Geomorphic Assessment
Fekete Channel, South Thames River Subwatershed
2004 Hamilton Road, City of London

Prepared For:

Kreative Development Inc.

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MOMENTUM
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1. Introduction

Momentum Earth Sciences Ltd. (Momentum) has been retained by Kreative Development Inc. to provide a geomorphic assessment associated with the Fekete Channel as it relates to the proposed development of the property located at 2004 Hamilton Road in London, Ontario (subject property). The subject property is part of a tract of land bounded by agricultural fields and the South Thames River valley to the north, Veteran Memorial Parkway the east, Hamiton Road to the South and agricultural fields to the West (**Figure 1**; **Appendix A**).

The purpose of this report is to provide recommendations that support the erosion hazard limit associated with the Fekete channel (former Fekete Drain) within the subject property and additional geomorphic recommendations to support the proposed draft plan. The assessment has been prepared in accordance with the Proposal Review Meeting Summary & Record of Consultation (June 2023) and the Environmental Study Scoping Checklist discussed with the City of London and the Upper Thames River Conservation Authority (UTRCA; November 13, 2024) with regards to the re-zoning development application.

Specifically, the following tasks were undertaken in support of the geomorphic assessment:

Background Review and Desktop Assessment

- Historical aerial photographs to determine reach-based channel migration tendencies;
- Relevant digital mapping layers of local soils and topography;
- Topographic survey and contour mapping;
- Delineated channel reaches based on UTRCA mapping; and
- Background studies and existing technical reports.

Field-Based Fluvial Geomorphic Assessment

- Confirmation of the valley setting and channel reaches based on geomorphic controls;
- Documentation of existing property and/or structures within the existing and potential erosion hazard limits; and
- Completion of watercourse characteristic and rapid field assessments to determine existing geomorphic conditions and evidence of active channel processes.

Geomorphic Assessment

- Delineation of the meander belt width following applicable guidelines, referencing recent aerial imagery, historical trends in channel planform (where feasible), valley type and floor dimensions, and empirical models [UTRCA Comments #28];
- Provide a recommended toe erosion or 100-year migration rates (where feasible), allowance based on field observations, migration rate calculations and/or empirical tables to support the erosion hazard assessment.
- Provide recommendations related to the mitigation and design of watercourse improvements as it relates to the proposed road crossing.
- Provide recommendations related to the mitigation and design of watercourse erosion potential as it relates to the proposed Stormwater Management design.

2. Applicable Natural Hazard Policies and Regulations

2.1 Provincial Planning Statement (2024)

The Provincial Planning Statement (MMAH 2024) issued under the Planning Act (1990) outlines areas of provincial interest with respect to natural hazards. The Technical Guide – Rivers and Streams: Erosion Hazard Limit was prepared by the Ministry of Natural Resources (MNR 2002) to support this aspect of the Planning Statement. The Technical Guide outlines procedures for the delineation and management of riverine erosion hazards in the Ontario based on two generalized landform systems: confined and unconfined valley systems.

2.2 The London Plan (2020)

The London Plan is the City of London's Official Plan and was adopted by City Council in June 2016 and approved by the Minister December 2016. The most recent version was consolidated in October 2020. It outlines current policies related to natural hazards within the City of London. Natural and Human-made Hazard lands include floodplain lands, riverine erosion and wetland hazards, unstable soils and steep slopes, and contaminated lands and abandoned resource wells. The extent of the riverine erosion hazard limit depends on whether the erosion is occurring in a confined system (where the physical presence of a valley corridor containing the system is visibly discernable), or an unconfined system (where there is no discernable valley slope or bank that can be detected from the surrounding landscape). The erosion access allowance, which is required for the purpose of maintaining sufficient access for emergencies, maintenance, and construction activities.

Natural and Human-made Hazards are included in the City's Natural Heritage System and shown on Map 6 – Hazards and Natural Resources. Specific to the subject property Map 6 indicates the presence of Significant Groundwater Recharge Areas and Highly Vulnerable Aquifers, as well as a Flood Hazard Limit. Riverine Erosion Hazard Limits appear to be immediately east of the subject property. The riverine erosion hazard limits are subject to interpretation and refinement without an amendment to the Plan, based on a technical study prepared in conformity with the Maximum Hazard Line policies of this Plan and completed to the satisfaction of the City and Conservation Authority having jurisdiction.

2.3 Upper Thames River Conservation Authority

2.3.1 Conservation Authorities Act (Ontario Regulation 41/42)

Erosion hazard lands are regulated by the Upper Thames River Conservation Authority (UTRCA) in accordance with Ontario Regulation 41/24: Prohibited Activities, Exemptions and Permits and Ontario Regulation 42/24: Mandatory Programs and Services under Section 28 of the Conservation Authorities Act. This new, single regulation replaces all individual conservation authority permit regulations, including UTRCA's Ontario Regulation 157/06.

