

665 Eliza Street Meander Belt Width Assessment

FINAL REPORT

Prepared for

Tribute/Sorbara Arthur Holdings Inc.

1815 Ironstone Manor, Unit 1

Pickering, Ontario

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February 7, 2025

Project No. P2022-616

Prepared by



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1. Introduction



GeoProcess Research Associates Inc. (GeoProcess) has been retained by Tribute/Sorbara Arthur Holdings Inc. to undertake a meander belt width assessment for two properties in Arthur, ON. The first property is located at 665 Eliza Street and the second is bounded by Wells Street, Macauley Street and Eliza Street, with no municipal address; collectively, these two properties are referred to as the “Subject Properties” (Figure 1). An unnamed tributary to Farleys Creek traverses the Subject Properties, which is located within the jurisdiction of the Grand River Conservation Authority (GRCA).

The proposed development plan for the Subject Properties consists of single and semi-detached homes, townhouses, parklands, internal roads, and two stormwater management ponds. East of Eliza Street, realignment of the Farleys Creek Tributary is proposed within a naturalized corridor. The purpose of this report is to delineate the meander belt (riverine erosion hazard) to inform development limits and sizing of the proposed realigned stream corridor. The following tasks were undertaken in support of this study:

- Background review of available mapping and delineation of watercourse reaches for the portion of Farleys Creek Tributary relevant to the Subject Properties;
- Historical assessment of trends in land use and channel planform over time;
- Reconnaissance-level field investigation to characterize existing geomorphic conditions on a reach basis following standard rapid geomorphic assessment protocols;
- In conformance with relevant policies and regulations, delineate the meander belt for relevant reaches of the Farleys Creek Tributary; and
- Provide geomorphic design recommendations for the naturalized linear corridor.

