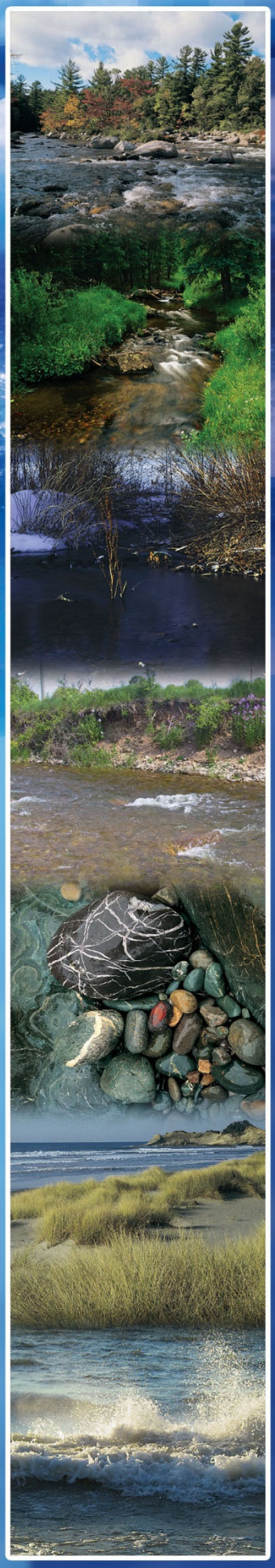


water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Improvements to Williams Parkway from Dixie Rd. to Torbram Rd.

Brampton, Ontario

Fluvial Geomorphological and Meander Belt Width Assessment

March 20, 2023

March 20, 2023
WE 19023

Ms. Salina Chan
Environmental Planner
Parsons
625 Cochrane Dr., Suite 300
Markham On.
L3R 9R9

Dear Ms. Chan:

RE: Improvements to Williams Parkway from Dixie Rd. to Torbram Rd. – Brampton, Ontario
Fluvial Geomorphological and Meander Belt Width Assessment

1.0 INTRODUCTION

The City of Brampton has engaged Parsons along with Water's Edge to complete studies for road improvements along a segment of Williams Parkway in Brampton. The Terms of Reference found within the proposal document state that a Fluvial Geomorphology report is required to support the project. The study area is located on Williams Parkway and is bounded by Dixie Rd. to the west and Torbram Rd. to the east (see **Figure 1**). Within this section there are two watercourse crossings that need to be assessed through a fluvial geomorphological and meander belt width study. These studies will provide insights into the existing conditions as well as the historical conditions of the watercourses and suggest the appropriate corridor and road crossing sizes where applicable.

The larger of the two creeks is Spring Creek which is the east branch tributary of Etobicoke Creek. It runs north to south across Williams Pkwy and is located between Dixie Rd. and Bramalea Rd. The second watercourse is the east branch of Mimico Creek. It drains Professor's Lake which is north of Williams Pkwy and runs along Williams Pkwy between Jordan Blvd. and Torbram Rd.

The improvements to Williams Pkwy may affect either one or both of the creeks within the Study Area. Potential widening of the road could interfere with the suggested meander belt width of the creeks or require extension/replacement of the crossings. In this case, proposed changes near the watercourse are to follow specific guidelines from the TRCA that focus on the ecological and geomorphic aspects of a natural channel. These include limiting the impact to the existing form and function of the existing watercourse as well as the potential future form and function as far as is feasible.

Site inspections and a geomorphic survey of the study area were completed by Water's Edge staff in the summer of 2022. The site inspections were undertaken after an initial review of the mapping and available literature was completed to confirm site and general system characteristics. In this report, we have outlined the results of our investigations on the watercourses associated with the proposed road improvements.