Development activities and activities to straighten, change, divert or interfere in any with the existing channel of a river and creek, stream or watercourse or to change or interfere in any way with a wetland are prohibited from commencing within a regulated area prior to obtaining a permit from UTRCA. UTRCA may issue a permit if the activity is not likely to affect the control of flooding, erosion, dynamic beaches or unstable soil or bedrock; and the activity is not likely to create conditions or circumstances that, in the event of a natural hazard, might jeopardize the health and safety of persons or result in the damage or destruction of property. Site-specific investigations and studies are required to precisely define the location of hazards and features and the legal extent of the Regulation.

2.3.2 Environmental Planning Policy Manual (*2006*)

The UTRCA Environmental Planning Policy Manual (2006, revised 2017) provides policies which guide development and site alteration while protecting, preserving and enhancing the natural environment. The manual defines natural hazard lands as including the following main components:

- Riverine Flood Hazards – floodplain;
- Riverine Erosion Hazards – slopes and meander belt;
- Watercourses – streams, rivers, creeks, ditches and municipal drains; and
- Wetlands – includes swamps, marshes, bogs, fens and may contain organic soils.

The manual considers the hazard lands to be the maximum extent of the Riverine Hazards (greater of the Riverine Flood Hazards and Riverine Erosion Hazard limits) plus wetlands. An allowance is applicable to the Riverine Hazard Limit for the purpose of maintaining sufficient access for emergencies, maintenance, and construction activities. Amendments to the UTRCA Environmental Planning and Policy Manual are forthcoming to reflect the new framework of Ontario Regulation 41/42.

3. Desktop Assessment

3.1 Related Technical Studies

The following is a list of referenced technical studies that were prepared for the subject property regarding the re-zoning application:

- 2004 Hamilton Road Environmental Impact Study (NRSI 2025).
- Flood Line Delineation Study, 2004 Hamilton Road, City of London (DevEng 2025)
- Preliminary Stormwater Management Report, 2004 Hamilton Road, City of London (DevEng 2025)
- Geotechnical Investigation & Hydrogeological Assessment, 2004 Hamilton Road, London, (Stone Cairn 2025)

3.2 Watershed Conditions

3.2.1 Climate

Precipitation records obtained from climate normals (1981-2010) recorded at the London International Airport station, located southwest of the study area, averaged 80 mm per month in the winter (November through February) and 83 mm per month in the summer (July and August) with the highest amount of rainfall per month of 103 mm occurring in September (Environment Canada 2024). While total precipitation amounts are slightly greater during the summer months, snowmelt and rain-on-snow events tend to produce the highest flows within a subwatershed. The total yearly amount of precipitation for the Fekete Channel basin is 1015 mm annually (MNRF 2024).

3.2.1 Geology

The South Thames basin is in the northwestern extent of the physiographic region known as the Mount Elgin Ridges and is set within a transition zone between till moraines and glacial spillways. Subgrade soils are generally expected to be comprised of silt till, with intermittent sand seams, transitioning to sand and gravel soils to the north, near the Thames River (Chapman and Putnam 1984; OGS 2024). Pleistocene geology mapping for the St. Thomas area (Pleistocene Geology of St. Thomas Area, East Half, Southern Ontario; Ontario Department of Mines, Map P606, Scale 1:50,000, 1970) indicates that the southern portion of the study area consists of undifferentiated glacial till deposits, comprised of layered sand and silt till deposits, transitioning to the north to glaciolacustrine and glaciofluvial beach deposits, comprised of gravel and gravelly sand, from the Late Wisconsin glaciation period.

3.2.2 Subwatershed Characteristics

The study area is situated in the Dorchester watershed, which is one of 28 subwatersheds within the Upper Thames River watershed. The Dorchester watershed includes the Fekete Channel, which is one of flows perennially in a north - northwesterly direction. It originates as headwaters approximately 2 km upstream of Hamilton Road, eventually flowing to its confluence with the South Thames River approximately 1 km downstream from the subject property. A tributary (former Hudson Drain) enters the Fekete Channel along the northern edge of the subject property, located within the woodland that originates from drainage in the agricultural field just east of Veterans Memorial Parkway. The South Thames River runs along the northerly limit of the subject property, and the lands immediately adjacent to the river consist of floodplain, and a well vegetated valley slope. The total drainage area of the Fekete Channel subwatershed is approximately 2.77 km^2, with a main channel length of 4.2 km and an average slope of 0.86 % (MNRF 2024; DevEng 2025a). The Fekete Channel, a former Class C municipal drain, is characterized by permanent flow with potential spring spawning habitat and no sensitive freshwater fish species (Kavanagh et al. 2018).

The land use within the Dorchester watershed is predominantly agricultural (~55%) with natural areas (~24%), and a small portion of urban areas (~14%). Land use in the Fekete Channel subwatershed is a combination of wooded and agricultural areas, with significant valleylands east of Veterans Memorial Parkway. Recent land use changes in the subwatershed includes the Innovation Park development and associated Stormwater Management (SWM) Facilities constructed south of the subject property.

