

Geomorphic Assessment 12363 Dixie Road, Town of Caledon, region of Peel Humber River Watershed

Prepared For:

2476998 Ontario Inc.

Prepared By:

Beacon Environmental Limited

Date:

2023-05-31

Project:

222071



GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

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Report Versions Issued

Version	Date	Revisions
1.	August 2022	
2.	September 2022	Section 1.6 Revision – Updated monitoring details

1. Introduction

Beacon Environmental Limited (Beacon) was retained by 2476998 Ontario Inc. to undertake a geomorphic assessment for the lands located at 12363 Dixie Road in the Town of Caledon, Regional Municipality of Peel (hereto referred as the subject property; **Figure 1**). It is our understanding that the construction of a transportation depot is proposed for the subject property. A tributary of the West Humber River, known locally as Kilmanagh Creek, traverses the subject property.

It is our understanding that the reach of Kilmanagh Creek relevant to the subject property has been classified as Redside Dace (*Clinostomus elongatus*) occupied habitat by the Ministry of Conservation, Environment and Parks (MECP). Under Ontario Regulation 242/08 of the Endangered Species Act (ESA 2007), the definition of regulated habitat includes the meander belt width, plus vegetated areas or agricultural lands within 30 metres of the meander belt. The purpose of this geomorphic assessment is to inform the determination of environmental constraint limits in relation to the subject property through delineation of Redside Dace regulated habitat limits (referencing 30 m from the meander belt). Specifically, the following tasks were completed in support of the study:

- Background review of available materials (topographic mapping, recent and historical aerial photography, watershed reports);
- Desktop assessment to delineate reaches based on underlying geomorphic controls;
- Historical assessment to determine trends in channel planform and land use;
- A field assessment to characterize existing geomorphic conditions and document evidence of active channel processes;
- Following applicable policies and guidelines, delineation the meander belt width on a reach basis, referencing recent aerial imagery, historical trends in channel planform and valley floor dimensions; and
- In accordance with Ontario Regulation 242/08, delineation of the Redside Dace regulated habitat limit referencing 30 m from the meander belt.

2. Policy Context

2.1 Endangered Species Act (2007)

The ESA (2007) came into effect on June 30, 2008, with over 200 species in Ontario identified as extirpated, endangered, threatened, or of special concern. The MECP provides oversight of the ESA for the regulation of Species at Risk (SAR) in Ontario. Under the ESA, native species that are in danger of becoming extinct or extirpated from the province are identified as being extirpated, endangered, threatened and special concern. These designations are defined as follows:

- Extirpated - a species that no longer exists in the wild in Ontario but still occurs elsewhere;
- Endangered – a species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's Endangered Species Act;
- Threatened - a species that is at risk of becoming endangered in Ontario if limiting factors are not reversed; and

- Special Concern (formerly Vulnerable) - a species with characteristics that make it sensitive to human activities or natural events.

Under the ESA, protection is provided to threatened or endangered species and their habitat, as well as providing stewardship and recovery strategies for species. Permitting is required to conduct works within habitat regulated for threatened or endangered species.

2.2 Provincial Policy Statement (2020)

The Provincial Policy Statement (MMAH 2020) issued under the *Planning Act* (1990) outlines areas of provincial interest with respect to natural hazards. In support of the Policy Statement, a Technical Guide - Rivers and Streams: Erosion Hazard Limit document was prepared by MNR (2002) to outline standardized procedures for the delineation and management of riverine erosion hazards in the Province of Ontario. The guide presents erosion hazard protocols based on two generalized landform systems through which watercourses flow: confined and unconfined valley systems. Through this approach, the meander belt width plus an erosion access allowance is defined to determine the erosion hazard limit of an unconfined valley system. 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).

2.3 Toronto and Region Conservation Authority Regulations and Guidelines

2.3.1 Conservation Authorities Act (Ontario Regulation 166/06)

The Toronto and Region Conservation Authority (TRCA) regulates land use activities in and adjacent to wetlands, watercourses and valleylands under Ontario Regulation 166/06 (*Regulation for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*) made under the *Conservation Authorities Act*.

Subject to conformity with the municipality's Official Plan, the completion of appropriate studies and application for Conservation Authority permits, The Authority may grant permission for development within these areas if it can be proven that control of flooding, erosion, pollution or the conservation of land will not be affected by the development.