Data sources for this assessment include the following:

- Aerial Photos (City of Brampton and TRCA),
- Physiography of Southern Ontario by Chapman & Putnam (digital data from Ministry of Northern Development and Mines (MNDM)),
- Geomorphic and Engineering Design Services for Jefferson, Jayfield, and Jordan Parks Restoration Project (Beacon Environmental Ltd.)
- Ontario Flow Assessment Tools III (OFAT III) (from MNRF) and,
- Site Inspections by Water's Edge staff.

2.0 EXISTING CONDITIONS

2.1 Geology and Physiography

Reviewing the site's surficial materials is important to evaluate active channel processes. Stream channel form and sediment supply are controlled by the region's physiography and surficial geology. The Study Site is split between two physiographic regions, with Spring Creek in the South Slope and Mimico in the Peel Plain. The surficial geology of Spring Creek at the Study Site is modern alluvials of clay, silt, sand, and gravel situated within a till consisting of clay to silt-textured till derived from glaciolacustrine deposits or possibly shale. Immediately upstream of Williams Pkwy there is also an exposure of Paleozoic bedrock. Mimico Creek is also partially found within modern alluvials at the upstream portion of the Study Area but move into fine-textured glaciolacustrine deposits consisting of silt and clay with minor sand and gravel. The watercourse through here of course is a concrete lined channel although it does interact with underlying material due to the erosion along it.

2.2 Watershed and Creek Characteristics

The following data was acquired using the Ontario Watershed information Tool from the MNRF. Subwatershed information such as drainage area and landcover percentages are based on the subwatershed at Williams Pkwy. Spring Creek is likely a 2nd or 3rd order creek that has a total drainage area of 14.9 km^2 upstream of Williams Pkwy. The creek originates north of the Study Area and has approximately 10.1 kms of length in the main channel before the Study Site. The general slope of Spring Creek above the Study Area is 0.5%. The major land cover/use for Spring Creek subwatershed is community and infrastructure at 47% while agricultural land accounts for 37%. Mimico Creek is a 2nd order creek that has a total drainage area of 3.8 km^2 upstream of Williams Pkwy. The creek originates northwest the Study Area and has approximately 4.3 kms of length in the main channel before the Study Site. The general slope of Spring Creek above the Study Area is 0.9%. The major land use for Mimico Creek subwatershed is community and infrastructure at 96%.