3.3 Historical Aerial Photographs

Historical aerial photograph assessments were completed to review the scale of natural and human-induced changes within the study area, 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 qualitative assessment of key historical conditions. A summary of specific observations in the vicinity of the study area with respect to change in land use, land cover and channel conditions based on available historical aerial imagery for the period of record was completed (**Table 1**; **Appendix B**).

Table 1. Summary of Historical Aerial Photographs

Year	Key Historical Observations
1967	Land use in the drainage area and immediate surrounding lands and within the subject property is agricultural. The current alignment of Hamilton Road alignments can be observed, however, Veteran Memorial Parkway is not constructed. The subject property contains mixed agricultural use with forested areas north to the South Thames valley system. The Fekete Channel system bisects the property and generally flows north before it traverses to the west at the western property boundary. In Reaches FC-4 and FC-3 the watercourses appear to lack any wooded vegetation along its banks, as it has been cleared for agricultural operations. Channel realignments (i.e., straightening or disturbances) appear along most of the reaches, except for the western property boundary where a large meander, and potential cut-off can be observed. A notable on-line pond is observed further downstream in Reach FC-2.
1979	Land use in the drainage area and immediate surrounding lands and the subject property are limited, with the exception of the widening of Hamilton Road and the Veteran Memorial Parkway observed. There are limited observed changes in the Reach FC-4, however, natural channel migration tendencies are observed compared to the straightened alignment in the previous observed year of record. The large meander bend in Reach FC-3 is no longer observed, and more sinuous migration tendencies are observed in that location. Vegetation remains limited along both reaches. The on-line pond is still observed further downstream in Reach FC-2 and the expansion of farming operations includes a horse track along the boundary of the subject property.
1999	Land use changes can be observed in the catchment, including the expansion of the urban structures and buildings in the vicinity of Hamilton Road. There are limited changes on the subject property. Both Reaches FC-3 and FC-4 appear to have been further realigned away from the western property boundary to its current location. The straightened alignments have reduced the overall sinuosity of the channel. Vegetation clearing has occurred to support the realignment however, Raech FC-4 now abuts the western edge of the forested portion of the subject property. The on-line pond is no longer observed further downstream in Reach FC-2.
2014	There are considerable changes in the surrounding land use with the expansion of commercial buildings and stormwater management facilities south of Hamilton Road. There are no observed changes in the watercourse alignment through the subject property, except for limited natural channel migration and further establishment of riparian vegetation.
2023	No significant land use or subject property changes can be observed. No significant changes in channel planform or surrounding land use can be observed.

Notes: Areial imagery scale and source for the above years:

1967	Scale: 1:12,000; Source: Western Libraries Air Photo Collection
1979	Scale: 1:12,000; Source: Northway/Photomap/Remote Sensing Ltd.
1999	Scale: N/A (Orthophoto); Source: City of London
2014	Scale: N/A (Orthophoto); Source: City of London
2023	Scale: N/A (Orthophoto); Source: City of London

4. Field-Based Assessment

4.1 Reach Delineation

4.1.1 Methodology

Reaches are homogenous sections of watercourse form and function that are expected to respond consistently along their length to changes in hydrology and sediment inputs, as well as to other modifying factors along its length (Montgomery and Buffington 1997; Richards et al. 1997). Reach extents were originally delineated in consideration of background and supporting reports, and the UTRCA on-line mapping. Verification of reach extents was subsequently undertaken in the field to confirm that mapped reach extents accurately reflect existing conditions and underlying geomorphic controls.

4.1.2 Results

The reach limits associated with the Fekete Channel in the study area, were deemed appropriate based on an observed changes in valley type, channel planform and observed reach confluence (**Figure 2**). The reach limits in the subject property generally coincide the reaches identified in the Subject Lands Status Report (NRSI 2024).

4.2 Rapid Visual Assessments

4.2.1 Methodology

In order to confirm existing geomorphic conditions along reaches of the Fekete Channel within the subject property and to the South Thames River, rapid field assessments were conducted on November 13 and 29, 2024. This included documented observations and a photographic inventory of observed historical channel and floodplain activity identified through the desktop assessment and current watercourse conditions. The following standardized rapid visual assessment methods were applied:

i. Rapid Geomorphic Assessment (RGA – MOE, 2003)

The RGA documents observed indicators of watercourse instability by quantifying observations using an index that identifies watercourse sensitivity. Sensitivity is based on evidence of aggradation, degradation, watercourse widening and planimetric form adjustment. The index produces values that indicate whether the watercourse 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 watercourse health and includes the consideration of biological indicators (Galli, 1996). Observations concerning watercourse stability, watercourse scouring/sediment deposition, physical in-stream habitat, water quality, and riparian habitat conditions are used to calculate a rating that indicates whether the watercourse is in poor (<13), fair (13-24), good (25-34), or excellent (35-42) condition.

iii. Downs Classification Method (Downs, 1995)

A modified Downs (1995, outlined in Thorne et al., 1997) classification method infers the present and future potential adjustments based on physical observations anticipated through successional stages based on the Channel Evolution Model (CEM). The CEM describes the type of adjustments of watercourse as a result of a perturbations. The resultant index classifies streams as stable, laterally migrating, enlarging, undercutting, aggrading, or recovering. As with the rapid geomorphic assessments, model applicability is affected by the non-alluvial channel conditions.