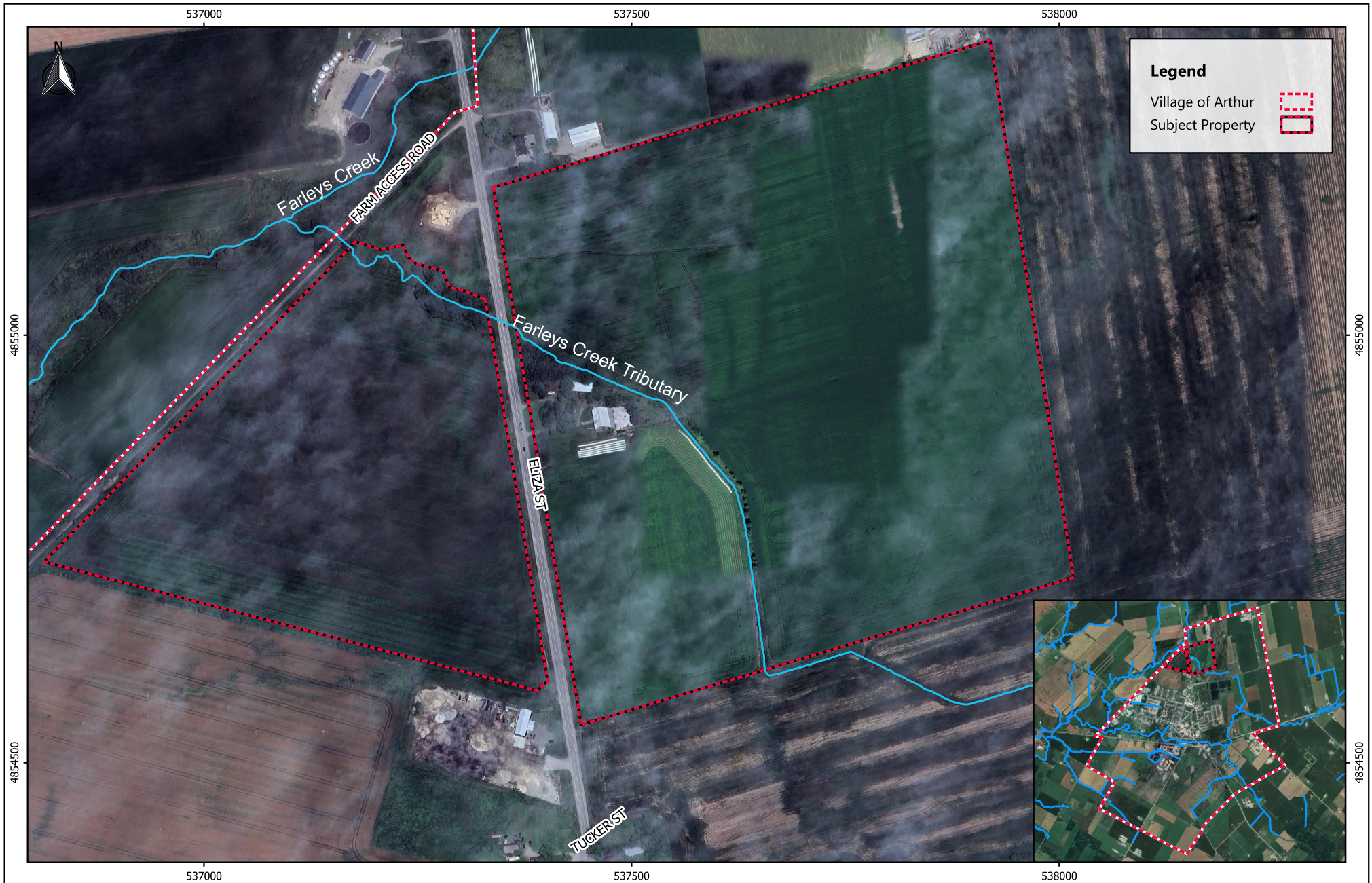
2. Policy Context

Municipal and provincial policies applicable to this study have been reviewed and are described below.

2.1. Provincial Policy Statement (2020)

Section 5.2 of the Provincial Planning Statement (MMAH 2024) issued under the *Planning Act* (1990) outlines areas of provincial interest with respect to natural hazards (i.e., flooding, erosion, unstable soils). The MNR (2002) Technical Guide - Rivers and Streams: Erosion Hazard Limit was prepared to outline standardized procedures for the delineation and management of erosion hazards in the Province of Ontario. The guide differentiates the applicability of riverine erosion hazard protocols based on two generalized landform systems: confined and unconfined valley systems. The erosion hazard limit associated with unconfined valley systems consists of the meander belt plus an erosion access allowance. For confined valley systems, the erosion hazard limit is governed by geotechnical considerations, including the stable slope allowance and an applicable toe erosion allowance (i.e., channel migration component), as well as an erosion access allowance, as illustrated in Figure 2.





Legend

- Village of Arthur
- Subject Property



GeoProcess
RESEARCH ASSOCIATES

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0 125 250 375 500 m



NAD83 / UTM zone 17N (EPSG:26917)

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Figure 1.

Subject properties.

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	Confined	Unconfined
Watercourse Profile		
Typical Geologic Setting	Valley corridors	Glaciated plains, flat to gently rolling

Hazard Allowances	Confined	Unconfined
Stable Slope	Yes	No
Toe Erosion	Yes	No
Meander Belt	No	Yes
Access Allowance	Yes	Yes

Figure 2: River and stream systems landform classification and applicability of landform components to the hazard allowance designation (adapted from MNR, 2002 Technical Guide)

2.2. County of Wellington Official Plan (2024)

The County of Wellington Official Plan (CWOP) is a legal document intended to give direction over the next 20 years, to the physical development of the County, its local municipalities and the long-term protection of County resources. All land use and servicing decisions must conform to the policies of this plan. The CWOP was adopted by Wellington County Council on September 24, 1998, and was approved by the Ministry of Municipal Affairs on April 13, 1999. This report references the consolidated version of the CWOP that was last updated July 2024.

The County's Greenlands System is "intended to include those features and areas which are part of Wellington's natural heritage or areas in which natural or human-made condition may pose a threat to public safety." These areas include:

- Wetlands
- Environmentally sensitive areas
- Streams and valley lands
- Ponds, lakes and reservoirs
- Areas of natural and scientific interest
- Woodlands
- Fish and wildlife habitat
- Floodplains and hazardous lands
- Threatened or endangered species

As per Schedule B6-2 of the CWOP (County of Wellington 2024), the Subject Properties contain designated Core Greenlands, a watercourse, and Future Development land use. The Core Greenlands designation

includes areas subject to flooding and erosion hazards. Section 5.4.3 of the Official Plan states that development must avoid areas that pose a threat to public health or safety.