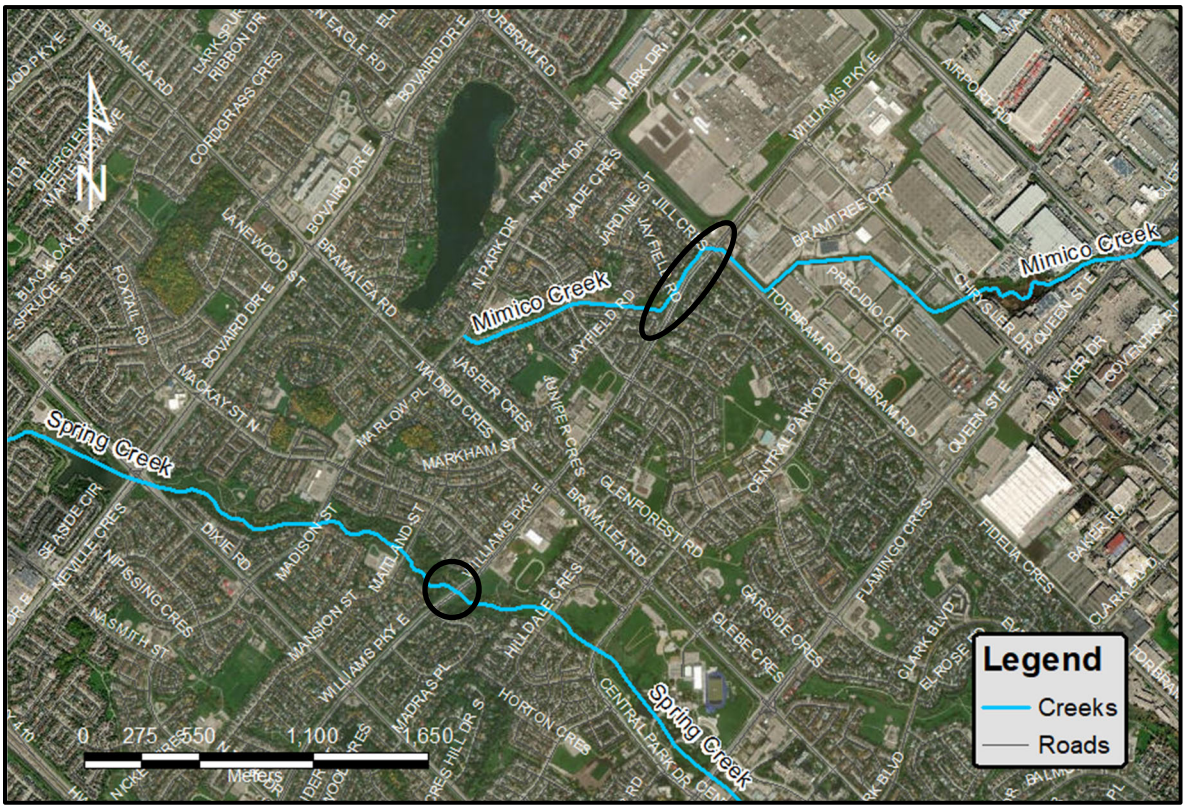


Figure 1: Study Area and Crossing Locations

2.1 Geomorphic Channel Conditions

Field investigations collected the general bankfull characteristics of the channel as well as observations of the surrounding floodplain and riparian zone. Characteristics such as the bankfull width and depth of a cross section were measured and recorded. In addition to the survey, the existing substrate was analyzed for each watercourse through visual assessment to determine the approximate particle size. However, both watercourses have been heavily modified with gabion baskets and concrete therefore the existing substrate is either influenced by rip rap or as is the case for stretches of Mimico Creek there is no substrate as the channel is completely concrete.

Spring Creek (Etobicoke Creek East Branch)

The Study Reach for this section of Spring Creek is from Maitland St. down to halfway between Williams Pkwy and Hilldale Crescent where the channel changes from gabion (failed) and concrete. Although the concrete is also failed it had mush different characteristics than the upstream section of Spring Creek and was therefore not included in the study. Spring Creek flows from north to south through Williams Pkwy. The existing conditions of the channel are heavily influenced by its urban setting. It is immediately clear the channel regularly sees flashy rapid urban runoff from storm events. The floodplain shows signs of regular flooding with debris and loose vegetation caught in the underbrush of trees and shrubs.

The channel had a significant realignment during the 1970s when the surrounding subdivision was created. This realignment included the placement of gabion baskets as the channel lining as well as concrete through the Williams Pkwy bridge. Since that time the gabion baskets have all but completely disintegrated leaving only small portions of basket and copious amounts of rip rap in the channel. Upstream of Williams Pkwy the original width of the gabion lined channel was approximately 3 m, while the existing channel has widened to approximately 4 m. The bankfull width of the channel downstream of Williams Pkwy ranges from approximately 4 m through the narrower riffles to as large as 7 m in some pools. The downstream reach has more space between the channel and the trail system to allow for lateral migration. On the upstream side of the road the channel comes into contact with this asphalt trail system in a few locations. This points to lateral migration of the channel although the failure of the gabion plays into this. Erosion is common throughout the entire Study Reach of the creek, with the outside bends of pools being heavily eroded but erosion is also occurring on both sides of most riffles.

The riparian zone is typically densely vegetated which provides upwards of 80% shading of the channel. The roots of trees and shrubs that line the creek are exposed where both old and young roots are visible. The substrate majority of the substrate found within the channel is sourced from the failed gabion baskets. These dominate the riffles and are also found in pools although often silted over. Silt is found throughout the watercourse, likely sourced from the underlying tills which were exposed in some locations. Deposits of gravels were also found within some riffles and deposition zones however it is most likely these are sourced from channel modification works as well.