4.2.2 Results

The results of the field assessment are summarized for each Reach below and in **Table 2**. A summary of the rapid assessment results is provided in **Table 3** and a photographic record at the time of the assessment is provided in **Appendix B**.

Reach FC-1 was characterized as a perennial and moderately sinuous watercourse, situated within a confined valley setting. The reach generally displayed a low gradient and low degree of entrenchment which allows for more frequent flow to access the floodplain area. Riparian vegetation was characterized as continuous, extending 1 to 5 watercourse widths laterally on each side. Vegetation consisted of a mid-aged deciduous forest community, including herbaceous plants with wetland / marsh-type grasses and sedges near the confluence with the South Thames River.

Within the watercourse, bank angles ranged from 0-30 degrees in the more stable sections and 60-90 degrees where active erosion was observed. Less than 30% of banks had identified indicators of active erosion and were associated with areas near the confluence with the South Thames River. Bank materials were dominated by clay-silt/organics and sand. Average bankfull widths and depths were 5.2 m and 0.5 m in riffle sections, respectively. Average bankfull widths and depths in the pool sections were 5.9 m and 0.7 m, respectively. Riffle substrate consisted of predominantly sand, gravel and cobble. Pool substrate consisted of predominantly sand and clay/silt with some gravel. Few disturbances within the watercourse were observed and include an island bar from a historical avulsion.

Reach FC-2 was characterized as a perennial and moderately sinuous watercourse, situated within a partially confined valley setting. The reach generally displayed a moderate gradient and moderate degree of entrenchment. Riparian vegetation was characterized as continuous, extending 1 to 5 watercourse widths laterally on each side. Vegetation consisted of scattered deciduous trees, and mostly herbaceous plants with wetland / marsh-type grasses and sedges adjacent to the watercourse banks, particularly in the former on-line pond location (**Figure 2**).

Within the watercourse, bank angles ranged from 0-30 degrees in the more stable sections and 60-90 degrees where active erosion was observed. Approximately 30 - 60% of banks had identified indicators of active erosion. Bank materials were dominated by clay-silt/organics and sand. Average bankfull widths and depths were 2.9 m and 0.6 m in riffle sections, respectively. Average bankfull widths and depths in the deeper pool sections were 3.5 m and 0.9 m, respectively. Riffle substrate consisted of predominantly gravel and cobble, with exposed till bed substrate observed in some areas. Pool substrate consisted of predominantly sand and clay/silt with some gravel. Disturbances within the watercourse included an existing culvert crossing at the downstream reach break, and a small drainage culvert to the south floodplain at the upstream reach limits.

Reach FC-3 was characterized as a perennial and straightened watercourse, situated within a partially confined valley setting. The reach generally displayed a moderate gradient and high degree of entrenchment, which allows for limited flow to access the floodplain area. Riparian vegetation was characterized as continuous, extending 1 to 5 watercourse widths laterally on each side. The vegetation along the western portion of the woodland had composition of a White Pine plantation but was dominated by Scot's Pine in the canopy, and to the west there were pockets of Broad-leaved Cattail (i.e. in the areas of historical realignment; **Figure 2**).

Within the watercourse bank angles were steep 60-90 degrees, with undercuts where active erosion was observed. Approximately 60 - 90% of banks had identified indicators of active erosion. Bank materials were dominated by clay/silt and sand. Average bankfull widths and depths were 2.8 m and 0.5 m in riffle sections, respectively. Average bankfull widths and depths in the deeper pool sections were 3.7 m and 0.7 m, respectively. However, some notable areas of wider sections were observed, and along with the local entrenchment, reflective of past modification efforts. Riffle substrate consisted of predominantly sand, gravel and cobble. Pool substrate consisted of sand and clay/silt with some gravel. Traces of iron staining along the exposed banks suggest shallow groundwater upwelling in the reach. Disturbances within the watercourse included an existing beaver at the upstream reach break.

Reach FC-4 was characterized as a perennial and historically straightened watercourse, situated within an unconfined valley setting. However, the development of sinuosity was observed suggesting channel adjustments are occurring. The reach generally displayed a low gradient and high degree of entrenchment which allows for limited flow to access the floodplain area. Riparian vegetation was characterized as continuous, on each side and consisted of Broad-leaved Cattail and Common Reed were, including herbaceous plants.

