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Memorandum

Date: July 20, 2020
Project #: 1903701

To: Frank Merulla
From: Dan McParland & Robin McKillop
cc: Natalie Dunn & Nick Dell
Re: Fluvial Geomorphology Review
2935 & 2955 Mississauga Road

1. Introduction

Palmer completed a fluvial geomorphology review of previously completed geomorphology assessments of Credit River and Sawmill Creek in the vicinity of 2935 & 2955 Mississauga Road in the City of Mississauga (**Figure 1**). This technical memorandum summarizes the findings of our review, particularly in association with development setbacks. Key information about the subject properties (Section 1.1) is followed by a summary of pertinent background information (Section 1.2) and the objectives of the review (Section 1.3). A summary of the methods (Section 2) is followed by a description of the channel morphology and erosional processes near the subject properties (Section 3). Discussion and key conclusions are provided in Section 4.

1.1 Study Area

The subject properties are situated atop a terrace on the north side of Mississauga Road, east of Dundas Street, in the City of Mississauga (**Figure 1**). The combined area of the subject properties is 2.13 hectares. The properties are currently vacant. The proposed development consists of two multi-story apartment buildings. Credit River flows along the northern limits of both properties. The channel has incised through alluvial deposits and till into shale bedrock of the Georgian Bay Formation, which has formed a prominent (up to 11 m high) scarp within the subject properties. The channel incision prevents flood waters from accessing the terrace (Parish Aquatic Services, 2015).

Since 1977, Sawmill Creek discharged into Credit River through a concrete flume structure immediately west of the subject properties (**Figure 1**). Prior to 1977, Sawmill Creek flowed through the subject properties and discharged into Credit River near the eastern property limit (**Figure 1**). Between 1954 and 1977, Sawmill Creek was realigned and straightened on several occasions. Following the construction of the concrete flume, the old Sawmill Creek channel within 2955 Mississauga Road was infilled. The old Sawmill Creek channel within 2935 Mississauga Road conveys storm water from a small catchment (approximately 2 ha) along Mississauga Road. During large flood events on Credit River, the downstream portion of the

Old Sawmill Creek channel can be inundated by backwater from Credit River (Parish Aquatic Services, 2015).

