ARVA SUBDIVISION
MEDWAY CREEK MEANDER BELT ASSESSMENT

February 24, 2025

Prepared for:

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161414396

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1 Introduction

Stantec Consulting Ltd. (Stantec) conducted a meander belt assessment of Medway Creek in Arva, Ontario. The Study Area of Medway Creek is situated along the northern and western boundary of a residential development (Subject Parcel) proposed by York Developments (London) Inc. (Figure 1). It is understood that existing Silver Shiner habitat is present in this area. The meander belt will support establishing erosion hazard limits that will be referenced in the plans for the proposed development and inform the delineation of Silver Shiner habitat. The meander belt assessment is based on a protocol outlined by the Toronto and Region Conservation Authority (TRCA, 2004).

The meander belt is a term used to quantify the land area representing the expected lateral limit of a watercourse's channel migration processes over time (TRCA, 2004). Meander belts depend on several controlling factors including hydrology, channel dimensions, slope, and the degree of channel confinement. This assessment applied TRCA (2004) Procedure 3 to estimate the meander belt for the Study Area. Procedure 3 assumes ongoing land use changes with increased urbanization and subsequent changes in the hydrologic regime.

1.1 Erosion Hazards

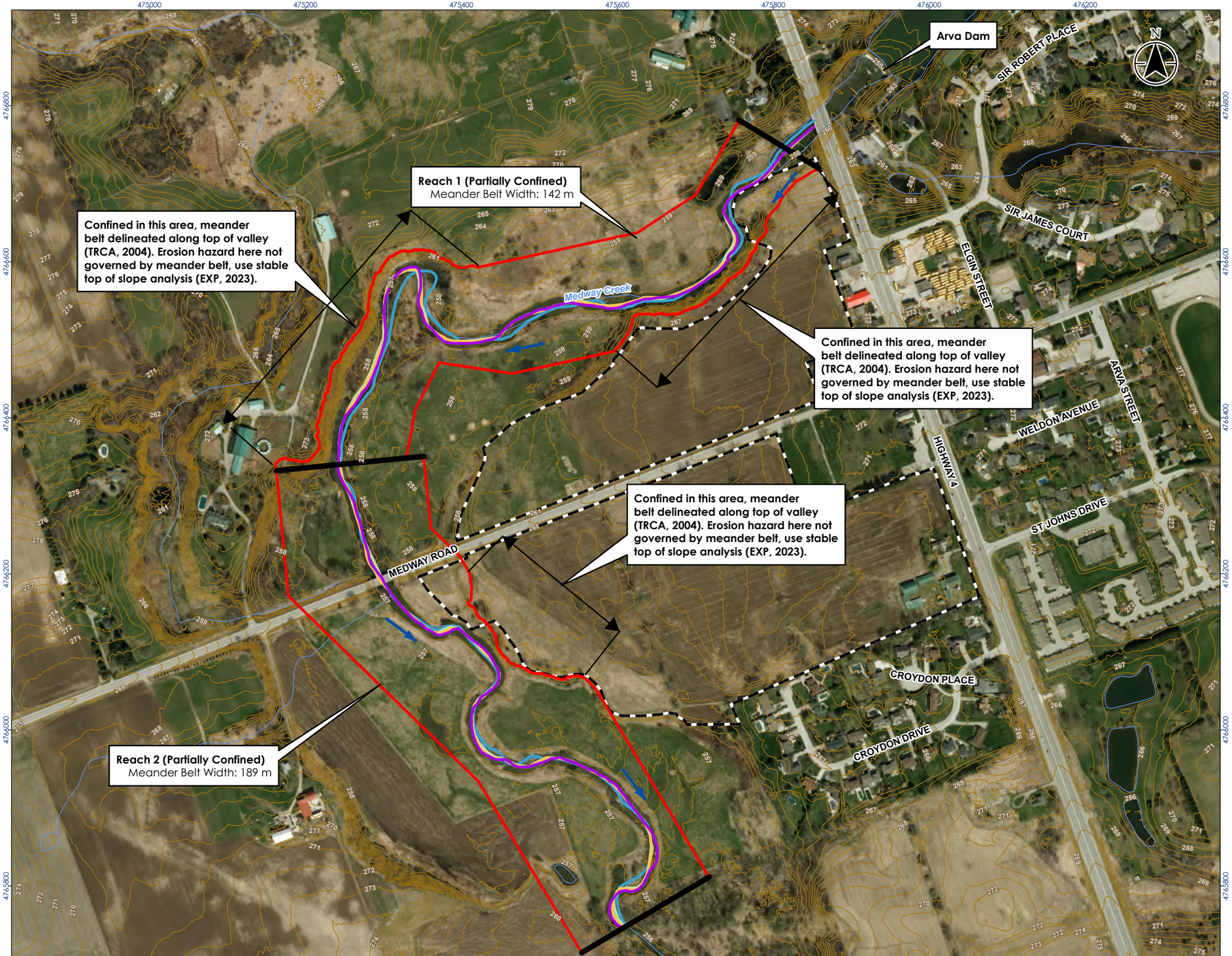
The Upper Thames River Conservation Authority (UTRCA) undertakes watershed planning and management programs to prevent, eliminate, or reduce the risk to life and property from erosion hazards. UTRCA administers a Development Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation (Ontario Regulation 157/06) (UTRCA, 2006). Under this regulation, UTRCA regulates development and site alterations within the erosion hazard zone.