Within the watercourse, bank angles ranged from 60-90 degrees likely a result of past modifications. Approximately 30-60% of banks had identified indicators of active erosion. Bank materials were dominated by clay/silt and sand, and well vegetated where stable. Average bankfull widths and depths were 3.2 m and 0.9 m in riffle sections, respectively. Average bankfull widths and depths in the deeper pool sections ranged from 3.8 m and 1.6 m, respectively. Riffle and pool substrate consisted of predominantly silts and sands, and bedform features were poorly defined. This was a reflection of the backwater conditions created by the beaver dam.

Table 2. General Reach Characteristics – Fekete Channel

Reach	Avg. Bankfull Width (m)	Avg. Bankfull Depth (m)	Substrate	Riparian Vegetation	Notes
FC-1	5.2 (Riffle) 5.9 (Pool)	0.5(Riffle) 0.7 (Pool)	Sand, gravel, cobbles, sparse boulders	Mixed-age deciduous forest Grasses, sedges	• South Thames River confluence • Island / bar formation • Cut banks and Avulsions
FC-2	2.9 (Riffle) 3.5 (Pool)	0.6 (Riffle) 0.9 (Pool)	Gravel and cobbles	Cattail and Comon Reed; Scattered Trees	• Former on-line pond area • Culvert crossing • Bank slumping • Till bed exposed
FC-3	2.8(Riffle) 3.7 (Pool)	0.5 (Riffle) 0.7 (Pool)	Sand, gravel, cobbles, sparse boulders	Cattail and Pine Plantation	• Straightened reach / modified • Beaver dam • Groundwater indicators
FC-4	3.2 (Riffle) 3.8 (Pool)	0.9 (Riffle) 1.6 (Pool)	Silt and sand	Cattail and Comon Reed	• Straightened reach / modified • Beaver dam • Culvert crossing (Hamilton Rd.)

Table 3. Rapid Assessment Results – Fekete Channel

Reach	Rapid Geomorphic Assessment			Rapid Stream Assessment Technique			Downs Classification Method
	Score	Condition	Dominant Mode of Adjustment	Score	Condition	Limiting Feature	
FC-1	0.25	In Transition	Planimetric Form Adjustment	30	Good	Channel Stability	M – 'lateral migration'
FC-2	0.27	In Transition	Widening	22	Fair	Riparian Habitat	M – 'lateral migration'
FC-3	0.30	In Transition	Widening	23	Fair	Channel Stability	M – 'lateral migration'
FC-4	0.32	In Transition	Planform Adjustment	19	Fair	Riparian Habitat	M – 'lateral migration'

5. Geomorphic Hazard Assessment

5.1 Meander Belt Delineation – Unconfined Valley Systems

5.1.1 Methodology

The erosion hazard limit associated with an unconfined system (i.e., non-apparent riverine system) considers the meander belt, which is generally defined as the lateral extent that a meandering watercourse has historically occupied and will likely occupy in the future. For confined systems (i.e., apparent riverine system), the erosion hazard limit is determined through a slope stability study, and where applicable, a toe erosion allowance is required to support the analysis (MNR 2002). The procedures to delineate the meander belt generally follow detailed analyses as provided in the Technical Guide (MNR 2002), including the more detailed Belt Width Delineation Procedures (TRCA 2004), and supplementary geomorphic guidelines (e.g., CVC 2015). Empirical relations based on field-determined watercourse parameters may also be applied for comparison purposes to the procedures. However, the empirical formula to estimate meander belt width dimensions have limitations for larger watercourses within southern Ontario. Modeling approaches should be reserved for heavily impacted channels or where substantial changes to hydrology may be anticipated (TRCA 2004; CVC 2015).

Based on a review of the topographic survey and field observations, Reach FC-4 was characterized as an unconfined system, with increased confinement in Reach FC-3. A meander belt limit for Reach FC-4 was determined based on available historical aerial imagery (1967, 1976, 1999, 2014 and 2015), including the most recent available (2023) aerial imagery for the study area. Referencing this information, the watercourse planform alignments and notable features were delineated for each year of record (**Figure 2; Appendix A**).

5.1.2 Results

Throughout the 56-year period of record, there was evidence of significant channel migration/planform adjustment and modifications observed for Reaches FC-4 within the subject property. The more recent historical channel planform alignments were overlain to determine if a refinement (shift) to the central tendency of the meander axis was required to align (centre) the meander belt limits. There was no shift in the meander belt axis as the central tendency was consistent over the applicable period of record. The rapid assessment results characterized the reach as stressed/in transition with minimal evidence of erosion, and limited active channel migration characteristics.

To review the determined meander belt width dimension, an empirical model approach was employed that considers the channel dimensions, referencing geomorphic field data. To determine the belt width (B_w), these models use simple power functions based on measurements of the average bankfull width (W_b) and mapped drainage area (DA), following relations from Williams (1986 – Equation 1) and Ward

(2001 – Equations 2 and 3). Research by Ward et al. (2002) indicated that the Williams (1986) equation, at times, under-predicted the belt width dimensions. As such, a modified approach incorporates a 20% factor of safety (Equation 2), was applied.

$$Bw = (4.3*W_b^{1.12})*1.2 \quad [Eq. 1]$$
$$Bw = 6*W_b^{1.12} \quad [Eq. 2]$$
$$Bw = 120*DA^{0.43} \quad [Eq. 3]$$

The results of the empirical relation analyses for Reach FC-4, is provided below (**Table 4**). Given the wide range in modelled values, a recommended meander belt based on the average of the empirical relations and considers the historical alignment within the reach (**Figure 3**).