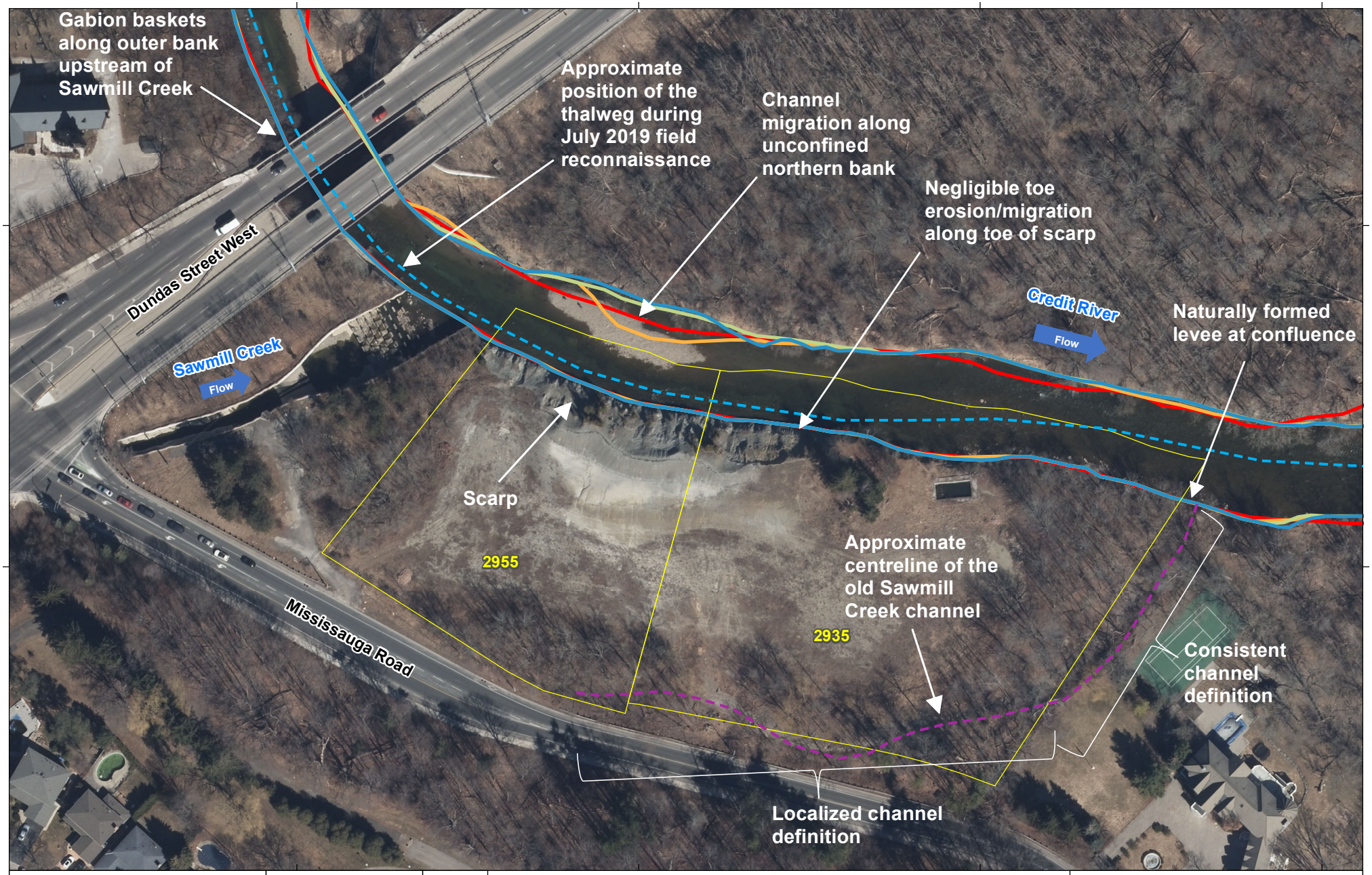
1.2 Background

To facilitate the review of the Official Plan Amendment and Rezoning applications for the subject properties, the City of Mississauga requires Geomorphic and Geotechnical Assessments as requested in its letter dated April 12, 2019 (File: DARC 19/78 W8). Geomorphic and geotechnical assessments have been completed near and within the subject properties over the past 12 years. Terraprobe (2008, 2010) completed a slope stability and streambank erosion analysis along Credit River and the old Sawmill Creek channel. Parish Aquatic Services (2015) completed a geomorphic assessment of former Sawmill Creek channel, concluding that the former channel of Sawmill Creek only conveys storm flows periodically and no longer functions as a natural watercourse. Active bed and bank erosion along the old Sawmill Creek channel were not observed as part of their assessment.

Terraprobe (2008) determined the long-term stable slope for the scarp along the northern property using subsurface information obtained from four boreholes positioned near the crest of the scarp. The boreholes ranged in depth from 7.4 m to 9.2 m. Terraprobe found a thin layer of topsoil or fill underlain by *in situ* till. Shale bedrock is present beneath the till and is currently exposed along the lower 2-3 m of the scarp. The long-term stable slope of the scarp was determined using stable slope lines for the shale bedrock and overburden in conjunction with a toe erosion allowance. A toe erosion allowance of 5 m was chosen for the scarp along Credit River because 1) it was the most conservative option for active erosion along shale bedrock (2 m to 5 m) according to Ontario Ministry of Natural Resources (MNR) protocols (2001) and 2) a 5 m minimum toe erosion allowance is required based on Credit Valley Conservation (CVC) protocols (1992). Due to lack of active erosion along the former Sawmill Creek channel, a 4 m toe erosion allowance was determined based on CVC protocols (1992) for clayey silt till soil. Additional analyses by Terraprobe (2010) using shallow boreholes determined that historic site grading did not have implications for the previously conducted stable slope assessment.

1.3 Objectives

The main objective of this geomorphology review is to confirm the currency and representativeness of the applicable results of the previously completed geomorphic assessments of the old Sawmill Creek channel (Parish Aquatic Services, 2015) and Credit River (Terraprobe, 2008). In particular, Palmer reviewed Parish Aquatic Services' (2015) conclusion that the former channel of Sawmill Creek is no longer considered to function geomorphologically and hydraulically as a natural watercourse. As well, the toe erosion allowances used by Terraprobe (2008) in the stable slope analyses are thoroughly reviewed. Review of the stable slope component of the erosion hazard analyses completed by Terraprobe (2008) and of the regulatory flood elevation analyses completed by Parish Aquatic Services (2015) were not part of Palmer's scope.



CLIENT: Frank Merulla

PROJECT: 2935 & 2955 Mississauga Road

PREPARED BY: Palmer

0 5 10 15 20 25 metres

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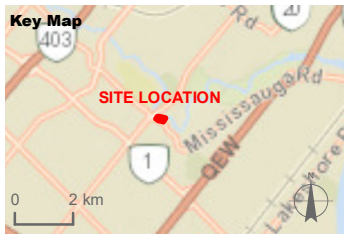
PROJECT NO.	1903701
REVISION:	1-1
DATE:	Jul 20, 2020
SCALE:	1:1500
DRAWN:	KG
DATUM:	NAD 1983
CHECKED:	DM
PROJECTION:	UTM zone 17

LEGEND:

Historic Channel Banks
- 2018
- 2009
- 1999
- 1975

Subject Properties

Imagery (2018) provided by Region of Peel.