Meander belts are used to delineate the erosion hazard zone in unconfined valley settings, and stable top of valley slopes are used in confined valley settings (OMNR, 2002). Confined systems are depressional features associated with a river or stream which have their meander bends adjacent to both valley walls (TRCA, 2004). Unconfined systems are depressional features without discernible slopes or valley walls, characterized by relatively flat to gently rolling terrain (TRCA, 2004).

Topographic mapping and field observations confirm that Medway Creek is partially confined at the Study Area based on the watercourse having a combination of meander bends that are adjacent to a valley wall and meander bends that migrate within the creek's floodplain without being impeded by a valley wall. As a result, the erosion hazard will be defined by a combination of the meander belt delineated in this assessment, and the stable top of slope that has been delineated by others where the creek is confined (EXP, 2023).

1.2 Silver Shiner Habitat

Silver Shiner (Notropis gibbosus) is listed as threatened under the *Species at Risk Act,* requiring additional measures to assess and protect its habitat. The meander belt is used to support the delineation of Silver Shiner habitat.



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Legend

- Subject Parcel
- Flow Direction
- Watercourse (Permanent)
- Waterbody
- Topographic Contour (1 m Interval)
- Meander Belt
- Reach Break

Medway Creek Alignment (Note 5)

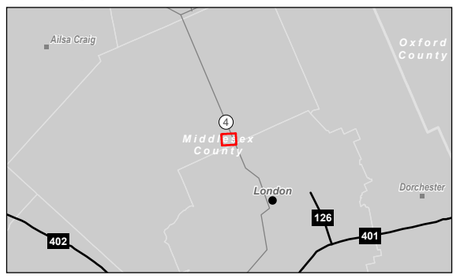
- 1980
- 2006
- 2010
- 2020

0 150 300 m

1:5,000 (At original document size of 11x17)

Notes

1. Coordinate System:NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2024.
3. Orthoimagery from Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2024. Imagery Date, 2010
4. Topographic Contours generated from Ontario Digital Terrain Model (LiDAR Derived), Land Information Ontario (LIO), Dataset, 2016-18).
5. The Centerline of Medway Creek delineated using orthoimagery obtained from First Base Solutions and Ontario Natural Resources and Forestry © King's Printer for Ontario, imagery date, 2020, 2010, 2006, and 1980.



Project Location
County of Middlesex, ON

161414396 REVA
Prepared by bcowper on 2025-02-24
Technical Review by AD on 2025-02-21

Client/Project
York Developments (London) Inc
Arva Subdivision

Figure No.
1

Title
Medway Creek Meander Belt Assessment

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1.3 Scope of Work

The assessment involved desktop and field components to inform the meander belt delineation at the Study Area. The key tasks included in the scope are summarized as follows:

1. Review background information, including topographic mapping, geologic mapping, and available historical aerial photographs.
2. Desktop assessment to delineate reaches based on underlying geomorphological controls.
3. Scoped field assessment to characterize existing geomorphological conditions, document degree of valley confinement, and document evidence of active channel processes.
4. Meander belt width delineation and mapping using standards developed by the TRCA (2004).

2 Desktop Analysis

2.1 Location

The proposed Subject Parcel extends north and south of Medway Road along the west side of Highway 4 in Arva, Ontario (Figure 1). Medway Creek flows around the north and west sides of the Subject Parcel and has a drainage area[1] of approximately 179.6 km^2 (OMNR, 2024). The headwaters of Medway Creek originate near north of Highway 7 and Granton Line, approximately 6 km north of the Study Area. The creek drains into the North Branch of the Thames River near London, Ontario, located approximately 6 km south of the Study Area. The Study Area is located approximately 110 m downstream of the Arva Dam.