Table 4. Meander Belt Empirical Approach – Fekete Channel (FC-4)

Reach	Williams – Width (m) (1986)	Ward – Width (m) (2001)	Ward – Drainage Area (km^2) (2001)	Recommended Meander Belt[1] (m)
FC-4	21	28	38	29

[1]Recommended Meander Belt based on average of all empirical model equations.

5.2 Toe Erosion Allowance – Confined Valley Systems

5.2.1 Methodology

For the purposes of determining the erosion hazard limit for a confined system where lateral migration is limited by the presence of valley walls (i.e., apparent riverine system), determination of a toe erosion allowance and a stable slope allowance is required (MNR 2002). The intent of the toe erosion allowance is to mitigate risk to the adjacent tablelands by accounting for the potential of the channel to migrate laterally into the valley wall and erode the toe of slope. According to the *Technical Guide* (MNR 2002), erosion hazard limits require the inclusion of a toe erosion allowance for areas where the watercourse is within 15 m of the valley toe of slope. The toe erosion allowance can be determined through referencing available published data and field observations regarding soil composition and watercourse conditions (MNR 2002), or calculation of the annual recession rate (100-year migration total). Based on a more detailed evaluation of soil and watercourse conditions, the Technical Guide provides recommendations for the toe erosion allowance referencing existing soil structure and channel stability conditions (**Table 5**).

Table 5. Minimum Toe Erosion Allowance based on Existing Conditions (MNR 2002)

MINIMUM TOE EROSION ALLOWANCE - River Within 15 m of Slope Toe*

Type of Material Native Soil Structure	Evidence of Active Erosion** OR Bankfull Flow Velocity > Competent Flow Velocity*** RANGE OF SUGGESTED TOE EROSION ALLOWANCES	No evidence of Active Erosion** OR Bankfull Flow Velocity <Competent Flow Velocity*** Bankfull Width < 5m	5-30m	> 30m
1.Hard Rock (granite) *	0 - 2 m	0 m	0 m	1 m
2.Soft Rock (shale, limestone) Cobbles, Boulders *	2 - 5 m	0 m	1 m	2 m
3.Stiff/Hard Cohesive Soil (clays, clay silt), Coarse Granular (gravels) Tills *	5 - 8 m	1 m	2 m	4 m
4.Soft/Firm Cohesive Soil, loose granular, (sand, silt) Fill *	8 - 15 m	1-2 m	5 m	7 m

*Where a combination of different native soil structures occurs, the greater or largest range of applicable toe erosion allowances for the materials found at the site should be applied

****Active Erosion** is defined as: bank material is exposed directly to stream flow under normal or flood flow conditions where undercutting, oversteepening, slumping of a bank or down stream sediment loading is occurring. An area may have erosion but there may not be evidence of 'active erosion' either as a result of well rooted vegetation or as a result of a condition of net sediment deposition. The area may still suffer erosion at some point in the future as a result of shifting of the channel. The toe erosion allowances presented in the right half of Table 3 are suggested for sites with this condition. See Step 3.

*****Competent Flow Velocity** is the flow velocity that the bed material in the stream can support without resulting in erosion or scour. For *bankfull width* and *bankfull flow velocity*, see Section 3.1.2.

5.2.2 Results

Based on the findings of the field assessment, the upper portion of Reach FC-3 was determined to be in a confined valley setting in proximity to valley walls, and as such require a toe erosion allowance (MNR 2002; UTRCA 2013). The general location and limits of the toe erosion allowance applicability within the reach, adjacent to the subject property, is shown on **Figure 3** (**Appendix A**).

The toe erosion allowance can be determined through calculation of the annual recession rate (100-year migration rate) using reliable (historical) data records. However, due to georeferencing limitations, scale and resolution of available aerial imagery and degree of vegetative cover, annual recession rates could not be reliably determined for the reach. To support the analyses the recommended ranges for the toe erosion allowance referencing existing soil structure and channel stability conditions from the Technical Guide was used (MNR 2002). Based on the available data, the toe erosion allowance of 5 m has been recommended for Reach FC-3 (**Table 6**). The erosion hazard limit for Reach FC-3 was adjusted to reflect the recommended stable top assessment determined through the geotechnical assessment for the subject property (Stonecairn 2025).

Table 6. Recommended Toe Erosion Allowance – Fekete Channel (Reach FC-3)

Reach	Rapid Geomorphic Assessment (RGA)			Channel Bank	Toe Erosion Allowance[1]			
	Score	Condition	Dominant Mode of Adjustment	Native Soil Structure	Active Bank Erosion	Within 15 m of toe of slope (Y/N)	Bankfull Width (m)	Setback (m)
FC-3	0.30	In Transition	Widening	Gravel and Silt (till)	Yes	Y	< 5	**5**

[1] MNR Natural Hazards Technical Guides for River and Stream Systems – Table 3, p. 38.