2.3. Grand River Conservation Authority

On April 1, 2024, *Ontario Regulation 41/24 – Prohibited Activities, Exemptions and Permits Regulation* (hereinafter referred to as “the Regulation”) came into force. Conservation authorities may grant permission for development activities if, in the opinion of the Conservation Authority, the proposal is not likely to affect the control of flooding, erosion, dynamic beaches, unstable soil or bedrock and when the development activities are not likely to create conditions or circumstances that in the event of a natural hazard might jeopardize the health or safety of persons or result in the damage or destruction of property.

The Farleys Creek Tributary is a regulated watercourse under *Ontario Regulation 41/24*. Section 8.2 of the GRCA (2024) Policies for the Administration of the Prohibited Activities, Exemptions and Permits Regulation document defines the Regulated Area for riverine erosion hazards. As defined in Section 8.2,

The Riverine Erosion Hazard within river or stream valleys is that area of riverbank and lands adjacent to watercourses where erosion is actively occurring or where development activity could create slope stability issues.

The Riverine Erosion Hazard applies to both apparent (confined) and not apparent (unconfined) valley systems. Valley systems with valley walls greater than 3 m in height are considered apparent, with or without a floodplain. When a watercourse *is not contained within a clearly visible valley section*, it is considered unconfined/not apparent. The Regulated Area for watercourses with no apparent valley is defined as: “*the greater of the extent of the Riverine Flooding Hazard plus the prescribed allowance or the Meander Belt Allowance plus an allowance of 15 metres (49.2 feet).*”

3. Historical Assessment

A series of historical aerial photographs spanning approximately 45 years were reviewed to evaluate changes in channel form and land use conditions over time. Table 1 summarizes key historical observations, while Appendix A illustrates an overlay of the channel planform as delineated for each year of record.

Table 1: Summary of historical observations (1979-present).

Year	Observation
1979	Land use within and surrounding the Subject Properties consists of agriculture. Eliza Street and a farm access road have been constructed. Within the Subject Properties the existing barn and residence can be observed. East of Eliza Street, the tributary has been channelized within a narrow riparian corridor. A driveway crossing of the tributary can also be observed, along with an associated upstream backwater zone. Downstream of the driveway, there is evidence of channel planform adjustment in the form of slumping banks and secondary flow paths. West of Eliza Street, the tributary maintains a sinuous planform within a wider, vegetated corridor. Active erosion is evident through the formation of scour pools downstream of Eliza Street and at the farm access road crossing. There is evidence of channel planform adjustment in the form of erosion and slumping along banks and the formation of secondary flow paths
1984	Except for the construction of a residence at 8565 Eliza Street and a commercial trucking business at 8035 Line 2, there is no discernible change in land use. or channel planform relative to 1979. East of Eliza

Year	Observation
	Street, minimal change in channel planform can be observed. West of Eliza Street, adjustments in channel planform can be observed through the development of a secondary meander pattern.
2024	No discernible changes in land use or channel planform can be observed.

4. Existing Conditions

The following section summarizes existing geomorphic conditions within the Subject Properties.

4.1. Reach Delineation

To facilitate a systematic evaluation of the portion of Farleys Creek Tributary relevant to the Subject Properties, the watercourse was delineated into reaches. Reaches are sections of the watercourse that are relatively consistent in terms of channel form and function and can, therefore, be expected to respond consistently to impacts, such as changes in hydrology and sediment inputs, as well as to other modifying factors (Montgomery and Buffington 1997).

Two reaches were delineated within the Subject Properties: Reaches FCT-1 and FCT-2 (Figure 3). Reach breaks were defined based on changes in the degree of historic alteration, riparian vegetation, and channel planform. Reach FCT-1 extends approximately 125 m upstream of the property limit, flowing through an unconfined and channelized corridor within the property to Eliza Street. Reach FCT-2 extends from Eliza Street to the tributary confluence with Farleys Creek. Reach FCT-2 maintains a sinuous planform within a broader, unconfined valley corridor.

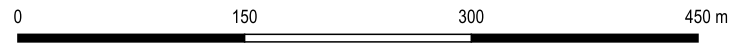


Legend

- Subject Property
- Reach Break
- Extent Assessed
- Photo Location ●

Watercourse

- 1979
- 2016
- 2024



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Notes:
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Figure 3.
 Reach delineation and existing conditions characterization for FCT-1 and FCT-2.



