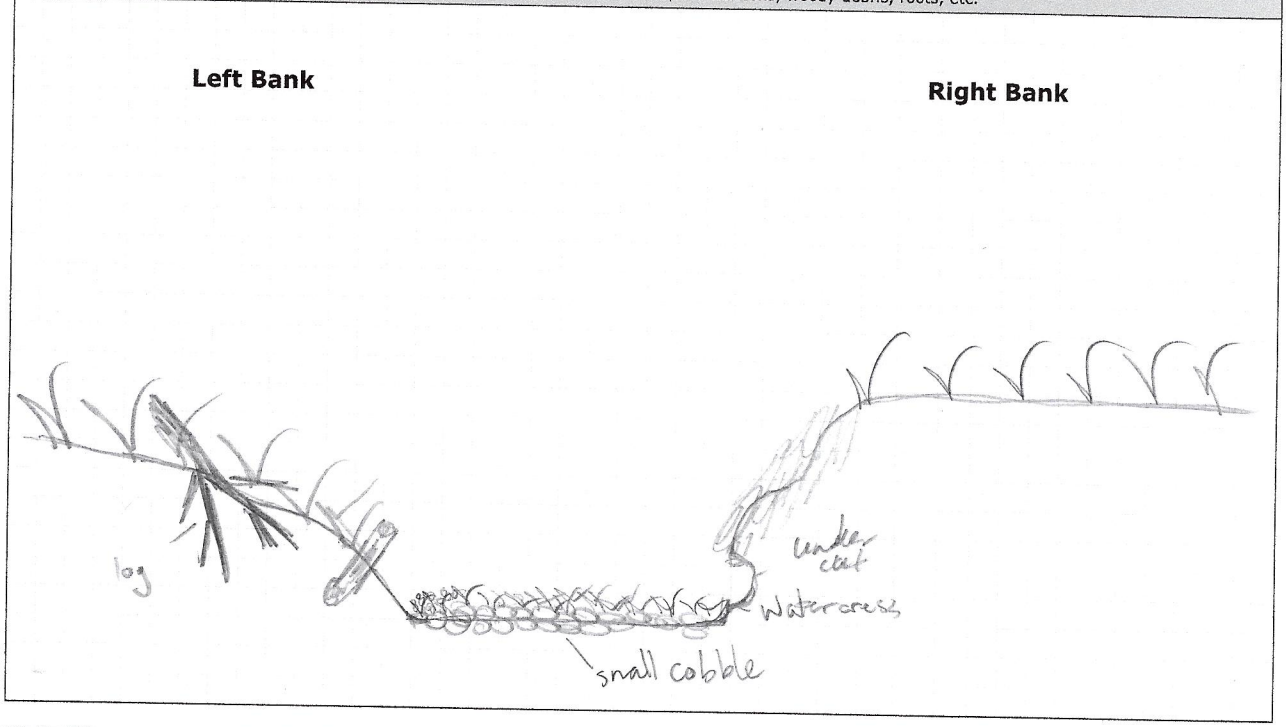
GEO | MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB2 / XS4 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 0.56 | m | |
| Bank Angle: | 30-45 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | \ | m | |
| Penetrometer: | \ | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Right Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 1.06 | m | |
| Bank Angle: | 85 | ° | |
| Root Depth: | 0.05 | m | |
| Root Density: | 10 | % | |
| Undercut: | 0.10 | m | |
| Erosion Pin: | \ | m | |
| Penetrometer: | \ | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Additional Notes

US LB

DS RB

**Photo Order:**

Completed by: _____ Checked by: _____

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GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB2 - XS5 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 1699 | | | | |
| 0.5 | 1784 | | | | |
| 1.0 | 2076 | | | | |
| 1.5 | 2250 | | | | |
| 2.0 | 2289 | | | | |
| 2.3 | 2290 | | | | |
| 2.6 | 2394 | | | | |
| 2.9 | 2490 | | | | |
| 3.14 | 2526 | WE/WL | | | |
| 3.3 | 2556 | | | | |
| 3.4 | 2561 | | | | |
| 3.57 | 2539 | We Medial Bar | | | |
| 3.70 | 2510 | | | | |
| 3.90 | 2499 | | | | |
| 4.18 | 2551 | We / WL Medial Bar - WL | | | |
| 4.30 | 2574 | | | | |
| 4.50 | 2586 | | | | |
| 4.70 | 2610 | | | | |
| 5.0 | 2567 | WE Bed | | | |
| 5.0 | 2545 | WE WL | | | |
| 5.1 | 2459 | | | | |
| 5.3 | 2440 | | | | |
| 5.6 | 2419 | | | | |
| 5.8 | 2377 | Base slope | | | |
| 6.0 | 2170 | | | | |
| 6.2 | 1955 | | | | |
| 6.40 | 1825 | | | | |
| 6.70 | 1634 | | | | |
| 7.0 | 1531 | Top of Bank | | | |
| 7.4 | 1488 | | | | |
| 8.0 | 1462 | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### Cross-sectional Morphology

☒ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 6 | 11. 4.5 | 21. .7 | 31. 8 |
| 2. 1 | 12. .5 | 22. .6 | 32. 2 |
| 3. 1.5 | 13. 2 | 23. 4 | 33. .5 |
| 4. 1 | 14. 6 | 24. 2 | 34. .2 |
| 5. 3 | 15. 1 | 25. 1.5 | 35. Sand |
| 6. 0.8 | 16. 4.5 | 26. .5 | 36. |
| 7. 0.4 | 17. .8 | 27. .4 | 37. |
| 8. .5 | 18. .5 | 28. .6 | 38. |
| 9. 1.5 | 19. .5 | 29. 1 | 39. |
| 10. 2 | 20. .3 | 30. 9 | 40. |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.120 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ $m^3/s$
☐ Measured _____ $m^3/s$