5.3 Erosion Hazard Limits

In accordance with the Technical Guide – Rivers and Streams: Erosion Hazard Limit document (MNR 2002), an erosion access allowance of 6 m has been applied to determine the final hazard limits as shown in this report. The combined erosion hazard limits (i.e., greater of meander belt and stable slope limit) within the subject property are illustrated on **Figure 3** (**Appendix A**).

6. Geomorphic Design Recommendations

6.1 Preliminary Culvert Crossing Structure – Street 'A'

The proposed draft plan requires a new crossing within Reach FC-4 of the Fekete Channel. The City of London Design Specifications & Requirements Manual (Chapter 6; Section 6.5.5) outlines standards that apply to Storm Culverts constructed for access crossings within a watercourse. From a geomorphic perspective, an appropriate design for new crossings should consider existing channel characteristics, current and potential future channel migration and erosion potential, including any watercourse restoration details that address these components. The current design for the proposed draft plan includes a 1.8 m H x 3.9 m W Concrete Box Culvert that is suitable for the conveyance of the 250-yr Regional Flood, and addresses the minimum hydraulic requirements as per the City's standards. Below is a summary of the considerations to support this proposed structure, from a geomorphic perspective, as well as future design recommendations:

- Channel Planform – the proposed crossing location is along a relatively straight section of the Fekete Channel. This location limits impacts compared to a more sinuous meandering channel with active channel migration tendencies. Future design details should consider the natural tendency of the channel to migrate and limit erosion in the vicinity of the crossing. This may include the installation of engineering structures or bioengineered measures to mitigate long-term erosion impacts and improve bank stability.

- Channel Conveyance – the proposed culvert, at minimum, spans the active channel width (3.5. m avg.), which will allow for the replication of the bankfull channel dimension and appropriate channel bed substrate. As this tributary is also considered fish habitat, bankfull channel dimensions should consider low-flow channel characteristics through the culvert to support fish passage. It is noted that the minimum culvert size may be increased at the detail design stage to support terrestrial passage requirements as per the City's standards.

- Channel gradient and tie-in limits – the field assessment, as confirmed through the topographic survey, observed significant channel sedimentation (i.e. deposition) within Reach FC-4. This may be attributed to both upstream agricultural activities and previous Innovation Industrial Park Phase construction activities but has been exacerbated by an existing beaver dam at the downstream reach extent. This condition locally impacts natural conveyance of flow and sediment through the system. The proposed crossing installation provides and opportunity to address removal of the excessive sediment and restore a more natural gradient to improve sediment transport processes and improve aquatic habitat conditions. If that can be supported by the regulatory agencies, removal of the beaver dam should be considered.

- In-stream hydraulics – the hydraulic parameters (i.e. channel velocity) of the more frequent flow events (25 mm and 2-year) for the proposed culvert sizing, indicates a nominal change in erosion potential between the immediate upstream and downstream sections. The decrease in the downstream velocities is reflective of a reduced channel profile between the HEC model sections at that location (**Table 7**).

Table 7. Hydraulic Results- Existing Vs Design Conditions – Fekete Channel (Reach FC-3)

River Station[1]	Hydraulic Results – Existing Conditions		Hydraulic Results – Proposed Conditions	
	Vel. Channel (m/s)		Vel. Channel (m/s)	
	25 mm	2-Yr	25 mm	2-Yr
Hamilton Road				
2636	0.60	0.71	-	-
2641	-	-	0.65	0.71
2611	0.67	0.80		
2609	-	-	0.74	0.79
			Street 'A' Culvert	
2561	0.67	0.85	-	-
2556	-	-	0.53	0.61
2536	1.14	1.24	-	-
2537			*0.49*	*0.57*
2511	1.54	1.70		
2513	-	-	*1.06*	*1.28*

[1]River Station represent the nearest comparative sections between the existing and proposed HEC model (DevEng 2025a).

- Natural channel variability – future design details should consider elements that are spatially complex with respect to morphology and hydraulics. Varying the bedform features (i.e. runs and pools) mimic conditions observed within naturalized portions of the system will improve sediment transport processes and the quality and function of existing aquatic habitat.

- Aquatic habitat – in addition to channel variability future design details should consider habitat elements and bank treatments that enhance habitat diversity for local aquatic species. This includes a riparian zone planted to provide enhanced stability along the channel banks.

It is noted that further discussion with the City regarding the various site design constraints and associated environmental requirements that will be addressed through future detailed design. The final dimensions for culvert to be confirmed through detailed design and include headwall/wingwalls structures, integration with site SWM/storm drainage (outlet) features and any environmental requirements as outlined above.