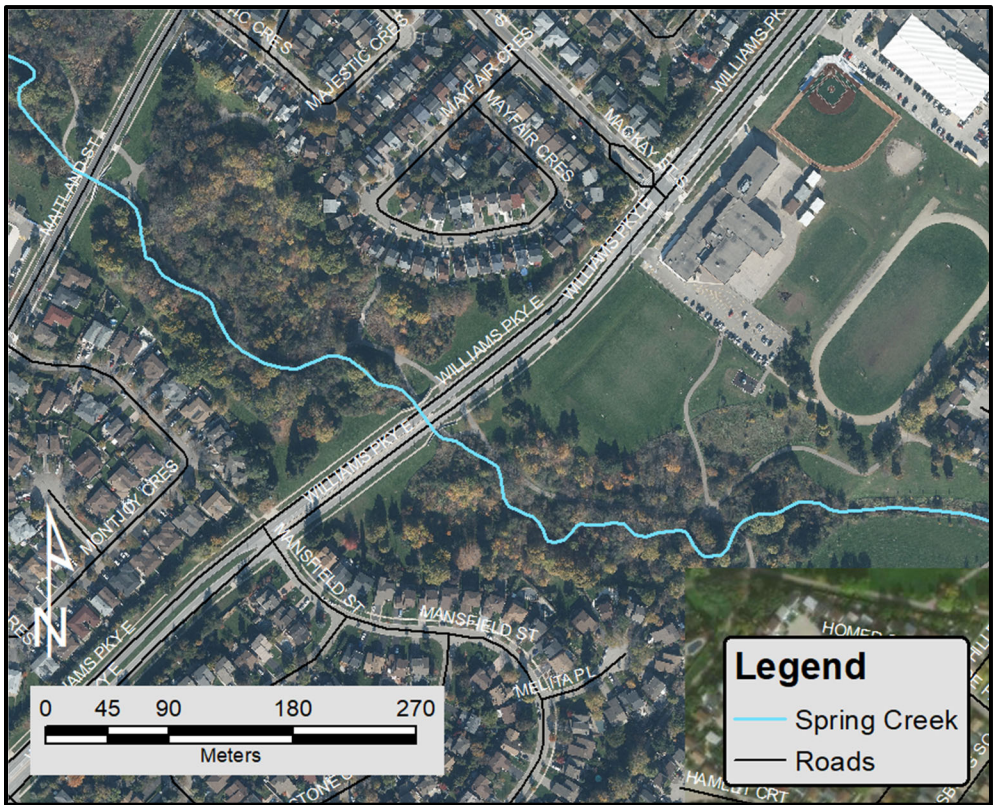


Figure 2: Aerial View of Spring Creek at Williams Pkwy

East Branch Mimico Creek

The Study Area for the East Branch of Mimico Creek extends from Jayfield Rd. to Torbram Rd., which is 500 m in length. The existing channel is a concrete lined channel that was constructed in the 1970s. Over time this straightened concrete channel has degraded and at this point has essentially failed. The concrete channel has been scoured along both sides and large pools have formed there. In 2021 the TRCA initiated a stream restoration project on the section from Professor's Lake up to Williams Parkway to restore the channel to a more stable and natural condition. However, a short 200 m section up to Torbram Rd. has been left out of the stream restoration construction, and it is also in very poor structural condition.

As noted, the channel is a failed concrete lined channel that is eroding the banks adjacent to it. Very little can be gleaned from the channel geomorphic characteristics due to the interference of the concrete providing no opportunity for the creek to establish any equilibrium. The riparian along this 200 m reach is narrow and includes trees and shrubs with some grasses. Canopy coverage is roughly 75% and the riparian has localized gaps along it. The banks have young and old roots that have been exposed by the bank erosion. The substrate found along the channel where the banks have been exposed by erosion includes silt, sand, and gravel which are likely native. Additional materials were also present in the eroded areas which included blocks of shale and concrete which are likely not normally native to this section of the channel and could have been imported when the concrete channel was constructed.