Study Area

Figure 1

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2. Methods

The fluvial geomorphology assessment was completed through a combination of desktop analysis and field investigations. We reviewed several important background information sources, including the previous geomorphic assessments (Terraprobe 2008, 2010; Parish Aquatic Services, 2015), 0.5 m-contour topographic data provided by Terraprobe, existing physiography and surficial geology mapping (Ontario Geological Survey, 2019a, 2019b). Historic and recent aerial imagery from the Region of Peel's webmap server (1975, 1999, 2009, 2018) were examined to characterize historical channel conditions and previous anthropogenic disturbances. In particular, the toe of the scarp near the northern property limits was delineated in ArcGIS to determine if the scarp had eroded and migrated over the period of photographic record.

Field reconnaissance was completed by a Palmer Senior Fluvial Geomorphologist on July 11, 2019. Credit River was near base flow conditions and no water was observed in the old Sawmill Creek channel. The purpose of the field visit was to examine patterns and processes of erosion, observe bed and bank materials, and ground truth aerial photograph-based interpretations along Credit River and the old Sawmill Creek channel.

3. Description of Channel Morphology and Erosional Processes

3.1 Old Sawmill Creek Channel

Within 2955 Mississauga Road, the old Sawmill Creek alignment is anthropogenically infilled and/or lacked channel definition (**Figure 1**). Localized channel definition is present within the 2935 Mississauga Road property where the channel parallels Mississauga Road (**Photo 1**). Localized scour has occurred downstream of three separate storm water culverts that drain beneath Mississauga Road. Consistent channel definition is present along the eastern property limit, immediately upstream of the confluence with Credit River (**Photo 2**). Along this section, the channel cross-section is trapezoidal and the bed and banks are locally armoured with cobble, boulders and concrete rubble. The top of bank width (16 m) and top of bank depth (2 m) is considerably wider and deeper than along the upstream section parallel to Mississauga Road. It is also abnormally large for the drainage area (9.9 km^2) of Sawmill Creek prior to the realignment to the concrete flume in 1977. The trapezoidal shape, unnaturally large cross-sectional dimensions, and local hardening is likely a result of previous anthropogenic realignment and straightening prior to 1977.

Within the old Sawmill Creek channel along the eastern property limit, downstream-oriented small woody debris and a conspicuous absence of vegetation and organic litter along the centre of the channel (approximately 1.5 m wide) suggest the channel periodically conveys minor flow. Periodic flow could be a result of stormwater from the small upstream catchment or the falling limb of floods from the Credit River that inundate the lower section of the old channel. Along the periphery of the over-widened channel, deciduous trees are present suggesting flows rarely inundate the entire channel bed. A naturally formed levee and rafted woody debris block the mouth of the old Sawmill Creek channel at the confluence with Credit River (**Photo 3**). The formation and persistence of the levee demonstrate that flows in the old Sawmill Creek channel remain inconsequential.

Photo 1. Looking downstream along the Old Sawmill Creek channel adjacent to Mississauga Road in 2935 Mississauga Road. The channel lacks consistent definition.

Photo 2. Looking upstream in the Old Sawmill Creek channel along the eastern extent of 2935 Mississauga Road, just upstream of the confluence with Credit River. Remnants of localized bed and bank armouring are present. Trees and shrubs have grown along the periphery of the engineered channel.

Photo 3. Looking downstream at a naturally formed levee along Credit River that has blocked the mouth of the old Sawmill Creek channel. Rafted woody debris has accumulated on the berm and upstream into the old Sawmill Creek channel.

3.2 Credit River

The subject properties are located along the downstream limb of a large meander of Credit River (**Figure 1**). The high terrace scarp along the northern property limit confines the meander. Upstream of Dundas Street (i.e. along the upstream limb of the meander), the outer bank is hardened with gabion baskets. Sawmill Creek discharges into Credit River through the concrete flume near the apex of the meander. Downstream of the Sawmill Creek confluence, shale is exposed along the toe of scarp for approximately 150 m (**Photo 4**, **Photo 5**). Downstream of the scarp (i.e. near the eastern extent of 2935 Mississauga Road), the thalweg is gradually deflected towards the opposite bank near the confluence with the old Sawmill Creek channel (**Photo 6**). The southern bank of Credit River, downstream of the scarp, is well vegetated with mature trees and is protected by natural cobble-sized bed material and anthropogenically placed riprap and concrete rubble.