6.2 Stormwater Management Recommendations

6.2.1 Erosion Control – Site Drainage

The City of London Design Specifications & Requirements Manual (Chapter 6; Section 6.9) outlines standards that apply to Permanent Private Stormwater Systems. Specifically, the following was considered in support of the erosion control criteria for the subject property:

Case 3 (b), Subsection iii.

- *100% of quality and erosion controls are to be provided for the lands to be developed, as per the applicable Subwatershed Study.*

The scope of this geomorphic assessment considered the *Erosion Control Objectives* as outlined in Section 6.2.2 of the City's Manual, which sates that if erosion control target information is not available, the consulting engineer shall complete a site-specific study to determine the erosion threshold velocity and associated erosion control volume. Furthermore, a site-specific study may be warranted if an alteration or updates to the erosion control volume requirement is to be considered.

An erosion control criterion of 110 m^3/ha for the Fekete Channel subwatershed was originally provided in the Thames Valley Areas Subwatershed Study (Aquafor Beech 1995) and later updated to 150 m^3/ha as an appropriate target in the Functional SWM Servicing Report for the Innovation Industrial Park (AECOM 2008). As such, the objective of the stormwater management strategy for the subject property should achieve, at a minimum, the required erosion control volume as established through the previous studies. The stormwater management strategy for the erosion control volume storage may combination of infiltration facilities, on-site storage and low impact development practices (DevEng 2025b). The SWM strategy should also address water balance requirements related to sensitive features on the subject property, to ensure that the function of these features can be retained between the post- and the pre-existing development conditions.

As erosion control criteria established through the previous studies can be achieved within the current draft plan, an update to the associated erosion control volume was not deemed necessary as part of this study. It is noted that further discussion with the City regarding the stormwater management requirements will be completed through future detailed design. Should there be changes stormwater management strategy during subsequent design stages, further analysis of the erosion potential associated with the Fekete Channel downstream of the subject property may need to be considered.

6.2.2 Erosion Control – Storm Outlets

There are two proposed stormwater outfalls for the subject property. The outfalls have been proposed within the wing-walls of the proposed culvert structure to reduce further grading impacts of natural features within the subject property (DevEng 2025b and NRSI 2025). The outfalls will require flow dissipation measures (e.g. plunge pools or naturalized baffles prior to entering the watercourse. To address water quality requirements the stormwater strategy has been developed using a 'treatment train' approach, whereby a combination of measures that include inlet filters, oil/grit separators and grassed swales (DevEng 2025b).

It is noted that further discussion with the City regarding the various site design constraints and associated with the stormwater outfalls will be addressed through future detailed design. The final dimensions for outfall will need to be reviewed for hydraulic parameters to establish outlet protection measures, including plunge pool or alternative dissipations, to reduce concentrated discharge flows within the floodplain to the watercourse. Future design stages should also consider any environmental requirements (i.e. water quality) for the stormwater system prior to discharge within the watercourse.

7. Conclusions

A geomorphic assessment along the Fekete Channel was completed in the vicinity of the subject property at 2004 Hamiton Road, London, Ontario. The geomorphic assessment considers requirements of the Proposal Review Meeting Summary & Record of Consultation (June 2023) and the Environmental Study Scoping Checklist discussed with the City of London and the Upper Thames River Conservation Authority (UTRCA; November 13, 2024), The following points summarize the findings of this study:

- A review of historical aerial photographs indicated that the Fekete Channel on the subject property has been historically modified with a few areas of natural planform adjustments.
- Rapid geomorphic assessment results for all reaches assessed were *in transition* with evidence of *planform adjustment* or *widening*. Reaches FC-4 and FC-3 (subject property), indicated RGA scores of 0.32 and 0.30, respectively. Reaches FC-2 and FC-1 (downstream/off-site) had less sensitivity, with scores of 0.27 and 0.25, respectively.
- Following the applicable guidelines and referencing the available historical records, field-based observations and empirical modeling, a meander belt width of 29 m was recommended for Reach FC-4 of the Fekete Channel.
- Following the applicable guidelines and field-based observations, a toe erosion allowance of 5 m was recommended along Reach FC-3 of the Fekete Channel.
- A 6 m erosion access allowance has been applied to the stable slope and meander belt limits as shown in this report, as per the applicable guidelines and regulations.
- The proposed culvert crossing structure along the Fekete Channel addresses the minimum hydraulic requirements, with nominal change in downstream erosion potential. Proposed channel modification criteria have been recommended for future design stages.
- Two proposed stormwater outfalls within the wing-walls of the proposed culvert structure will reduce further grading impacts of natural features and will require flow dissipation measures prior to entering the watercourse.
- The erosion control criterion of 150 m^3/ha for the Fekete Channel subwatershed was recommended to be achieved within the current draft plan.
- Further discussion with the City regarding the culvert crossing, channel modifications, and erosion potential associated with the stormwater outfalls will be addressed through future detailed design.

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Appendix A

Supporting Figures

Appendix B

Historical Imagery

Appendix C

Photographic Log