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4.2. Field Investigation

To characterize existing geomorphic conditions along Reaches FCT-1 and FCT-2 of the Farleys Creek Tributary, a reconnaissance-level field investigation was conducted by GeoProcess staff on December 19, 2024. A photographic record of conditions at the time of the assessment is provided in Appendix B; photo locations are shown on Figure 3.

4.2.1. Methods

The following standardized rapid visual assessment methods were applied:

- RGA (MOE 2003) - provides a standardized semi-quantitative assessment of the geomorphic stability of the channel and corresponding processes (bank erosion, bed incision, and other indicators of active channel processes). The stability index (SI) produces scores that indicate whether the channel is stable/in regime ($SI > 21$), transitional/stressed ($0.21 < SI < 0.4$), or in adjustment ($SI > 0.4$).
- RSAT (Galli 1996) - provides a standardized assessment of overall stream health, encompassing instream habitat, water quality, riparian conditions, and biological indicators. Each stream characteristic is given a numeric score along with a corresponding health classification: excellent (42-50), good (30-41), fair (15-29), and poor (< 16).

4.2.2. Results

Reach FCT-1

Within the extent assessed, Reach FCT-1 was characterized as a substantially altered watercourse situated within an unconfined valley setting. Bankfull widths ranged from 1.6 – 3.2 m, while bankfull depths ranged from 0.32 – 1.4 m. Channel bed materials consisted of silt, sand and cobbles, while bank materials were comprised of a mixture of clay, silt and sand. Channel banks were characterized as steep with a vertical face. Riparian vegetation consisted of a narrow band of grasses adjacent to agricultural fields.

An RGA score of 0.26 classified Reach FCT-1 as being 'in transition' (stressed). Aggradation was identified as the dominant mode of adjustment, as evidenced by deposition in the overbank zone, poor longitudinal sorting of bed materials, and siltation in pools. Minor evidence of widening (basal scour along channel banks) and planform adjustment (bars poorly formed/reworked/removed) was also observed. An RSAT score of 29 indicated a 'fair' degree of overall stream health, with channel stability and physical instream habitat identified as limiting factors.

Reach FCT-2

Within the extent assessed, Reach FCT-2 was characterized as a sinuous, well-defined watercourse situated within an unconfined valley setting. Terraces flanking the downstream portion of the corridor were noted as a localized physical constraint to channel migration. Bankfull widths ranged from 1.3 – 3.1 m, while bankfull depths ranged from 0.27 – 0.78 m. Channel bed materials consisted of silt, sand, cobbles, boulders and exposed till, while bank materials were comprised of a mixture of clay, silt, sand and till. Channel banks were characterized as steep with a vertical face. Riparian vegetation consisted of grasses, shrubs and trees.

An RGA score of 0.39 classified Reach FCT-2 as being ‘in transition’ (stressed). Widening was identified as the dominant mode of adjustment, as evidenced by basal scour along the majority of channel banks, presence of fracture lines along top of bank and exposed tree roots/large organic debris, Evidence of aggradation (coarse materials in riffles embedded, deposition in overbank zone) and degradation (scour pools downstream of culverts, channel worn into underlying till) was also observed. An RSAT score of 37 indicated a ‘good’ degree of overall stream health, with channel scour/deposition identified as a limiting factor.

5. Meander Belt

The meander belt width is generally defined as the lateral extent that a meandering channel has historically occupied and will likely occupy in the future (i.e., 100-year planning timeframe). The Toronto Region Conservation Authority (TRCA 2004) Belt Width Delineation Procedures document outlines standards of practice for delineating the meander belt in southern Ontario.

5.1. Reach FCT-1

Given the extent to which the Farleys Creek Tributary has been historically modified within the Subject Properties (channelization from agricultural practices), an empirical modeling approach was applied to determine a recommended meander belt width. Referencing the upstream contributing drainage area, modeled 2-year flow, channel slope and bankfull dimensions (Table 2).

Table 2: Catchment and channel parameters – Farleys Creek Tributary.