2.3.2 The Living City Policies (2014)

The TRCA's Living City Policy was approved in November 2014 and replaces the Valley and Stream Corridor Management Program (1994). The Living City Policy document, among other matters, implements current federal, provincial and municipal legislation, policies and agreements affecting conservation authorities; and implements the policies for TRCA's updated section 28 of Ontario Regulation 166/06. For purposes of implementing TRCA's Environmental Management Policies:

- Confined River or Stream Valleys are considered Valley Corridors; and
- Unconfined River or Stream Valleys are considered Stream Corridors.



Site Location		Figure 1
12363 Dixie Road, Caledon Geomorphic Assessment		
		Project: 222071 Last Revised: May 2023
Client: 2476998 Ontario Inc.		Prepared by: SZ Checked by: MA
	1:4,500	Inset Map: 1:30,000
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According to the Living City Policy, the boundaries of a valley or stream corridor generally require a minimum 10 m setback from the greater of:

- Physical top of the valley feature;
- Long term stable top of slope, where geotechnical concerns exist (which must be confirmed through an appropriate geotechnical analysis);
- Regulatory floodplain;
- Meander belt; and
- Limits of significant vegetation which is contiguous with the valley corridor.

It is the policy of TRCA:

That erosion hazard limits will be determined through site specific field investigations and technical reports where required, in accordance with the text of TRCA's Regulation and Provincial and TRCA standards. Where erosion hazard limits are required and not available, or where existing erosion hazard information does not meet current Provincial or TRCA standards, TRCA may require the erosion hazard to be determined by a qualified professional, at the expense of the proponent, to the satisfaction of TRCA.

The Belt Width Delineation Procedures (TRCA 2004) document outlines standards for delineating the meander belt width in TRCA jurisdiction.

3. Background Review

3.1 Climate

Climate provides the driving energy for a fluvial system and directly influences basin hydrology and rates of channel erosion, particularly through precipitation. Precipitation records obtained from climate normals (1981-2010) recorded at Toronto Lester B. Pearson Airport, located east of the subject report, averaged 58 mm per month in winter (November through February), and 77 mm in summer (July and August; Environment Canada 2022). This increase over the summer months is likely a result of convective thunderstorms. While total precipitation amounts are greater during the summer months, snowmelt and rain-on-snow events tend to produce the highest flows within a watershed.

3.2 Watershed Conditions

In 2008, the TRCA prepared a State of the Watershed Report for the Humber River Watershed as a key reference document for land use planning decisions within and adjacent to the Humber River watershed. This report provided the basis for the Watershed Management Plan and provided an overview of existing environmental conditions within the watershed. The Humber River drains a total area of 903 km² and captures portions of the Town of Caledon, City of Brampton, Township of King, City of Vaughan, Town of Richmond Hill and City of Toronto (TRCA, 2008). The subject property is situated within the West Branch of the West Humber River Subwatershed. The watercourse is locally known as Kilmanagh Creek.

3.2.1 Geology

The planimetric form of a watercourse is fundamentally a product of the channel flow regime and the availability of sediment (i.e., surficial geology) within the valley corridor. The 'dynamic equilibrium' of these inputs governs channel planform. These factors are influenced in smaller systems by physiography, riparian vegetation and land use. The subject property falls within the South Slope physiographic region which is characterized by a "topography that gently slopes southward towards Lake Ontario and consists of a smooth, faintly drumlinized, clay till plain that contains deeply incised stream valleys (TRCA 2008a)".

3.2.2 Fluvial Geomorphology

The State of the Watershed Report summarized existing fluvial geomorphic conditions throughout the watershed based on long-term monitoring results from representative sampling stations set up through the Regional Watershed Monitoring Program. Monitoring of the sites was initiated in 2001 to establish baseline conditions within the watershed (TRCA 2008b). There are no monitoring stations located nearby or within the same tributary branch. The Watershed Report classified the portion of branch within the subject property as a third order stream. On-going pressures on stream corridors associated with urbanization throughout the watershed were identified as a major management challenge (TRCA 2008b). The upstream drainage area associated with Kilmanagh Creek at the subject property is approximately 12.1 km² (MNRF 2022). The average slope of Kilmanagh Creek upstream of the downstream property extent is 3.5% (MNRF 2022).