Completed by: PP Checked by: _____

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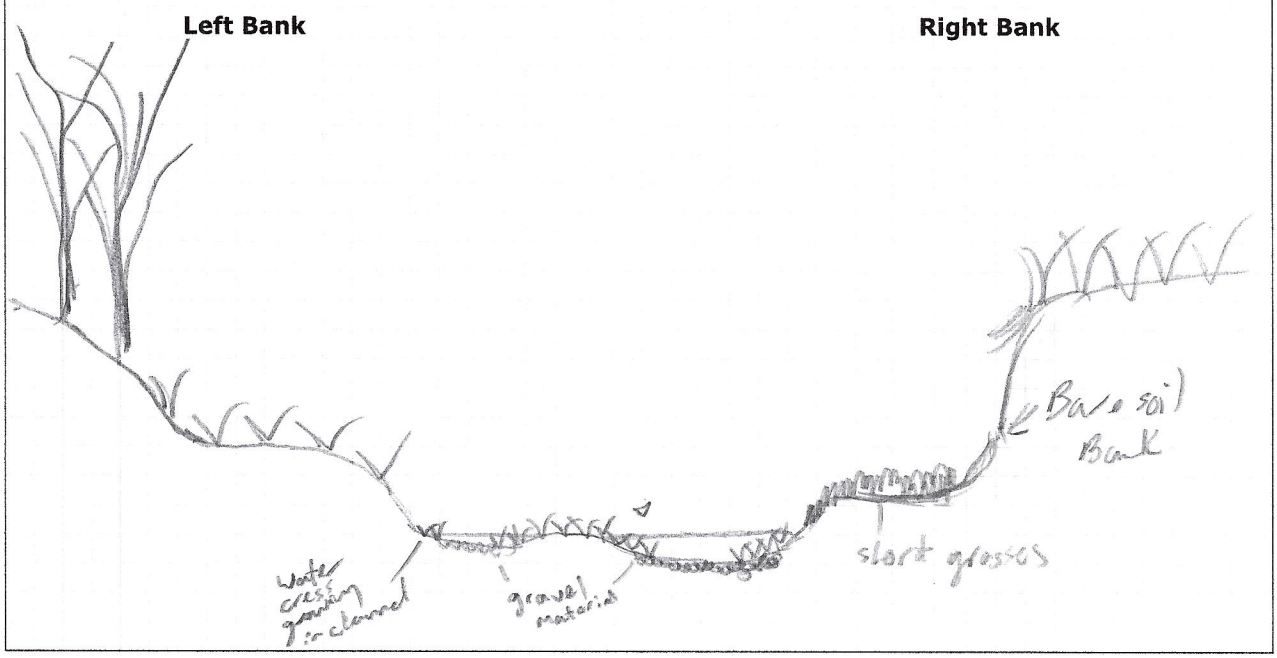
GEO MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB2 - XS5 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 1.0 | m | |
| Bank Angle: | 50-70 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | | m | |
| Penetrometer: | | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Right Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 1.2 | m | |
| Bank Angle: | 30-90 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | | m | |
| Penetrometer: | | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Additional Notes

US LB

**Photo Order:** DS RR

Completed by: _____ Checked by: _____

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GEO MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GR2 - XS6 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 1597 | | | | |
| 0.3 | 1679 | | | | |
| 0.5 | 1769 | | | | |
| 0.6 | 1896 | | | | |
| 0.65 | 2402 | Bottom | slope | | |
| 0.9 | 2497 | WEWL | | | |
| 1.1 | 2548 | | | | |
| 1.3 | 2570 | | | | |
| 1.5 | 2632 | | | | |
| 1.7 | 2654 | | | | |
| 1.9 | 2649 | | | | |
| 2.1 | 2663 | | | | |
| 2.3 | 2692 | | | | |
| 2.5 | 26898 | | | | |
| 2.7 | 2694 | | | | |
| 2.9 | 2620 | | | | |
| 3.13 | 2500 | WEWL | | | |
| 3.20 | 2440 | | | | |
| 3.30 | 2172 | | | | |
| 3.50 | 2160 | | | | |
| 3.80 | 2160 | | | | |
| 4.10 | 2253 | | | | |
| 4.40 | 2334 | | | | |
| 4.70 | 2351 | | | | |
| 5.0 | 2281 | | | | |
| 5.5 | 2250 | | | | |
| 6.0 | 2229 | | | | |
| 6.5 | 2223 | | | | |
| 7.0 | 2163 | | | | |
| 7.2 | 1969 | | | | |
| 7.4 | 1836 | | | | |
| 7.6 | 1639 | | | | |
| 7.8 | 1642 | | | | |
| 8.0 | 1559 | | | | |
| 8.3 | 1503 | Top of | Bank | | |
| 8.6 | 1534 | | | | |
| 9.0 | 1531 | | | | |

### Cross-sectional Morphology

☐ Riffle ☐ Pool ☒ Run ☐ Other

### Substrate

**Sample:** Sediment sample collected

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. _____ | 11. _____ | 21. _____ | 31. _____ |
| 2. _____ | 12. _____ | 22. _____ | 32. _____ |
| 3. _____ | 13. _____ | 23. _____ | 33. _____ |
| 4. _____ | 14. _____ | 24. _____ | 34. _____ |
| 5. _____ | 15. _____ | 25. _____ | 35. _____ |
| 6. _____ | 16. _____ | 26. _____ | 36. _____ |
| 7. _____ | 17. _____ | 27. _____ | 37. _____ |
| 8. _____ | 18. _____ | 28. _____ | 38. _____ |
| 9. _____ | 19. _____ | 29. _____ | 39. _____ |
| 10. _____ | 20. _____ | 30. _____ | 40. _____ |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☐ Sub-Rounded
☐ Rounded

Embededness: _____ %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.007 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