2.2 Geology and Physiography

The Medway Creek watershed is located within the Stratford till plain physiographic region (Chapman and Putnam, 1984). In this physiographic region, soils generally consist of calcareous tills formed by glacial processes (Chapman and Putnam, 1984). This physiographic region is generally associated with good natural fertility and a good supply of lime in the subsoil, making it one of the most productive agricultural areas in Ontario (Chapman and Putnam, 1984). The report titled *Preliminary Geotechnical Investigation & Slope Stability Assessment* done by EXP described the soil texture as sand/sand and gravel, silt/sandy silt/silty sand, and clayey silt till/silt till/trace to some clay at varying depths and thicknesses at the tested boreholes (EXP, 2023).

2.3 Topography

Desktop analysis and field investigations were performed to gain insight into the topography of the Subject Parcel. The upstream reach of Medway Creek within the Study Area flows within a valley that has a top width of 270 m. The valley is approximately 2 – 10 m in height, and slopes gently from east to west with a grade difference of approximately 12 m (EXP, 2023). Based on analysis of contour lines on the aerial imagery, channel slope is estimated as 15%.

2.4 Historical Analysis

Historical orthorectified aerial images (1980, 2006, 2010, 2020) were reviewed to gain insight into channel form and to identify any changes within the Study Area during the period of record. The imagery is presented in Appendix B. Key observations of the historical aerial images are summarized as follows:

- The Subject Parcel area has predominately been used for agricultural purposes throughout the period of historical imagery.

[1] Drainage area estimated using the Ontario Watershed Assessment Tool

- Tree cover in the creek valley has increased slightly over the period of the historical record.
- Residential development east of the Study Area is observed adjacent to the Subject Parcel in the 2006 imagery.

3 Reach Delineation and Description

3.1 Reach Delineation

Reaches are lengths of channel that have physical constraints (e.g., geology, slope, discharge, vegetation, sediment input) that remain nearly constant along their length and subsequently exhibit similar physical geomorphological characteristics (e.g., channel form, sinuosity, physical dimensions). As a result, the controlling and modifying influences of channel form in a reach are similar (TRCA, 2004). Partitioning the study creek into reaches guides the desktop and field analysis by considering the influence of localized channel patterns and processes. Medway Creek, within the Study Area, has been partitioned into two reaches, based on factors which include differences in confinement, bed morphology, channel width, and substrate composition. The locations of the reaches are presented on Figure 1.

The following reaches were delineated within the Study Area:

- Reach 1: Approximately 2060 m of watercourse, from Avra Dam to 160 m upstream of Medway Road.
- Reach 2: Approximately 914 m of watercourse from 160 m upstream of Medway Road to the southern Subject Parcel boundary, where the floodplain and riparian corridor transition from agricultural fields to deciduous trees and shrubs.

3.2 Reach Description

Existing site conditions were observed during a site visit completed by Stantec on February 7, 2024. The geomorphological characteristics of the reaches within the Study Area are described in the following text, summarized in Table 1, and shown in site photographs in Appendix A.

Reach 1 consists of pool-riffle bed morphology with runs. Channel instability and adjustment were observed throughout the reach, as evident by formations of medial bars and islands and bank erosion. Pasture was observed right up to the creek bank (i.e. lack of riparian vegetation), along several sections of the reach, which is likely contributing to the observed instability.

Reach 2 was observed to have poorly formed pool-riffle bed morphology. Similar to Reach 1, instability and adjustment were observed throughout the reach, as evident by medial bar formation, poor sorting of bed materials, and bank erosion. Pasture was observed right up to the creek bank (i.e. lack of riparian vegetation) along several sections of the reach, which is likely contributing to the observed instability.

Table 1: Summary of Medway Creek Geomorphological Characteristics

Parameter	Reach 1	Reach 2
Length (m)	2060	915
Confinement	Partially Confined	Partially Confined
Sinuosity	High – Index:2.10	Moderate – Index:1.27
Soil texture	Sandy clay loam	Sandy clay loam
Bankfull width (m)	18	12
Bed morphology	Riffle-pool/Run	Riffle-pool/Plane-bed
Channel substrate	Fine to coarse gravel with some boulders, cobble, and sand	Cobble, coarse gravel, and fine gravel
Riparian Vegetation	Deciduous trees, shrubs, saplings, herbaceous plants, and pasture	Deciduous trees, shrub-sapling, and pasture

4 Meander Belt Delineation

The meander belt delineation procedure included the following:

1. Historic channel mapping.
2. Delineation of meander axis.
3. Quantification of the Preliminary Belt Width.
4. Quantification of the Existing Belt Width.
5. Quantification of the Final Meander Belt Width.

4.1 Historic Channel Mapping

To evaluate historic river planform movement, channel mapping was conducted based on a series of historical orthorectified aerial images (1980, 2006, 2010, and 2020). Channel mapping was conducted by digitizing the centerline of the watercourse in ArcGIS. The centerline was digitized using visual assessment and geomorphological judgement.