Reach	Drainage Area (ha) ¹	2 Year Discharge (m ³ /s) ¹	Channel Slope (%) ¹	Bankfull Width (m) ^{1,2}	Bankfull Depth (m) ^{1,2}
FCT-1	200.16	2.17	1.4%	2.0	0.5

¹Provided by SCS Consulting Group Ltd. (SCS)

²Estimated from available satellite imagery and topographic base plan

The empirical modeling approach employed the TRCA (2004) equation:

$$W_b = -14.827 + 8.319 \ln(\gamma Qs * DA)$$

where W_b is the meander belt width (m), γ is the specific weight of water (kg/m²s²), Q is the 2-year flow, s is the channel gradient (m/m), and DA is the drainage area (km²). Based on correspondence with SCS, it is understood that post-development flows are expected to be less than or equal to the existing flows within the Farleys Creek Tributary. As such, use of the modeled existing condition 2-year flow in the equation was considered a conservative approach, and the TRCA equation standard deviation factor of safety was not applied.

The following Williams (1986) equations were also applied:

$$W_b = 18A^{0.65} \quad [\text{Williams 1986}]$$

$$W_b = 4.3W_{bkf}^{1.12} \quad [\text{Williams 1986}]$$

where W_b is the meander belt width (m), A is the cross-sectional area of the bankfull channel (m^2) and W_{bkf} is the bankfull width (m).

The Ward (2002) equation was applied, with factor of safety incorporated, as follows:

$$W_b = 6W_{bkf}^{1.12} \quad [\text{Ward 2002}]$$

where W_b is the meander belt width (ft) and W_{bkf} is the bankfull width (ft).

Table 3 lists meander belt dimensions calculated using the empirical equations. Of the methods applied, the TRCA equation yielded the largest recommended dimension. Considering the channelized nature of the watercourse, and that it was not possible to determine historical rates of channel migration, the recommended meander belt dimension of 24.6 m was derived using a weighted average approach (TRCA result weighted twice relative to the other models) to ensure a conservative approach.

Table 3: Meander belt empirical modeling results – Farleys Creek Tributary.

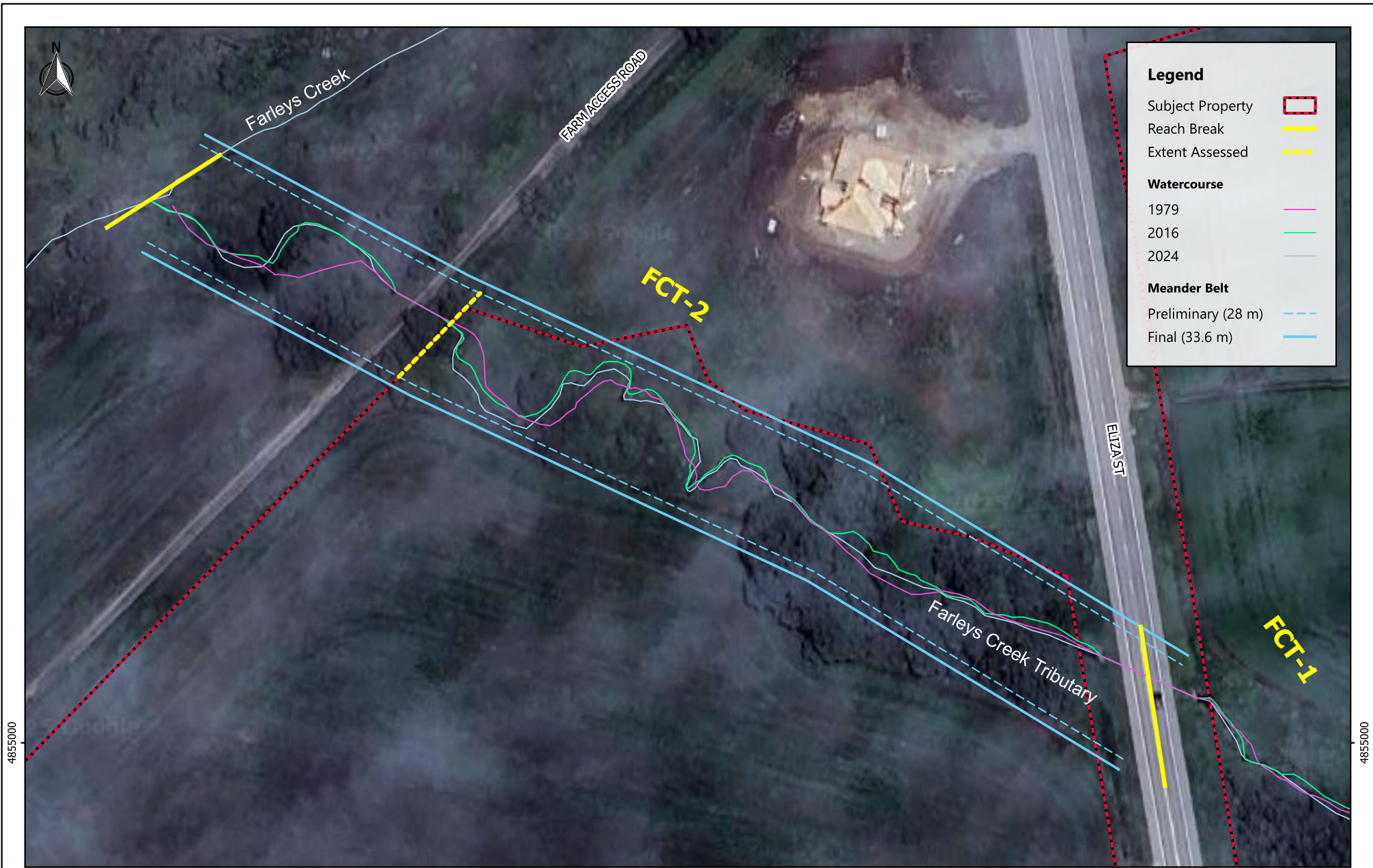
Reach	TRCA, 2001	Williams, 1986		Ward, 2002	Recommended Meander Belt (Weighted Average)
		Area	Depth		
FCT-1	38.3 m	20.0 m	11.3 m	15.0 m	24.6 m