**Discharge:**

☐ Estimated _____ $m^3/s$
☐ Measured _____ $m^3/s$

Completed by: PP Checked by: _____

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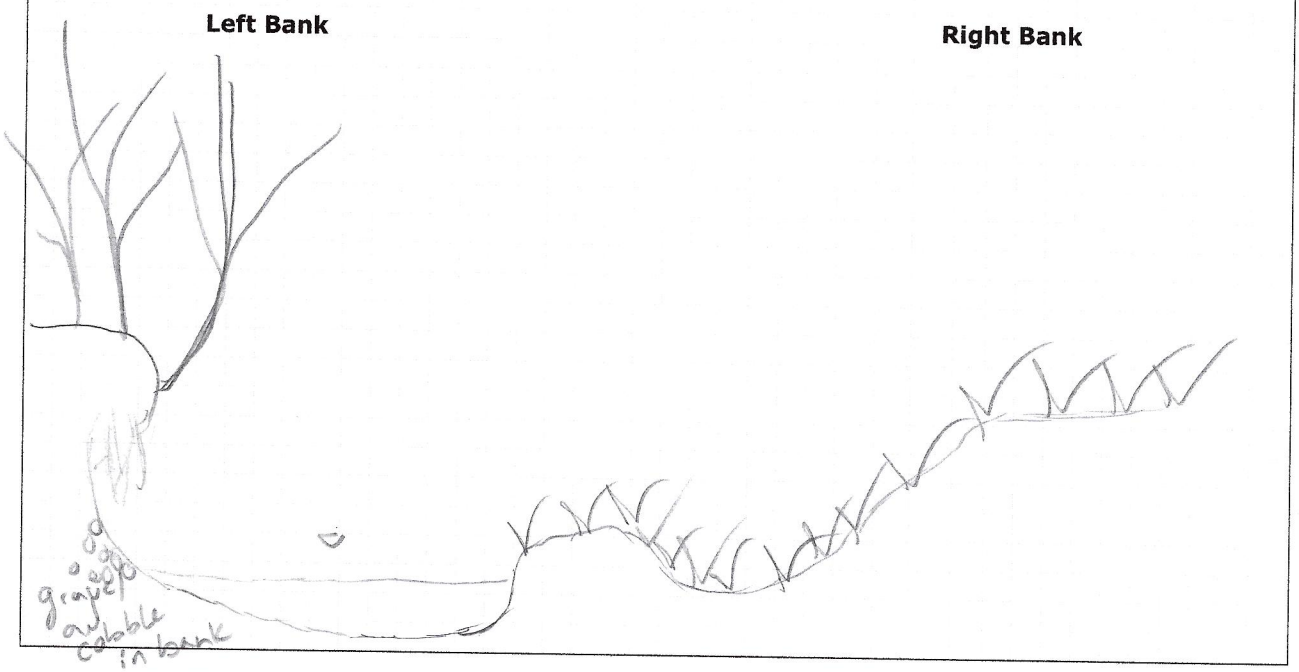
GEO MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB2-XS6 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | |
|---|---|
| ☐ Bedrock | ☒ Gravel |
| ☐ Till | ☒ Small Cobble |
| ☒ Clay | ☐ Large Cobble |
| ☒ Silt | ☐ Small Boulder |
| ☒ Sand | ☐ Large Boulder |

| | | |
|---|---|---|
| Bank Height: | 1.2 | m |
| Bank Angle: | 90 | ° |
| Root Depth: | .2-.3 | m |
| Root Density: | 45 | % |
| Undercut: | 0.27 | m |
| Erosion Pin: | \ | m |
| Penetrometer: | \ | kg/cm² |

Foot Used: ☐ Yes ☐ No

### Right Bank Materials

| | |
|---|---|
| ☐ Bedrock | ☐ Gravel |
| ☐ Till | ☐ Small Cobble |
| ☒ Clay | ☐ Large Cobble |
| ☒ Silt | ☐ Small Boulder |
| ☒ Sand | ☐ Large Boulder |

| | | |
|---|---|---|
| Bank Height: | 1.0 | m |
| Bank Angle: | 60-90 | ° |
| Root Depth: | N/A | m |
| Root Density: | N/A | % |
| Undercut: | N/A | m |
| Erosion Pin: | N/A | m |
| Penetrometer: | \ | kg/cm² |

Foot Used: ☐ Yes ☐ No

### Additional Notes

**Photo Order:** US LB DS RR

Completed by: _____ Checked by: _____

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GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 16106

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GR2 XS7 |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Gamatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 2228 | | | | |
| 0.3 | 2306 | | | | |
| 0.5 | 2370 | | | | |
| 0.65 | 2396 | WEWL | | | |
| 0.80 | 2464 | | | | |
| 1.0 | 2542 | | | | |
| 1.2 | 2608 | | | | |
| 1.4 | 2574 | | | | |
| 1.6 | 2577 | | | | |
| 1.8 | 2592 | | | | |
| 2.0 | 2572 | | | | |
| 2.2 | 2495 | | | | |
| 2.4 | 2458 | | | | |
| 2.65 | 2401 | WEWL | | | |
| 2.8 | 2307 | | | | |
| 3.1 | 2182 | | | | |
| 3.4 | 2017 | | | | |
| 3.7 | 1912 | | | | |
| 4.0 | 1849 | RBBF | | | |
| 4.4 | 1817 | | | | |

### Cross-sectional Morphology

☐ Riffle ☒ Pool ☒ Run ☐ Other

### Substrate

**Sample:**

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | 5 | 11. | silt | 21. | sand | 31. | silt |
| 2. | 7 | 12. | | 22. | | 32. | |
| 3. | 4.5 | 13. | | 23. | | 33. | |
| 4. | 4 | 14. | | 24. | | 34. | |
| 5. | 2.5 | 15. | | 25. | | 35. | |
| 6. | 3.5 | 16. | | 26. | | 36. | |
| 7. | 5 | 17. | | 27. | | 37. | |
| 8. | 7 | 18. | | 28. | | 38. | |
| 9. | 6.5 | 19. | | 29. | | 39. | |
| 10. | 12 | 20. | | 30. | | 40. | |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☒ Sub-Rounded
☐ Rounded