A natural channel design and report was prepared by Beacon Environmental for the new Mimico Creek channel. The assessment and design report for the project titled Geomorphic and Engineering Design Services for Jefferson, Jayfield, and Jordan Parks Restoration Project (Beacon Environmental Ltd.) discusses the conditions of Mimico Creek in the study area as well as the proposed conditions. The designed bankfull channel for the section immediately upstream of Williams Pkwy has a width of 3.90 m in riffles and 4.50 m in pools. The maximum bankfull depth is 0.60 m in riffles and 1.10 m in pools. The range of substrate in the riffles is 50 mm to 300 mm, with larger 500 mm rocks used in a series of vortex weirs to stabilize the channel.

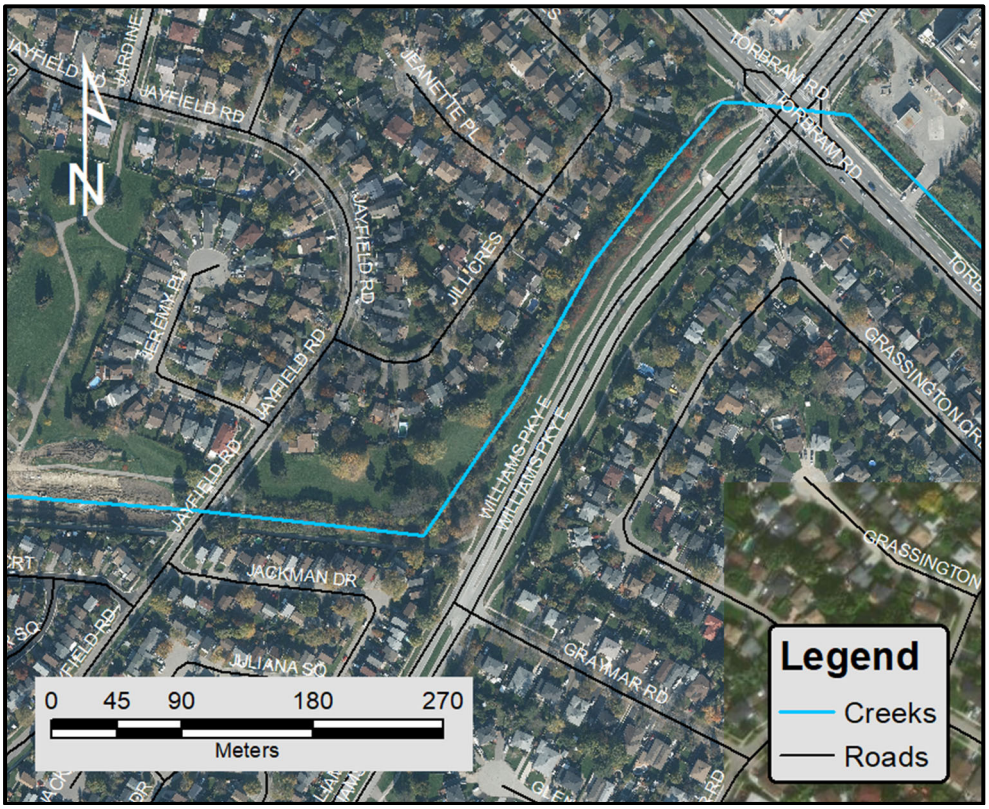


Figure 3: Aerial View of Mimico Creek at Williams Pkwy

3.0 MEANDER BELT WIDTH ASSESSMENT

Assessment of the meander belt widths of both creeks is undertaken in accordance with commonly accepted standard meander belt width delineation procedures which are established for watercourses as laid out by the Toronto Region Conservation Authority's *Belt Width Delineation Procedures* manual. Using the manual, the two creeks were evaluated to identify the final meander belt widths near Williams Pkwy.