5.1.1. Corridor Design

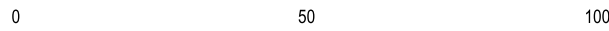
It is understood that the proposed Farleys Creek Tributary linear corridor will generally follow the existing watercourse alignment. To accommodate geomorphic design requirements, the bottom width of the corridor will be sufficient to accommodate the 24.6 m meander belt dimension recommended for Reach FC-1. This dimension will support the reinstatement of a natural, sinuous planform and allow for potential long-term adjustments in channel form. As applicable, the corridor will also incorporate a toe erosion allowance, stable slopes and an access allowance.

5.2. Reach FCT-2

Following methods outlined in the TRCA (2004) procedures, the 28 m preliminary meander belt for Reach FCT-2 was based on the lateral extent of governing (outermost) meander bends over the available historical record. To account for potential long-term adjustments in the hydrologic regime and/or channel form, a 20% factor of safety was applied, resulting in a recommended meander belt dimension of 33.6 m. Meander belt limits for Reach FCT-2 are shown on Figure 4.



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Figure 4.

Meander belt delineation for FCT-2.

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6. Conclusion



GeoProcess was retained by Tribute/Sorbara Arthur Holdings Inc. to undertake a meander belt width assessment for two properties in Arthur, ON: one located at 665 Eliza Street and the second bounded by Wells Street, Macauley Street and Eliza Street, with no municipal address.

The purpose of this report was to delineate the meander belt (riverine erosion hazard) to inform the determination of development limits and sizing of the proposed linear stream corridor east of Eliza Street.

Based on a review of available background information, including historical aerial imagery, and field confirmation of existing geomorphic conditions, meander belt dimensions of 24.6 m (Reach FCT-1) and 33.6 m (Reach FCT-2) are recommended for the portion of Farleys Creek Tributary relevant to the Subject Properties. The 24.6 m meander belt dimension for Reach FC-1 will be incorporated into the bottom width dimension of the proposed linear corridor design to ensure that the corridor size is sufficient to support a natural, sinuous planform and potential long-term adjustments in channel form.



7. References

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665 Eliza Street Meander Belt Width Assessment Final Report

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Information obtained during the site investigations or received from third parties does not exhaustively cover all possible environmental conditions or circumstances that may exist in the study area. If a service is not expressly indicated, it should not be assumed that it was provided. Any discussion of the environmental conditions is based upon information provided and available at the time the conclusions were formulated.