Embededness: 100 %

Subpavement: _____

**Sorting:** ☐ Well ☐ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:**

☐ Estimated _____ m/s
☒ Measured 0.00 m/s

**Method:**

☒ Wiffle ball
☐ Current Meter
☐ ADV
☐ Marsh McBirney
☐ Other

wood jam blocking flow

**Discharge:**

☐ Estimated _____ m³/s
☐ Measured _____ m³/s

Completed by: PP Checked by: _____

Page ____ of ____

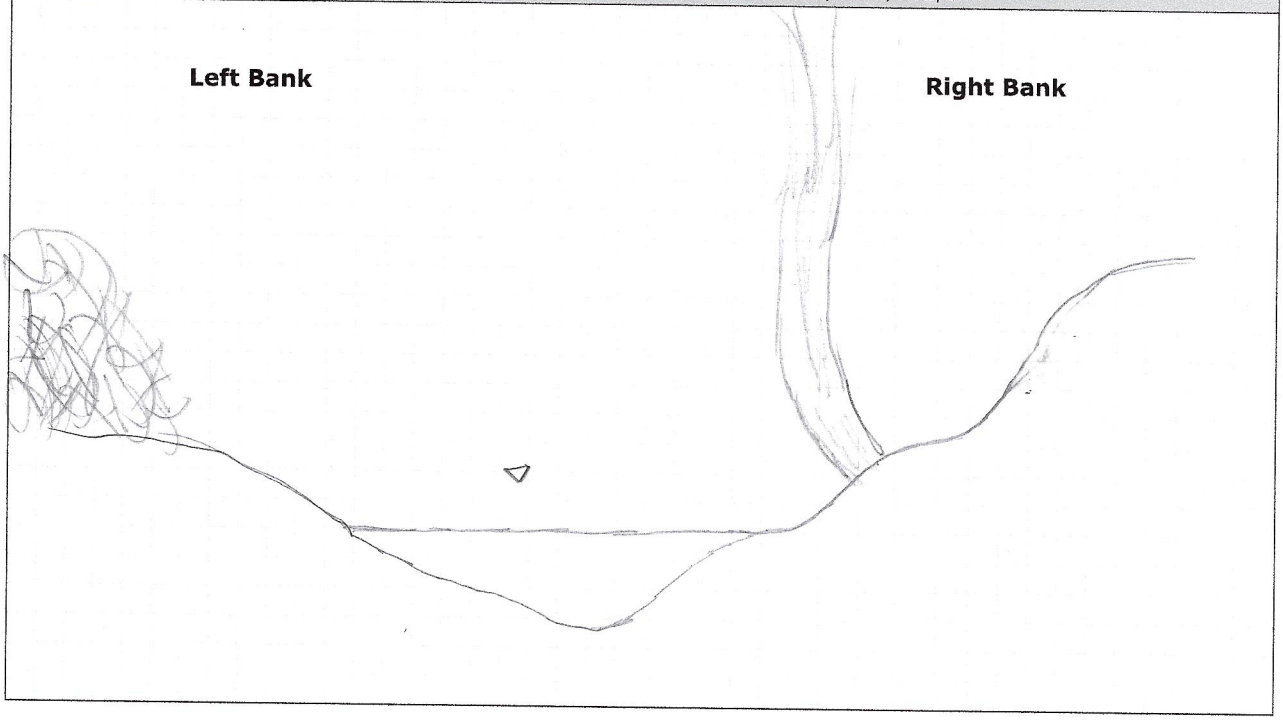
GEO | MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GR2-X57 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

☐ Bedrock ☐ Gravel
☐ Till ☐ Small Cobble
☒ Clay ☐ Large Cobble
☒ Silt ☐ Small Boulder
☒ Sand ☐ Large Boulder

Bank Height: 0.30 m
Bank Angle: 40 °
Root Depth: N/A m
Root Density: N/A %
Undercut: N/A m
Erosion Pin: N/A m

Penetrometer: ____ kg/cm²
Foot Used: ☐ Yes ☐ No

### Right Bank Materials

☐ Bedrock ☐ Gravel
☐ Till ☐ Small Cobble
☐ Clay ☐ Large Cobble
☐ Silt ☐ Small Boulder
☐ Sand ☐ Large Boulder

Bank Height: 0.70 m
Bank Angle: 60 °
Root Depth: N/A m
Root Density: N/A %
Undercut: N/A m
Erosion Pin: N/A m

Penetrometer: ____ kg/cm²
Foot Used: ☐ Yes ☐ No

### Additional Notes

**Photo Order:** US LB
DS RB

Completed by: _____ Checked by: _____

Page ____ of ____

GEO | MORPHIX
Geomorphology Earth Science Observations

## Cross-Section Characteristics

**Project Code:** 1606

| | | | |
|---|---|---|---|
| **Date:** | 16-12-13 | **Reach/Cross-section:** | GB2 - XS8M |
| **Weather:** | Overcast -3°C | **Location:** | Pickering |
| **Field Staff:** | PP + BM² | **Watershed/Subwatershed:** | Ganatsekiagon |

| | | | | | Notes |
|---|---|---|---|---|---|
| 0.0 | 2147 | Pin | | | |
| 0.3 | 2193 | | | | |
| 0.6 | 2143 | | | | |
| 0.9 | 2307 | | | | |
| 1.1 | 2327 | | | | |
| 1.27 | 2398 | WE/WL | | | |
| 1.5 | 2441 | | | | |
| 1.7 | 2457 | | | | |
| 1.9 | 2430 | | | | |
| 2.1 | 2438 | | | | |
| 2.3 | 2437 | | | | |
| 2.5 | 2419 | | | | |
| 2.7 | 2413 | | | | |
| 2.9 | 2404 | WE/WL | | | |
| 3.1 | 2347 | | | | |
| 3.2 | 1738 | | | | |
| 3.4 | 1602 | | | | |
| 3.6 | 1554 | BF - Right Bank | | | |
| 3.9 | 1496 | | | | |
| 4.4 | 1449 | | | | |
| 5.0 | 1423 | | | | |
| 5.3 | 1400 | | | | |
| 5.67 | 1385 | Pin | | | |
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### Cross-sectional Morphology

☒ Riffle ☐ Pool ☐ Run ☐ Other

### Substrate

**Sample:**

☒ Bed ☐ Bank ☐ Subpavement ☐ Water ☐ None

**Pebble Count (cm):**

| | | | |
|---|---|---|---|
| 1. 7 | 11. 1 | 21. Silt | 31. 6 |
| 2. 3 | 12. 2 | 22. | 32. .8 |
| 3. 5 | 13. .5 | 23. | 33. 1.5 |
| 4. 6 | 14. 3 | 24. | 34. .8 |
| 5. 8 | 15. 1.5 | 25. | 35. 2 |
| 6. 4.5 | 16. 3 | 26. | 36. .8 |
| 7. 5.5 | 17. 2 | 27. | 37. .5 |
| 8. 6 | 18. 6 | 28. | 38. 1.5 |
| 9. 6.5 | 19. 4 | 29. | 39. 1 |
| 10. 4 | 20. 2.5 | 30. | 40. 8 |

**Particle Shape:**

☐ Platy ☐ Sub-angular ☐ Well Rounded
☐ Very Angular ☐ Angular ☒ Sub-Rounded
☐ Rounded