3.1 Historical Review

As noted, both channels have been historically altered and forced into concrete or gabion lined channels. This has mostly changed the ability for the channels to develop a natural meander pattern, although since their realignments the channels have shown signs of lateral migration. A review of a series of historical air photos (1967, 1976, 1981, 1993, 2012, and 2021) shows that between 1976 and 1981 Spring Creek and Mimico Creek were both realigned and channelized. This coincides with the significant urban development in the area. Spring Creek shows signs of channelization and development in the 1976 air photo as well, although this channelization is south of Williams Pkwy.

For Spring Creek, prior to 1976 the channel and the surrounding landscape was solely agricultural. During this time, it appears the channel meandered freely through an unconfined landscape. Multiple cut-off and oxbow channels are also noted on the 1967 air photo. In the study area the maximum meander belt width in 1967 was 60 m and averaged 37 m, which stands in contrast to the roughly 40 m meander maximum belt and 27 m average belt width post-channelization. Similarly, and expectedly, sinuosity was significantly decreased through the channelization process. The 1967 channel had a sinuosity of 1.27 while the current channel has a sinuosity of 1.09. The current alignment of Spring Creek does generally follow the historical one, although with many of the meanders removed.

3.2 Belt Width Assessment

A typical meander belt width cannot be completed for Mimico Creek since the alignment of the channel does not represent the true potential belt width of Mimico Creek. In addition, the lack of historical air photos with which to provide a historical alignment were not available. Therefore, another method is required to determine the ideal meander belt width of the channel. The aforementioned report for the Mimico Creek restoration project listed meander belt widths for the creek based on regime equations. These belt widths were confirmed as part of this assessment using the same equations by Williams (1986) and Ward (2002). With these the final belt width for Mimico Creek along Williams Pkwy is assumed to have an ideal range of 21 - 28 m. However, these widths were not actually used for the design of the channel due to the constraints of the road and housing along either side. Instead, the design used a roughly 15 m belt width along with a sinuosity of 1.10. Since these constraints along the creek corridor are not likely to change in the future, particularly with the proposed road improvements, a 15 m or greater belt width is deemed acceptable.

For Spring Creek, the TRCA manual will be used to delineate the meander belt width. The manual notes that when a channel has been straightened but there are historical air photos on which to base a meander belt width that they should be used. This is the case for Spring Creek with the 1967 and 1976 air photos available and therefore they will be used to determine the ideal meander belt width for this study. They however not of high enough quality to produce erosion measurements from. Procedure 2 from the TRCA manual was most applicable as there is no anticipated change in the hydrologic regime through the study area. The process of identifying the final meander belt width is outlined below.

Firstly, the meander axis needs to be identified for the channel. The meander axis is the general valley direction or trend of a stream's planform (**Map 1**). Next, all procedures, including Procedure 2, require that the confinement of the channel be determined. The OMNR guideline considers unconfined channels to be in areas of 'relatively flat to gently rolling plains and not confined by valley walls.' Confinement can be difficult to determine for some creeks, but in general the main concern is whether the channel is definitively bound to its valley corridor or if it contacts large valley walls. A valley may be described as having slopes of 3 metres or greater as well. Reviewing the contours and through site observations the site was assessed to be unconfined. The contours of the area show that there are shallow slopes of approximately 3-4 m in some areas, however the majority of the slopes are very shallow. Steeper areas along the corridor have likely been graded for the development in the area. **Map 1** shows the contours through the study area.

Once the channel has had the meander axis delineated, parallel lines are drawn on either side of the meander axis at the outermost edge of the historical meanders. These parallel lines follow the meander axis' and are described as the preliminary belt width. The measured width of the preliminary belt width is 17.3 m at the Williams Pkwy crossing. **Map 1** shows this preliminary belt width as well as the belt widths of one or two meander axis upstream and downstream of the crossing. Once the belt width is set typically both the bankfull width and the 100-year erosion rate are then applied to the channel for the final erosion hazard offset, however due to the quality of the 1967 and 1976 air photos calculating erosion rates was not possible.