3.2.3 Aquatic Habitat

The portion of Kilmanagh Creek within the subject property falls within Fish Management Zone (FMZ) 9 – Campbell's Cross/Kilmanagh Creek, as documented in the Humber River Watershed Plan (TRCA 2008). These zones delineate areas within which fish communities, thermal regimes and underlying environmental controls remain relatively consistent.

FMZ 9 is categorized as small riverine coldwater habitat (MNR & TRCA 2005) managed for the following key target species:

- Redside dace (*Clinostomus elongatus*);
- Rainbow darter (*Etheostoma caeruleum*); and
- Brook trout (*Salvelinus fontinalis*) (TRCA 2008).

Redside dace is protected under the Ontario *Endangered Species Act* (ESA 2007).

3.3 Historical Assessment

The following section presents an overview of historic conditions in the vicinity of the subject property with respect to land use, land cover and channel conditions. Historical analyses provide insight into the scale of natural and human-induced changes within a watershed, particularly the degree to which

channel planform adjustment and land use has changed over time. In support of the historical assessment, black and white aerial photographs and digital colour imagery were analysed and compared to obtain a simple, qualitative assessment of the degree of land use and channel planform change over time (**Appendix A** and **Table 1**).

Table 1 provides a summary of specific observations regarding change in land use based on available historical aerial imagery.

Table 1. Summary of Key Historical Observations

Time Period	Scale, Source	Observations
1964	1:12,000 Northway/Photomap/Remote Sensing Ltd.	Forested areas converted to agricultural fields, with the exception of some woodlots and hedgerows. A few farmhouses and structures are observed along major roadways in the vicinity of the subject property. Riparian vegetation is largely absent. Tablelands within the subject property were actively farmed.
		Within the subject property, the watercourse appears to have been straightened (channelized). Upstream and downstream of the property limits, the channel maintains a more natural, sinuous planform. Upstream (west) of Dixie Rd, an online pond within the floodplain was observed. Evidence of active adjustments in channel form were observed in the form of bank erosion (valley wall contact), slumping and chute formation. An historical floodplain feature can be observed along the eastern valley slope, upstream of the subject property.
1972	1:12,000 Northway/Photomap/Remote Sensing Ltd.	No notable change in surrounding land use can be observed, except for the construction of a single residence immediately north of the subject property along Dixie Road. The online pond upstream (west of Dixie Road) appears to have been enlarged. No notable change in channel morphology or planform can be observed.
1988	1:8,000 Northway/Photomap/Remote Sensing Ltd.	No notable change in surrounding land use except for the construction of a few residences immediately north of the subject property along Dixie Road. A large pond was constructed east of the channel, upstream of the subject property (east of Dixie Road). An informal crossing of the creek had been constructed adjacent to the pond. Active bank erosion (slumping and at valley wall contact points) remained evident. No notable change in channel morphology or planform could be observed.
2002	1:3,000 First Base Solutions	Farming activities north of the subject property had expanded and a laneway had been constructed along a portion of the northern property boundary (west of the watercourse). Dixie Road had been widened, including extension of Kilmanagh Creek crossing structure. Land use within the subject property remained agricultural. No notable change in channel morphology or planform could be observed. The informal creek crossing downstream of the subject property could no longer be observed.
2021	1:3,000 First Base Solutions	No notable change in surrounding land use except for the expansion of the landscape supply operation immediately south of the subject property. Increased tree and shrub cover within the valley can be observed.

Time Period	Scale, Source	Observations
		No notable change in channel morphology or planform could be observed from the previous coverage reviewed; however, active bank erosion (slumping and at valley wall contact points) remained evident.

4. Existing Conditions

4.1 Reach Delineation

To facilitate a systematic evaluation of the relevant portion of Kilmanagh Creek, the watercourse was delineated into reaches. Reaches are homogenous sections of channel with regard to form and function and can, therefore, be expected to behave consistently along their length to changes in hydrology and sediment inputs, as well as to other modifying factors (Montgomery and Buffington 1997; Richards *et al.* 1997).

For the purposes of this study, the section of Kilmanagh Creek relevant to the subject property was delineated as a single reach (Reach KC-2, see **Figure 2**). The determination of reach extents was based on a desktop assessment of transitions in riparian vegetation, degree of valley confinement, meander geometry (channel planform) and road crossings based on available aerial imagery and topographic mapping. Due to property access limitations, the reach extents could not be field-verified.