Embededness: 25 %

Subpavement: _____

**Sorting:** ☐ Well ☒ Moderate ☐ Poor ☐ Very poor

### Sediment Transport

☐ Observed ☒ Not Observed

**If Observed:**

☐ Suspended ☐ Sliding ☐ Rolling ☐ Saltation

Percentage of Bed Active: _____ %

### Velocity and Discharge

**Velocity:** **Method:**

☐ Estimated _____ m/s ☐ Wiffle ball
☒ Measured 0.056 m/s ☐ Current Meter

**Discharge:** ☐ ADV

☐ Estimated _____ $m^3/s$ ☐ Marsh McBirney
☐ Measured _____ $m^3/s$ ☐ Other

Completed by: PP Checked by: _____

Page ____ of ____

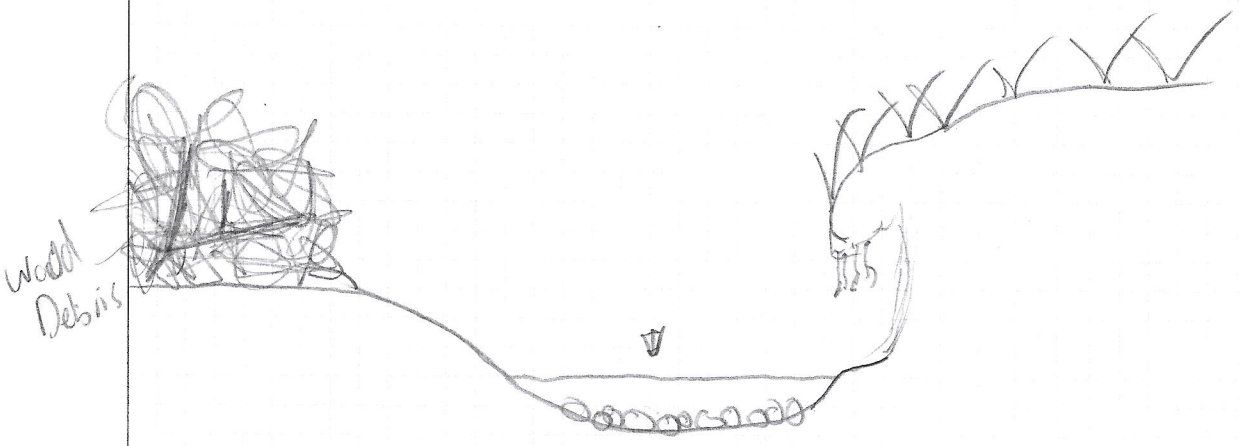
GEO | MORPHIX
Geomorphology Earth Science Observations

## Bank Characteristics

**Project Code:** 16106

| Date: | 16-12-13 | Reach/XS: | GB2 / XS8 |
|---|---|---|---|

**Sketch (Viewed Downstream)** Include: vegetation type and location, soil horizons, woody debris, roots, etc.




### Left Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☒ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☒ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 0.32 | m | |
| Bank Angle: | 25 | ° | |
| Root Depth: | N/A | m | |
| Root Density: | N/A | % | |
| Undercut: | N/A | m | |
| Erosion Pin: | N/A | m | |
| Penetrometer: | / | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Right Bank Materials

| | | | |
|---|---|---|---|
| ☐ Bedrock | ☐ Gravel | | |
| ☐ Till | ☐ Small Cobble | | |
| ☒ Clay | ☐ Large Cobble | | |
| ☐ Silt | ☐ Small Boulder | | |
| ☒ Sand | ☐ Large Boulder | | |
| Bank Height: | 0.61 | m | |
| Bank Angle: | 90 | ° | |
| Root Depth: | 0.05 | m | |
| Root Density: | 30 | % | |
| Undercut: | .32 | m | |
| Erosion Pin: | 0.2 | m | |
| Penetrometer: | / | kg/cm² | |
| Foot Used: | ☐ Yes | ☐ No | |

### Additional Notes

**Photo Order:** US LB DS RB

Completed by: _____ Checked by: _____

Page ____ of ____

# Appendix D:
# Detailed Assessment Summaries

# Detailed Geomorphological Assessment Summary

| | | | |
|---|---|---|---|
| **Project Number:** | PN15089 | **Date:** | November 18, 2015 |
| **Client:** | 1133373 Ontario Inc. Seaton Mid-Block | **Length Surveyed (m):** | 120.9 |
| **Location:** | Reach G6, Sideline 22, Pickering | **# of Cross-Sections:** | 8 |

## Reach Characteristics

| | | | |
|---|---|---|---|
| **Drainage Area:** | Not measured | **Dominant Riparian Vegetation Type:** | Trees |
| **Geology/Soils:** | Modern alluvium | **Extent of Riparian Cover:** | Continuous |
| **Surrounding Land Use:** | Forest | **Width of Riparian Cover:** | >10 channel widths |
| **Valley Type:** | Partially confined | **Age Class of Riparian Vegetation:** | Mature (>30 years) |
| **Dominant Instream Vegetation Type:** | None | **Extent of Encroachment into Channel:** | None |
| **Portion of Reach with Vegetation:** | 0% | **Density of Woody Debris:** | Moderate |

## Hydrology

| | | | |
|---|---|---|---|
| **Measured Discharge ($m^3/s$):** | 0.02 | **Calculated Bankfull Discharge ($m^3/s$):** | 3.20 |
| **Modelled 2-year Discharge ($m^3/s$):** | Not modelled | **Calculated Bankfull Velocity (m/s):** | 1.34 |
| **Modelled 2-year Velocity (m/s):** | Not modelled | | |

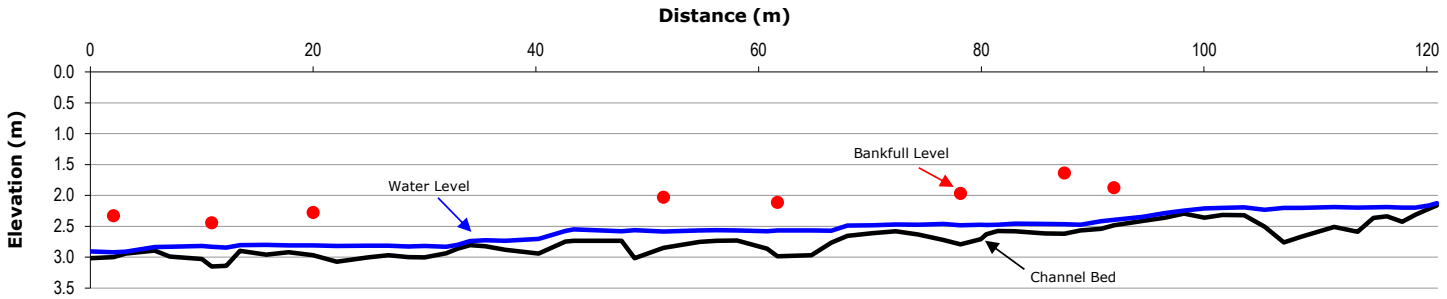
## Profile Characteristics

| | |
|---|---|
| **Bankfull Gradient (%):** | 0.68 |
| **Channel Bed Gradient (%):** | 0.63 |
| **Riffle Gradient (%):** | 4.25 |
| **Riffle Length (m):** | 8.75 |
| **Riffle-Pool Spacing (m):** | 29.08 |