4.2 Delineation of Meander Axis and Preliminary Belt Width

A preliminary meander belt width was delineated following protocols outlined in TRCA (2004). First, a meander axis that follows the watercourse's general down-valley trend was identified. Lines were then drawn parallel to the meander axis and tangential to the outermost meanders to define the limits of the preliminary meander belt. As a result, the preliminary meander belt is approximately centred around the meander axis. The perpendicular distance between these limits represents the width of the preliminary meander belt. The preliminary belt widths for Reach 1 and 2 are 100 and 145 metres, respectively.

4.3 Existing Belt Width

The channel width was incorporated into the meander belt width by adding the average bankfull width of each reach to the preliminary belt width. Bankfull widths were estimated during the site visit and were presented in Table 1. The resulting sum of the preliminary belt width and the bankfull width yields the existing belt width. The existing belt widths for Reach 1 and 2 are 118 and 157 metres, respectively.

4.4 Final Meander Belt Width

To account for the fact that the existing meander belt does not necessarily reflect a quasi-equilibrium form, a factor of safety must be added to the measured width of the meander belt to determine the final meander belt width (TRCA, 2004). According to TRCA (2004), the method required to delineate an appropriate factor of safety depends on the dimensions of the existing belt width. For reaches with an existing belt width greater than 50 m, the margin of safety is calculated by applying a factor of safety of

1.2 to the existing belt width to produce the final belt width. After applying this factor, the final meander belt widths for Reach 1 and 2 are calculated to be 142 and 189 metres, respectively.

In a confined watercourse, channel migration is constrained by the valley wall. In the Study Area, the channel is partially confined, with sections located along the toe of the valley and the valley wall providing a constraint to channel migration. Where channel migration is constrained by the valley wall, the meander belt was delineated along the top of valley (TRCA, 2004). Therefore, in these areas, the erosion hazard limit will be governed by the stable top of slope assessment (by others; EXP 2023). The locations where this stable top of slope assessment will govern are indicated in Figure 1

Table 2: Meander Belt Width Delineation Summary

Reach	Preliminary Belt Width (m)	Bankfull Width (m)	Existing Belt Width (m)	Final Belt Width (m)
1	100	18	118	142
2	145	12	157	189

5 Summary

Stantec conducted a meander belt width assessment of Medway Creek in Arva, Ontario. A meander belt was developed to support the establishment of erosion hazard limits and Silver Shiner habitat delineation for a proposed residential development (Figure 1). The delineated meander belt is summarized as follows:

- **Reach 1:** Meander belt width of 142 m.
- **Reach 2**: Meander belt width of 189 m.

Medway Creek at the Study Area was assessed to be partially confined based on the watercourse having a combination of meander bends adjacent to a valley wall and bends that migrate within the creek's floodplain without being impeded by a valley wall. As a result, the erosion hazard will be defined by a combination of the meander belt delineated in this assessment and the stable top of slope delineated by others (EXP, 2023), as required where the creek is confined (Figure 1).

6 References

Chapman, L.J. and Putnam, D.F. 1984. *The Physiography of Southern Ontario*, Third Edition; Ontario Geological Survey, Special Volume 2, 270p

EXP Services Inc. (EXP). 2023. *Preliminary Geotechnical Investigation & Slope Stability Assessment*.

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Ontario Ministry of Natural Resources (OMNR). 2002. *Technical Guide River and Stream Systems: Erosion Hazard Limit.*

Toronto and Region Conservation Authority (TRCA). 2004. *Belt Width Delineation Procedures*.

Upper Thames River Conservation Authority (UTRCA). 2006. *O. Reg. 157/06: Regulation of Development Interference with Wetlands and Alterations to Shorelines and Watercourses.*

APPENDIX A:
Site Photographs

Photo 1: Reach 1, looking 150 m downstream of Highway 4

Photo 2: Outside bank confined by valley wall at Reach 1.

Photo 3: Reach 1 looking downstream, surrounded by shrub-sapling.

Photo 4: Upstream boundary of Reach 2, looking downstream.

Photo 5: Bar formation, looking downstream of Reach 2.

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Photo 6: Looking downstream of Reach 2, bank observed to be migrating to farm field

Photo 7: Culvert observed, downstream boundary of Reach 2.

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Medway Creek Meander Belt Assessment

Survey date: February 7, 2024

APPENDIX B:
Historical Imagery

Orthorectified Aerial Imagery
2020
Ontario Natural Resources and Forestry

Orthorectified Aerial Imagery
2010
Ontario Natural Resources and Forestry


Orthorectified Aerial Imagery
2006
Ontario Natural Resources and
Forestry

Orthorectified Aerial Imagery
1980
First Base Solutions