4.2 Rapid Assessments

4.2.1 Methods

In order to characterize existing geomorphic conditions along the relevant portion of Kilmanagh Creek, rapid field assessments were conducted on September 20, 2022. The following standardized rapid visual assessment methods were applied:

i. Rapid Geomorphic Assessment (RGA – MOE 2003)

The RGA documents observed indicators of channel instability by quantifying observations using an index that identifies channel sensitivity. Sensitivity is based on evidence of aggradation, degradation, channel widening and planimetric form adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or in adjustment (score >0.41).

ii. Rapid Stream Assessment Technique (RSAT – Galli 1996)

The RSAT uses an index to quantify overall stream health and includes the consideration of biological indicators (Galli 1996). Observations concerning channel stability, channel scouring/sediment

12363 Dixie Road,
Caledon Geomorphic Assessment

Legend

- ▭ Subject Property
- Watercourse (Beacon 2021)
- Reach Break
- - - Extent Assessed
- Photo Location



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deposition, physical in-stream habitat, water quality, and riparian habitat conditions are used to calculate a rating that indicates whether the channel is in poor (<13), fair (13-24), good (25-34), or excellent (35-42) condition.

iii. Downs Classification Method (Downs 1995)

The Downs (1995; outlined in Thorne *et al.* 1997) classification method infers present and future potential adjustments based on physical observations, which indicate the stage of evolution, and type of adjustments that can be anticipated based on the channel evolution model. The resultant index classifies streams as stable, laterally migrating, enlarging, undercutting, aggrading, or recovering.

4.2.2 Results

Results of the rapid assessments are summarized in **Table 2** and **Table 3** below. A photographic record of site conditions at the time of the assessment is provided in **Appendix B**.

4.2.2.1 Reach KC-2

Based on the extent assessed within the subject property, Reach KC-2 was characterized as a well-defined, sinuous channel situated within a confined valley setting. The reach displayed a low gradient and low degree of entrenchment. Riparian vegetation was generally characterized as continuous and consisted of grasses and herbaceous species. Bank angles ranged between 30-60 degrees, with 30-60% of banks identified as exhibiting indicators of active erosion, such as slumping. Bank materials were dominated by clay/silt and sand. Bankfull widths and depths ranged from 1.3 to 1.7 m and 0.55 to 0.65 m, respectively. Riffle substrate consisted of sand, gravel, and some cobble while pool substrate consisted of clay/silt, sand and gravel.

Rapid assessment results indicated that Reach KC-2 was slightly stressed or 'in transition', with a score of 0.29. Widening was identified as the dominant mode of adjustment, with minor evidence of aggradation and planimetric form adjustment. Indicators of widening included slumping, basal scour on inside meander bends, and observed evidence of bank erosion extending greater than 50% of the reach. Indicators of aggradation included embedded coarse riffle materials, siltation in pools and poor longitudinal sorting of bed materials. Dense riparian grasses were noted as the governing control on channel form.

An RSAT score of 26 indicated a 'good' degree of overall ecological health, with channel stability and riparian habitat conditions identified as the primary limiting factors. The Downs model reflected the RGA evaluation of this reach through a classification of m – 'lateral migration' based on initiation of bank erosion and meander bend formation within a previously straightened channel.

Table 2. General Reach Characteristics – Kilmanagh Creek

Reach	Bankfull Width (m)	Bankfull Depth (m)	Riffle Substrate	Riparian Vegetation	Notes
KC-2	1.3-1.7	0.55-0.65	Cobble, gravel, sand	Grasses, herbaceous species	<ul style="list-style-type: none"> Dense riparian grasses Chute formation Bank erosion, slumping

Table 3. Rapid Assessment Results – Kilmanagh Creek

Reach	Rapid Geomorphic Assessment			Rapid Stream Assessment Technique			Downs Classification Method
	Score	Condition	Dominant Mode of Adjustment	Score	Condition	Limiting Feature	
KC-2	0.29	In Transition	Widening, Aggradation	26	Good	Channel Stability; Riparian habitat conditions	m – 'lateral migration'

5. Analysis

5.1 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. Where the watercourse is confined, such as Kilmanagh Creek within the subject property, the valley wall acts a constraint to channel migration along portions of the corridor.