## Planform Characteristics

| | |
|---|---|
| **Sinuosity:** | 1.28 |
| **Meander Belt Width (m):** | Not measured |
| **Radius of Curvature (m):** | Not measured |
| **Meander Amplitude (m):** | Not measured |
| **Meander wavelength (m):** | Not measured |

## Longitudinal Profile




## Bank Characteristics

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Bank Height (m):** | 0.30 | 1.00 | 0.60 |
| **Bank Angle (deg):** | 20 | 90 | 61 |
| **Root Depth (m):** | 0.00 | 0.80 | 0.43 |
| **Root Density (%):** | 0 | 90 | 17 |
| **Bank Undercut (m):** | 0.05 | 0.45 | 0.21 |

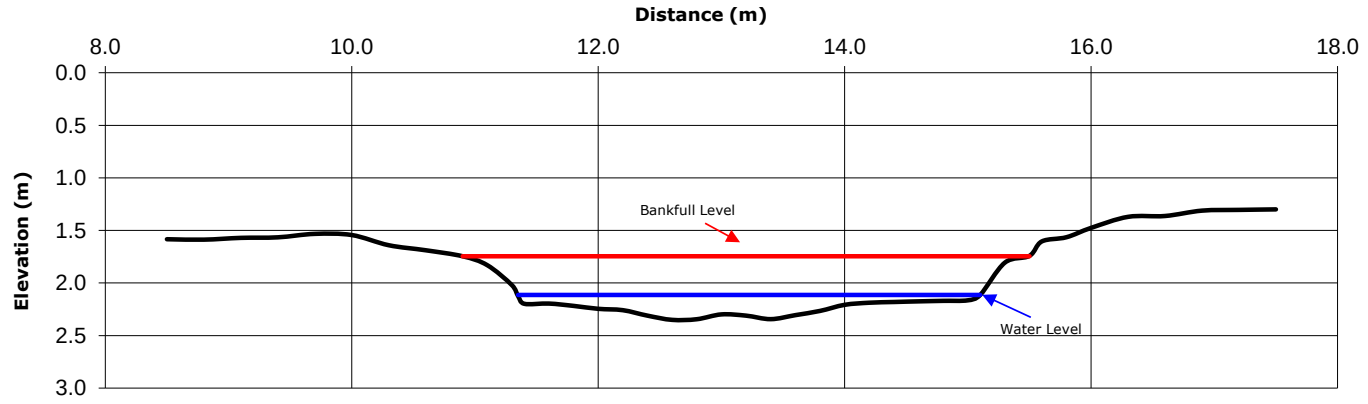
| | Minimum | Maximum | Average |
|---|---|---|---|
| **Torvane Value ($kg/cm^2$):** | | Not measured | |
| **Penetrometer Value ($kg/cm^3$):** | | Not measured | |
| **Bank Material (range):** | | Silt to clay | |

## Cross-Sectional Characteristics

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Bankfull Width (m):** | 3.60 | 5.70 | 4.59 |
| **Average Bankfull Depth (m):** | 0.39 | 0.66 | 0.52 |
| **Bankfull Width/Depth (m/m):** | 5.72 | 13.60 | 9.25 |
| **Wetted Width (m):** | 1.85 | 3.75 | 2.88 |
| **Average Water Depth (m):** | 0.08 | 0.25 | 0.16 |
| **Wetted Width/Depth (m/m):** | 13.21 | 28.04 | 20.10 |
| **Entrenchment (m):** | | Not entrenched | |
| **Entrenchment Ratio (m/m):** | | Not entrenched | |
| **Maximum Water Depth (m):** | 1.85 | 3.75 | 2.88 |
| **Manning's *n* :** | | 0.040 | |

Photograph at cross-section 3 (looking downstream)

### Representative Cross-Section #3



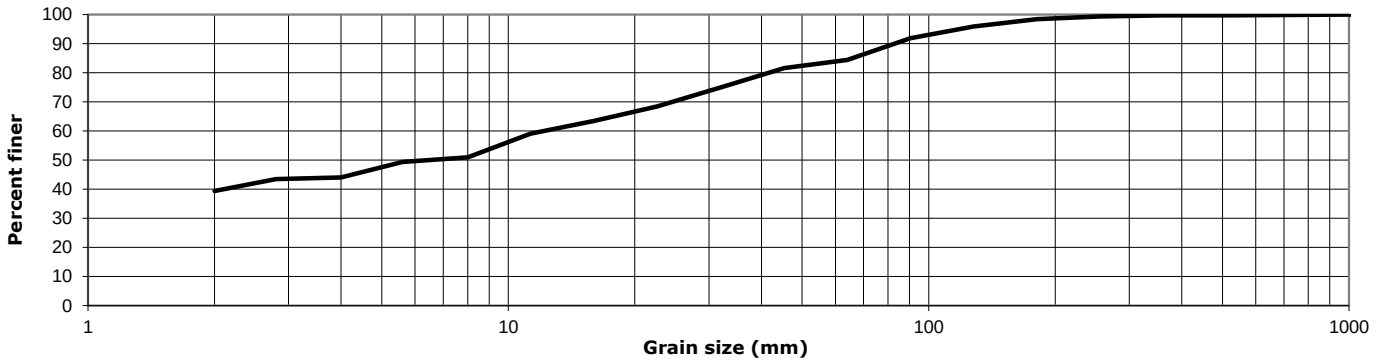

## Substrate Characteristics

**Particle Size (mm)**

| | | |
|---|---|---|
| **$D_{10}$ :** | < | 2.0 |
| **$D_{50}$ :** | | 6.6 |
| **$D_{90}$ :** | | 83.9 |

| | |
|---|---|
| **Subpavement:** | Sand and gravel |
| **Particle shape:** | Sub-rounded and sub-angular |
| **Embeddedness (%):** | 5 to 60% |
| **Particle range (riffle):** | Sand to boulder |
| **Particle Range (pool):** | Sand to boulder |