In place of the 100-year erosion rate a factor of safety will be used as the buffer along the meander belt. Typically, the final meander belt would consist of the belt width plus the erosion rate and a 5% factor of safety for belt widths less than 50 m. In this case the factor of safety of 20% will be used which is typically reserved for belt widths greater than 50 m. With this the final belt width will consist of the preliminary belt width, the bankfull width of the channel, and the 20% safety factor. This results in a 25.5 m final belt width. This can be applied to existing channel on which it would be centred.

4.0 PROPOSED CONDITIONS

4.1 Culvert Sizing

Proper culvert sizing is important for varying reasons for each channel crossing. Erosion concerns, capacity, fish passage, depth of substrate, and proper channel form and function can all be factors to consider when sizing most channel road crossings. Incorporating the information such as rapid assessments, bankfull flow data, bankfull width, and the existing upstream or downstream channel

conditions can be beneficial when determining the final crossing sizes. The 2015 TRCA Crossings Guideline for Valley and Stream Corridors recommends that the following geomorphic components be considered for existing crossings:

- Minimize the risks of damage to the crossing infrastructure from channel erosion,
- Avoid the need for future channel realignment by minimizing the probability of channel contact with the crossing infrastructure, and
- Improve existing crossing structures, where possible, to reduce erosion hazards.

In addition, the guideline requires that existing crossings that are small, stable watercourses be designed to accommodate either the meander belt width (most preferred), 100-yr erosion limit (preferred), or a geomorphic design or realignment (less preferred). These recommendations will be incorporated into the proposed structure width as best as possible, while keeping in mind the restrictive setting of the area.

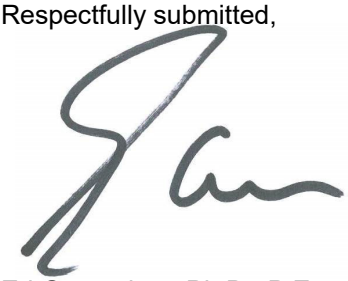
With this in mind, the proposed crossing size is based on the recommendation that the size of the crossing should accommodate the meander belt width of the creek. Therefore, the crossing would span 25.5 m which would allow a rehabilitated channel to meander through the crossing while accommodating any potential future migration. This crossing would also have footings rather than a smaller box structure and therefore would accommodate another of the TRCA's guidelines.

5.0 SUMMARY AND RECOMMENDATIONS

Based on the observations and information provided in this study we present the following summary and recommendations:

- Williams Pkwy. is scheduled for road improvements which require a meander belt width and crossing assessment to protect the two creeks that are within the study area,
- Spring Creek and Mimico Creek are highly urbanized creeks having been realigned in the 1970s,
- Both creeks are heavily degraded and show severe signs of erosion throughout,
- A section of Mimico Creek has been rehabilitated by the TRCA,
- A meander belt width assessment of the two creeks suggests that Mimico Creek should have a meander beltwidth of approximately 15 m, although this creek is heavily constrained,
- Spring Creek was assessed to have a 25.5 m belt width at the Williams Pkwy crossing,
- Crossing structure span for Spring Creek at Williams Pkwy should be based on the final meander belt width of 25.5 m, and
- If either creek is to be disturbed by the proposed road improvements, the creeks should be realigned or protected using natural channel design principles supported by a professional Fluvial Geomorphologist.

Respectfully submitted,



Ed Gazendam, Ph.D., P.Eng.,
President, Sr. Geomorphologist
Water's Edge Environmental Solutions Team Ltd.

Nik Gazendam, C.Tech. CAN-CISEC
Project Manager and Senior Technician

ATTACHMENTS

Appendix A: Maps
Appendix B: Photo Inventory

REFERENCES

Chapman, L.J. and D.F. Putnam. 1984. Physiography of Southern Ontario: Ontario Geological Survey Special Volume 2.