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Appendix A

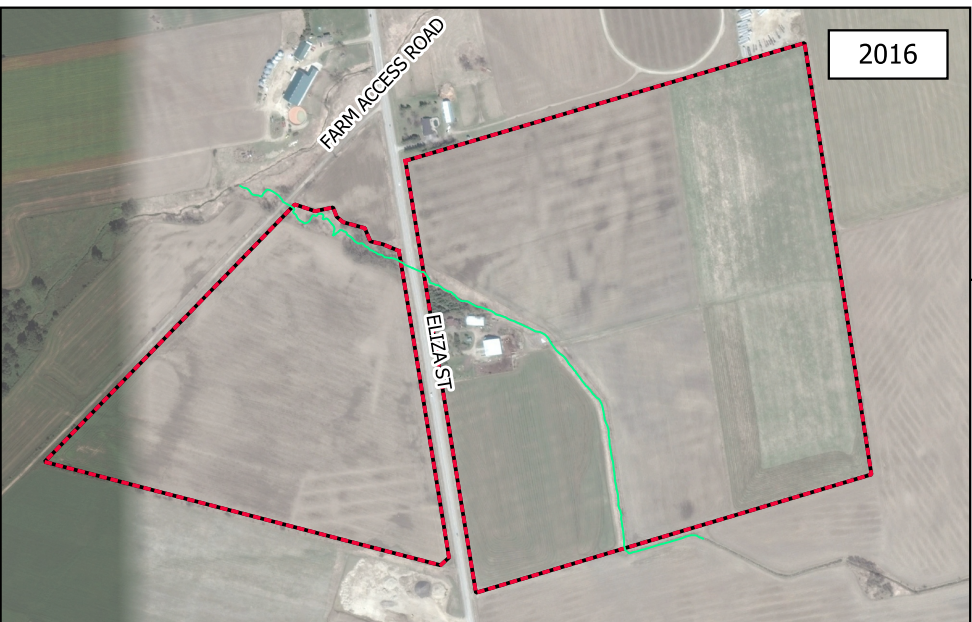
Historic Watercourse



4855000



1979



2016

4855000

4855000







2024

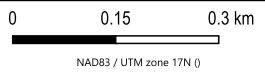


Comparison

4855000



- LEGEND**
-  Subject Property
 -  1979 Watercourse
 -  2016 Watercourse
 -  2024 Watercourse



Notes:
 [1] 1:8000 Aerial Image Flown Spring 1979
 [2] 2016 and 2024 Imagery from Google Earth.
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Appendix A.
 Historic Watercourse

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665 Eliza Street, Arthur
 Tribute/Sorbara Arthur Holdings Inc.

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Appendix B

Photographic Record



Photograph 1
Location 1
Reach FCT-1

Upstream view of general conditions at the extent assessed.



Photograph 2
Location 2
Reach FCT-1

Downstream view of 1.0 m CSP farm crossing with debris jam.



Photograph 3
Location 2
Reach FCT-1

Upstream view of riffle feature located downstream of large scour pool and tile drain outlet on right bank (photo left).



Photograph 4
Location 3
Reach FCT-1

Downstream view of a slightly steeper section with a narrowing flow path and minor evidence of planform adjustment with a narrow meander within the channelized ditch.



Photograph 5
Location 4
Reach FCT-1

Upstream view of run with wide bankfull width and embedded coarse materials.



Photograph 6
Location 4
Reach FCT-1

Upstream view of left bank undercutting of confined ditch embankment. Note, that large cobble materials were likely added as ad hoc protection as they are not representative within this reach.



Photograph 7
Location 5
Reach FCT-1

The upstream end of the Eliza Street 2.8 m diameter CSP with a large sand deposit as flows transition through sharp bend into the culvert.



Photograph 8
Location 6
Reach FCT-2

Upstream view of the Eliza Street CSP with minimal sign of scour or erosion.



Photograph 9
Location 6
Reach FCT-2

View of channel bed gravel deposit downstream of the Eliza Street CSP.



Photograph 10
Location 7
Reach FCT-2

Upstream view of riffle grade bound by dense willow roots.



Photograph 11
Location 8
Reach FCT-2

Downstream view of right bank erosion and woody debris within the channel.



Photograph 12
Location 9
Reach FCT-2

Upstream view of a sharp meander bend with erosion all the left bank valley wall contact resulting in a fallen fence post.



Photograph 13
Location 10
Reach FCT-2

Downstream view of right valley wall contact with fracture banks and well sorted point bar of fine to coarse gravels.



Photograph 14
Location 11
Reach FCT-2

Exposed till materials in channel bed.



Photograph 15
Location 12
Reach FCT-2

Upstream view of wood debris resulting in an alternative flow path.



Photograph 16
Location 12
Reach FCT-2

Downstream view of Wells Street East with 1.8 m tall and 2.8 m wide CSP at downstream extent of the Subject Property.