### Cumulative Particle Size Distribution



## Channel Thresholds

| | | | |
|---|---|---|---|
| **Flow Competency (m/s):** | | **Tractive Force at Bankfull (N/m$^2$):** | 34.84 |
| **for $D_{50}$:** | 0.47 | **Tractive Force at 2-year flow (N/m$^2$):** | Not modelled |
| **for $D_{84}$:** | 1.31 | **Critical Shear Stress ($D_{50}$) (N/m$^2$):** | 4.77 |
| **Unit Stream Power at Bankfull (W/m$^2$):** | 46.56 | | |

## General Field Observations

### Channel Description

This sinuous reach lies along the main branch of Ganatsekiagon creek, within a forested valley surrounded by agricultural land. Average bankfull width and depth were 4.59 m and 0.52 m, respectively. Geomorphic units were well developed and riffle to pool spacing averaged 29 m. Bank substrate was primarily silt and sand. Bank angles ranged from 20° to 90°. Riffle bed material consisted of sand to boulders. Pool bed material ranged from sand to boulders, with a higher percentage of sand. Particle sorting and sand/gravel bar formation was also observed. Erosion was observed on both banks with undercutting up to 0.45 m. Low to moderate woody debris was present within the channel.

**Cross Section 7 - Looking Upstream**

# Detailed Geomorphological Assessment Summary

**Reach GB2**

| | | | |
|---|---|---|---|
| **Project Number:** | PN 16106 | **Date:** | December 13, 2016 |
| **Client:** | Lebovic Enterprises | **Length Surveyed (m):** | 105.0 |
| **Location:** | Ganatsekiagon Creek, Pickering, ON | **# of Cross-Sections:** | 7 |

## Reach Characteristics

| | | | |
|---|---|---|---|
| **Drainage Area:** | Not measured | **Dominant Riparian Vegetation Type:** | Herbaceous |
| **Geology/Soils:** | Till (sandy silt to silty sand) | **Extent of Riparian Cover:** | Continuous |
| **Surrounding Land Use:** | Forest | **Width of Riparian Cover:** | >10 Channel widths |
| **Valley Type:** | Unconfined | **Age Class of Riparian Vegetation:** | Mature (>30 years) |
| **Dominant Instream Vegetation Type:** | Watercress | **Extent of Encroachment into Channel:** | Minimal |
| **Portion of Reach with Vegetation:** | 20% | **Density of Woody Debris:** | High |

## Hydrology

| | | | |
|---|---|---|---|
| **Measured Discharge ($m^3/s$):** | 0.008 | **Calculated Bankfull Discharge ($m^3/s$):** | 0.92 |
| **Modelled 2-year Discharge ($m^3/s$):** | Not modelled | **Calculated Bankfull Velocity (m/s):** | 0.94 |
| **Modelled 2-year Velocity (m/s):** | Not modelled | | |

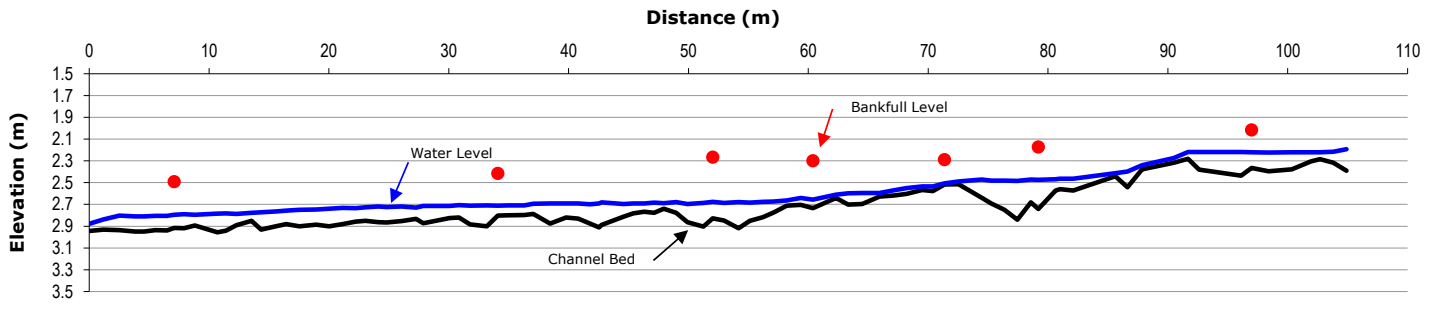
## Profile Characteristics

| | |
|---|---|
| **Bankfull Gradient (%):** | 0.49 |
| **Channel Bed Gradient (%):** | 0.57 |
| **Riffle Gradient (%):** | 1.36 |
| **Riffle Length (m):** | 5.22 |
| **Riffle-Pool Spacing (m):** | 21.68 |

## Planform Characteristics

| | |
|---|---|
| **Sinuosity:** | 2.37 |
| **Meander Belt Width (m):** | Not measured |
| **Radius of Curvature (m):** | Not measured |
| **Meander Amplitude (m):** | Not measured |
| **Meander wavelength (m):** | Not measured |

## Longitudinal Profile




## Bank Characteristics

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Bank Height (m):** | 0.3 | 1.20 | 0.74 |
| **Bank Angle (deg):** | 25 | 90 | 59 |
| **Root Depth (m):** | 0.00 | 75.00 | 4.72 |
| **Root Density (%):** | 0 | 45 | 6 |
| **Bank Undercut (m):** | 0.1 | 0.27 | 0.18 |