Crossings Guideline for Valley and Stream Corridors, Toronto and Region Conservation Authority, September 2015

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Williams, G.W., 1986. River meanders and channel size. Journal of Hydrology 88: 147-164.

APPENDIX A:

Maps

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.	Williams Parkway Environmental Assessment City of Brampton	Date: Dec. 2, 2022	Map 1
	Meander Beltwidth Assessment of Spring Creek	Checked By: EG	Drawn By: NG

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.	Williams Parkway Environmental Assessment City of Brampton	Date: Dec. 2, 2022	Map 1
	Meander Belt Width Assessment of Spring Creek	Checked By: EG	Drawn By: NG

APPENDIX B:

Photo Inventory

MIMCO CREEK

PHOTOGRAPH NO.: 1
FROM: Jayfield Park Restoration Project, north of Williams Pkwy.
LOOKING: Downstream towards the end of the restoration and start of concrete channel.

PHOTOGRAPH NO.:2
FROM: Centre of channel at upstream end of concrete channel section.
LOOKING: Downstream along channel. Heavily eroded banks.

PHOTOGRAPH NO.: 3
FROM: Centre of channel near start of concrete channel section.
LOOKING: At substrate found along eroded banks. Gravels, silts, and limestone blocks.

PHOTOGRAPH NO.: 4
FROM: Centre of channel near middle to end of concrete section.
LOOKING: Upstream at storm water outfall.

PHOTOGRAPH NO.: 5
FROM: Centre of channel near middle of concrete channel section.
LOOKING: Downstream along typical channel conditions, thick riparian with brush.

PHOTOGRAPH NO.: 6
FROM: Centre of channel, upstream of culvert.
LOOKING: Downstream into culvert.

SPRING CREEK

PHOTOGRAPH NO.: 7
FROM: Upstream end of study reach near Maitland St.
LOOKING: Upstream towards road.

PHOTOGRAPH NO.: 8
FROM: Upstream end of study reach near Maitland St.
LOOKING: Looking at typical substrate which is rip rap sourced from failed gabions.

PHOTOGRAPH NO.: 9
FROM: Trail along creek, near upper middle of study reach.
LOOKING: At channel bank which had recently been repaired for encroaching on trail.

PHOTOGRAPH NO.: 10
FROM: Centre of channel at middle of upper reach in study area.
LOOKING: Upstream at typical channel conditions, thick riparian, eroding banks.

PHOTOGRAPH NO.: 10
FROM: Centre of channel in mid to lower section of upper study area reach.
LOOKING: At channel substrate which includes exposed till, gabion stone, and gravels.

PHOTOGRAPH NO.: 10
FROM: Centre of channel, near lower section of upper study area reach.
LOOKING: Upstream at typical channel conditions.

PHOTOGRAPH NO.: 10
FROM: Left bank of creek immediately downstream of Williams Pkwy crossing.
LOOKING: Upstream at the existing crossing with small concrete channel and trail.

PHOTOGRAPH NO.: 10
FROM: Right bank of creek on asphalt trail downstream of Williams Pkwy.
LOOKING: Creek has likely migrated into existing concrete trail.

PHOTOGRAPH NO.: 10
FROM: Right bank of creek near middle of lower study reach area.
LOOKING: At channel with failed gabion baskets on left bank.

PHOTOGRAPH NO.: 10
FROM: Right bank of creek near middle of lower study reach area.
LOOKING: Across channel at typical channel conditions, eroding banks and exposed roots.

PHOTOGRAPH NO.: 10
FROM: Centre of creek near lower middle of lower study reach area.
LOOKING: Downstream at typical channel conditions.

PHOTOGRAPH NO.: 10
FROM: Centre of creek at lower section of lower study reach area.
LOOKING: Upstream towards end of gabion lined section of Spring Creek, start of concrete.