Along the scarp, the exposed shale is nearly vertical and extends approximately 2 m to 3 m up the bank (**Photo 7**). Till overlies the shale. Locally, an alluvial ‘cap’ of gravel, cobbles and boulders was observed atop the till. The alluvial material would have been deposited when the bottom of Credit River was roughly coincident with the top of the terrace in the early Holocene (i.e. before the channel incised and the scarp was formed). Based on overlay analyses, the position of toe of the scarp has remained consistent since 1975 (**Figure 1**).

Photo 4. Looking downstream from the existing confluence of Sawmill Creek and Credit River. The thalweg of Credit River is positioned against or near the terrace scarp for approximately 170 m before being deflected towards the eastern bank.

Photo 5. Looking upstream along Credit River from 2935 Mississauga Road.

Photo 6. Looking upstream along Credit River from the confluence with the old Sawmill Creek channel. Downstream of the exposed scarp the thalweg is deflected towards the opposite bank.

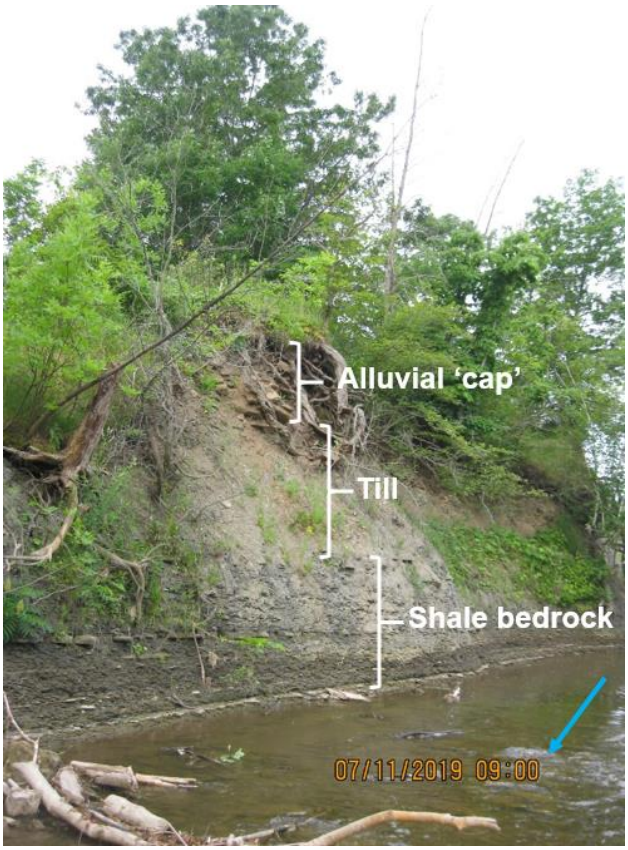

Photo 7. Generalized stratigraphy of the terrace scarp within the 2935 Mississauga Road property.

4. Discussion & Conclusions

Palmer's geomorphologists completed a review of previous fluvial geomorphic assessments (Terraprobe 2008, 2010; Parish Aquatic Services, 2015) for 2935 and 2955 Mississauga Road. Palmer's review involved desktop analyses, including a channel overlay assessment of Credit River, and field reconnaissance.

Due to a severe reduction in drainage area, a lack of active erosion, and vegetation growth within the channel, we concur with Parish Aquatic Services (2015) that geomorphic and hydraulic processes along the old Sawmill Creek channel have been so severely compromised that it no longer functions as a natural watercourse. The 4 m toe erosion allowance used by Terraprobe (2008) in association with its slope stability assessment along the southern limit of the property aligns with CVC (1992) protocols, based on the noted materials (clayey silt till) and a lack of active erosion along the old Sawmill Creek channel. However, a 4 m toe erosion allowance is overly conservative based on field observations, its abandonment as a watercourse, and more recent and widely applied MNR (2001) protocols. A toe erosion allowance of 2 m would align with MNR (2001) protocols for the old Sawmill Creek channel, based on the observed clayey silt till, lack of active erosion, and a bankfull width of 5 to 30 m, and thus be more appropriate.

The southern bank of Credit River has not migrated over 43 years of photographic record (**Figure 1**). In this case, however, the 5 m toe erosion allowance used by Terraprobe (2008) in association with its long-term stable slope assessment is appropriately conservative based on CVC (1992) and MNR (2001) protocols. The exposed face of shale comprising the lower bank is actively weathering and vulnerable to fluvial and colluvial erosion. Furthermore, if the error inherent in riverbank linework is assumed to be approximately 2 m, then a 43-year record of 'unmeasurable erosion' could equate to as much as 4.7 m (~5 m) of migration over a 100-year period.

5. Certification

This memo was prepared and reviewed by the undersigned:

Prepared By:

Dan McParland, M.Sc., P.Geo.
Senior Fluvial Geomorphologist

Reviewed By:

Robin McKillop, M.Sc., P.Geo., CAN-CISEC
Principal, Geomorphologist

References

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