According to the *Technical Guide – Rivers and Streams: Erosion Hazard Limit* document (MNR 2002), in the case of unconfined river systems, the meander belt width plus an erosion access allowance is defined to determine the erosion hazard limit. Conversely, in the case of confined valley systems, the erosion hazard is governed by geotechnical considerations, including the stable slope allowance and an applicable toe erosion allowance (i.e., channel migration component). As Ontario Regulation 242/08 does not distinguish between confined and unconfined systems, delineation of the meander belt referenced historical and current channel processes, but also considered valley floor (floodplain dimensions).

Following the TRCA (2004) *Belt Width Delineation Procedures* document, the meander belt for Reach KC-2 was delineated based on the lateral extent of the outermost meander bends along the reach over the available historical record. While the 1964 imagery could not be reliably georeferenced to delineate the watercourse location, it was referenced in determining meander belt limits. The resultant 35 m dimension was then reviewed relative to available topographic mapping and field observations to ensure that it considered valley floor dimensions and was sufficient to capture the active (bankfull) channel as

well as evidence of lateral occupation of the floodplain at the reach scale. **Figure 3** illustrates the recommended 35 m meander belt for Reach KC-2.

5.2 Redside Dace Habitat

Figure 3 identifies all lands within 30 m of the meander belt as they pertain to the subject property.

6. Policy Conformance

It is our opinion that the findings of this report are in conformance with the Provincial Policy Statement (2020), Ontario Regulation 166/06, TRCA Belt Width Delineation Procedures (2004) and Ontario Regulation 242/08.

7. Conclusion

Beacon was retained by 2476998 Ontario Inc. to complete a geomorphic assessment for the property located at 12363 Dixie Road, Town of Caledon, Region of Peel. The following points summarize the findings of this study:

- A review of available mapping indicated that Reach KC-2 of Kilmanagh Creek consists of a well-defined, sinuous channel situated within a confined valley system;
- An historical assessment of land use and channel planform change over time identified evidence of channelization, as well the formation of oxbow features over the available historical record;
- Rapid geomorphic assessment results identified the Reach KC-2 as being in a transitional state (RGA score of 0.29) with evidence of widening and aggradation observed;
- The RSAT assessment indicated that Reach KC-2 displayed a good degree of overall ecological health;
- In support of delineating Redside Dace habitat limits, a 35 m meander belt was recommended for Reach KC-2, referencing the lateral extent of governing meander bends over the available historical record, in addition to valley floor dimensions; and
- In conformity with Ontario Regulation 242/08, lands within 30 m of the meander belt have been identified as they pertain to the subject property.

Should you have any questions or require any additional information please contact the undersigned.

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Beacon Environmental Ltd.



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Report reviewed by:
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12363 Dixie Road,
Caledon Geomorphic Assessment

Legend

- Subject Property
- Proposed Development
- Greenbelt Boundary
- Meander Belt (35 m)
- Meander Belt + 30 m
- Reach Break
- Extent Assessed
- 2021 Watercourse
- 2002 Watercourse
- 1988 Watercourse
- 1972 Watercourse
- 1972 Historical Floodplain Feature



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Ontario Regulation 166/06 Regulations of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Appendix A





Historical Aerial Imagery

1964

12363 Dixie Road,
Caledon Geomorphic Assessment

Legend

 Subject Property



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0 60 120 m

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Historical Aerial Imagery

1972

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 Subject Property



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0 60 120 m

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Historical Aerial Imagery

1988

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Legend

 Subject Property



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0 60 120 m

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Historical Aerial Imagery

2002

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Historical Aerial Imagery

2021

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 Subject Property



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0 60 120 m

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Appendix B





**Photograph 1. Location 1.
Reach KC-1.**

Upstream view of the riparian conditions at the property limit. Note presence of dense riparian grasses and herbaceous species.



**Photograph 2. Location 1.
Reach KC-1.**

Downstream view of riparian conditions at property extent. Note the presence of dense riparian vegetation (grasses and herbaceous species).



**Photograph 3. Location 2.
Reach KC-1.**

Upstream view of chute formation (right bank).



**Photograph 4. Location 3.
Reach KC-1.**

Downstream view of general conditions. Note overhanging riparian grasses.



**Photograph 5. Location 4.
Reach KC-1.**
Upstream view island formation and multiple flow paths.



**Photograph 6. Location 5.
Reach KC-1.**
Upstream view of general channel conditions.



**Photograph 7. Location 6.
Reach KC-1.**
Downstream view of channel conditions.



**Photograph 8. Location 7.
Reach KC-1.**
Downstream view of channel conditions. Note dense overhanging riparian grasses.