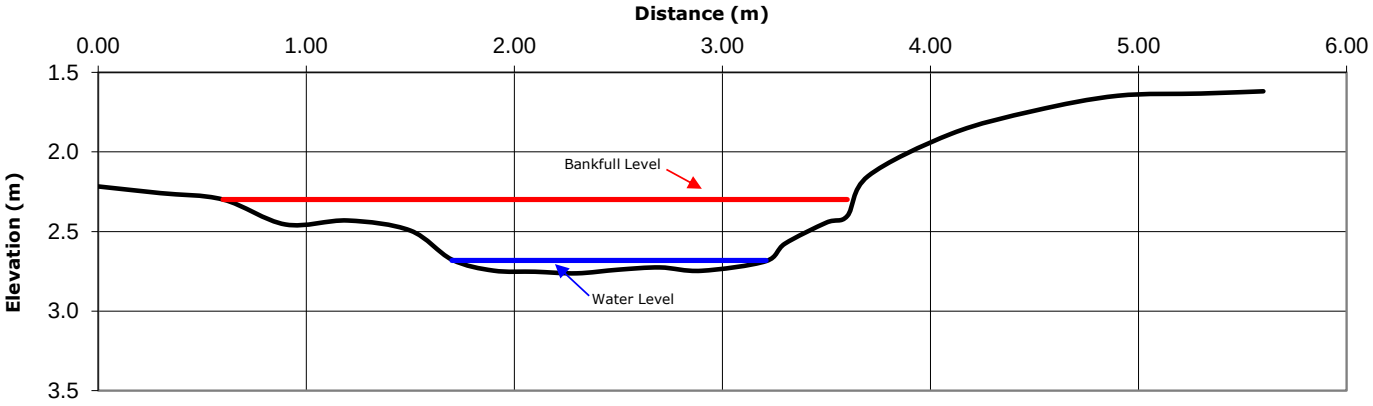
| | Minimum | Maximum | Average |
|---|---|---|---|
| **Torvane Value ($kg/cm^2$):** | | Not measured | |
| **Penetrometer Value ($kg/cm^3$):** | | Not measured | |
| **Bank Material (range):** | | Clay to small cobble | |

## Cross-Sectional Characteristics

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Bankfull Width (m):** | 2.40 | 3.70 | 3.01 |
| **Average Bankfull Depth (m):** | 0.22 | 0.43 | 0.32 |
| **Bankfull Width/Depth (m/m):** | 6 | 17 | 10 |
| **Wetted Width (m):** | 0.56 | 2.23 | 1.43 |
| **Average Water Depth (m):** | 0.05 | 0.14 | 0.10 |
| **Wetted Width/Depth (m/m):** | 8 | 24 | 15 |
| **Entrenchment (m):** | | Not measured | |
| **Entrenchment Ratio (m/m):** | | Not measured | |
| **Maximum Water Depth (m):** | 0.06 | 0.21 | 0.13 |
| **Manning's *n* :** | | 0.045 | |

Photograph at cross section 4 (looking downstream)

### Representative Cross-Section # 4



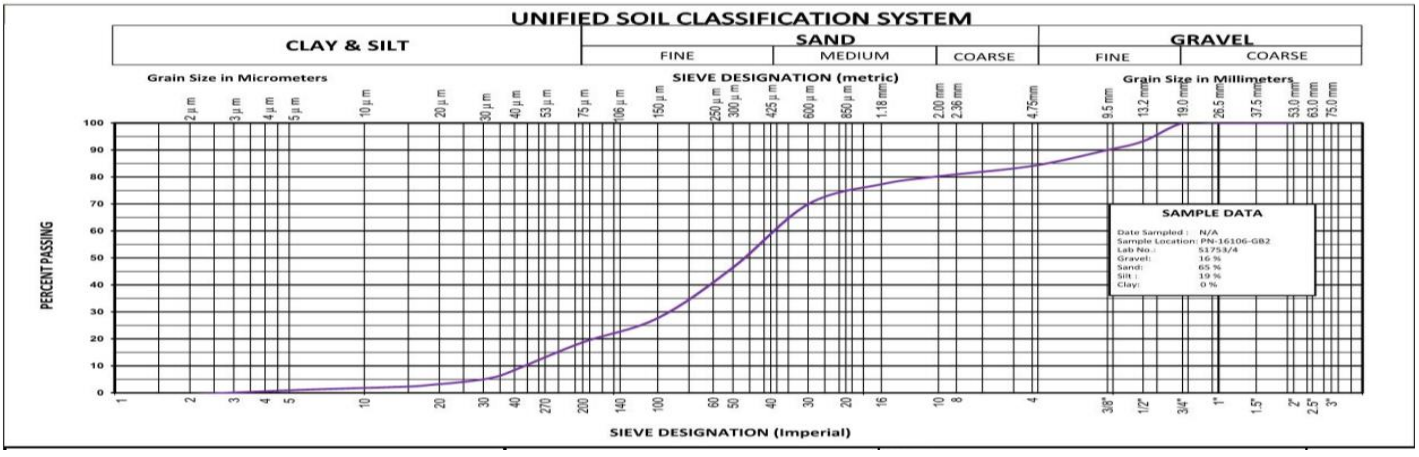

## Substrate Characteristics

**Particle Size (mm)**

| | |
|---|---|
| **$D_{10}$ :** | 0.044 |
| **$D_{50}$ :** | 0.34 |
| **$D_{84}$ :** | 4.75 |

Samples were analyzed by SHAD and Associates Inc.

| | |
|---|---|
| **Subpavement:** | Sand and Gravel |
| **Particle shape:** | Sub-Rounded |
| **Embeddedness (%):** | 0 - 100% |
| **Particle range (riffle):** | Gravel and Cobble |
| **Particle Range (pool):** | Sand and Gravel |



## Channel Thresholds

| | | | |
|---|---|---|---|
| **Flow Competency (m/s):** | | **Tractive Force at Bankfull (N/m$^2$):** | 15.58 |
| **for $D_{50}$:** | 0.27 | **Tractive Force at 2-year flow (N/m$^2$):** | Not modelled |
| **for $D_{84}$:** | 0.84 | **Critical Shear Stress ($D_{50}$) (N/m$^2$):** | 1.46 |
| **Unit Stream Power at Bankfull (W/m$^2$):** | 14.70 | | |

## General Field Observations

### Channel Description

This reach is meandering, has a low gradient and is within a partially confined valley. The riparian zone consisted primarily of cedar trees with no vegetative encroachment. Average bankfull width and depth were 4.02 m and 0.26 m, respectively. Bank material was primarily silt and sand, but ranged from clay to small cobble. Bank angles ranged from 30° to 90°. Erosion on both banks and undercuts of up to 0.30 m were observed. Riffle bed material consisted of gravel and cobbles. Pool bed material consisted of sand and gravel. High densities of woody debris were present within the channel and cutbank.

**Cross Section 3 - Facing Upstreamstream**