

---

**APPENDIX D**  
**Thurber Engineering Ltd. Geotechnical Slope**  
**Stability Hazard and Risk Assessment**

---





**THURBER ENGINEERING LTD.**

# **Geotechnical Slope Stability Hazard and Risk Assessment - Desktop Study & Site Inspection Report**

**East Morrison Creek Erosion Mitigation Study  
Town of Oakville, Ontario**

**Client:** Matrix Solutions Inc.

**Date:** April 11, 2025

**File:** 37329

---

## **EXECUTIVE SUMMARY**

---

This report presents the results of a geotechnical desktop study and site inspection completed by Thurber Engineering Ltd. (Thurber) in support of the East Morrison Creek Erosion Mitigation Study between Postridge Drive and the Morrison Wedgewood Diversion Channel (Reaches 39 to 45) in Oakville, Ontario. The study was completed for Matrix Solutions Inc. (Matrix) on behalf of the Town of Oakville (Town). The purpose of the report is to provide geotechnical comments and recommendations regarding additional investigations, and potential options for erosion mitigation and slope rehabilitation works.

From review of the existing subsurface information available from the study area, the subsurface stratigraphy along the valley alignment generally consists of surficial materials (pavement structure, fill, topsoil) underlain by till mantling shale bedrock.

Based on geotechnically relevant site features, the Study Area was divided into one hundred (100) zones which were then assessed for total slope instability risk using the Slope Stability Rating and Land Uses Charts, Tables 4.2 and 4.3 of the Ontario Ministry of Natural Resources' Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNR 2002).

In total, sixty-five (65) zones were identified as lower risk, twenty-four (24) were moderate risk, and eleven (11) zones were considered higher risk. Thurber recommends no additional investigation at the zones of lower risk, additional investigations at the zones of moderate risk, and a detailed geotechnical investigation at the zones of higher risk.

The primary mode of slope instability inferred within the Study Area is toe erosion from the East Morrison Creek causing slope oversteepening. A potential secondary mode of slope instability is erosion of the valley walls from active table land drainage over the slope face. Slope regression occurs as over-steepened sections of the slope naturally reinstate to a long-term stable slope inclination.

Potential measures to stabilize the slopes, along with the advantages and disadvantages, are presented in the report. Based on site observations and the potential advantages/disadvantages of the various options, it is anticipated that provision of toe protection will be the preferred method for slope stabilization in high risk areas. Additional investigation is recommended to confirm the slope conditions and preferred mitigation measures, and to develop geotechnical parameters for design.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	I
1. INTRODUCTION.....	1
2. PROJECT AND SITE DESCRIPTION .....	1
2.1 Project Description.....	1
2.2 Site Description.....	2
3. BACKGROUND INFORMATION .....	2
3.1 Topography and Drainage .....	2
3.2 Physiography .....	3
3.3 Regional Geology and Hydrogeology Settings .....	3
3.4 MECP Water Well Records Review .....	4
3.5 Existing Water Taking Permits .....	4
3.6 Existing Geotechnical Data .....	4
3.7 Other Technical Reports and Drawings.....	6
4. SUMMARY OF ANTICIPATED SUBSURFACE CONDITIONS.....	7
5. SLOPE STABILITY HAZARD AND RISK ASSESSMENT .....	7
5.1 Methodology .....	7
5.2 Existing Slope Instability Hazard Observations and Classification.....	9
5.3 Total Slope Instability Risk Classification .....	11
6. RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS .....	12
7. RECOMMENDATIONS FOR POTENTIAL MITIGATION OPTIONS.....	13
8. SIGNATURES/CLOSURE .....	14
9. REFERENCES.....	15

### STATEMENT OF LIMITATIONS AND CONDITIONS

## APPENDICES

Appendix A – Site Maps and Figures

Appendix B – Slope Stability Figures

Appendix C – Site Photographs

Appendix D – Slope Instability Hazard, Land Use, and Total Risk Tables

---

## **1. INTRODUCTION**

---

This report presents the results of a geotechnical desktop study and site inspection completed by Thurber Engineering Ltd. (Thurber) in support of the East Morrison Creek Erosion Mitigation Study between Postridge Drive and the Morrison Wedgewood Diversion Channel (Reaches 39 to 45) in Oakville, Ontario. The study was completed for Matrix Solutions Inc. (Matrix) on behalf of the Town of Oakville (Town).

The desktop report includes review of an existing slope inventory report, published information (aerial photographs, geologic and topographic maps), as-built drawings, topographic survey data, and existing drawings or geotechnical reports that were provided by the Town.

The site inspection includes slope instability hazard and risk assessment of the existing slopes in accordance with the Slope Stability Rating and Land Uses Charts, Tables 4.2 and 4.3 of the Ontario Ministry of Natural Resources' Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNRF 2002). The instability rating (low, slight, or moderate) determines the level of supplemental investigation that may be required to complete a comprehensive slope stability assessment.

The purpose of this investigation is to provide geotechnical comments and recommendations regarding additional investigations, and potential options for erosion mitigation and slope rehabilitation works.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

---

## **2. PROJECT AND SITE DESCRIPTION**

---

### **2.1 Project Description**

A Creek Inventory and Assessment Study was completed by Aquafor Beech Limited for the Town of Oakville in 2021. In the report, East Morrison Creek was identified as a high priority reach area of concern with the creek identified as being "in adjustment" and "in transition" with the dominant channel process being widening. The report identified degradation of the channel and undermining of existing creek protection measures (gabion baskets, riprap, and armour stone) and an existing storm sewer outfall. As specified by the Request for Proposal (RFP) for this project, a total of twenty-three (23) erosion sites were identified within the East Morrison Creek

area of concern with seventeen (17) of these erosion sites posing potential long-term risk to both public and private property.

To address the areas of erosion concern identified, the Town of Oakville has proposed to conduct a Schedule B Municipal Class Environmental Assessment (Study).

To provide geotechnical recommendations and comments, Thurber has been contracted complete a desktop study and site inspection to assess the slope stability hazard and risk of the valley slopes in the Study Area, in accordance with the Slope Stability Rating Chart and Land Uses Chart, Tables 4.2 and 4.3 of the Ontario Ministry of Natural Resources' Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNRF 2002). The results of the assessment have been displayed in Figures 1 to 13 of Appendix B.

## **2.2 Site Description**

The Study Area is an approximately three-kilometer-long section of the East Morrison Creek valley between Postridge Drive and the Morrison Wedgewood Diversion Channel (Reach 39-45) in the Town of Oakville, Ontario. The creek is aligned North-West to South-East, adjacent and parallel to Trafalgar Road (Halton Regional Road 3), as seen in Figure 1 of Appendix A.

The land use within the Study Area consists of low to high density urban residential areas, natural areas, recreational areas, and community use areas. Notably, there is a high-rise residential building at 1359 White Oaks Boulevard, and a system of public trails that traverse the East Morrison Creek valley. In general, the land use in the Study Area is mainly low density residential with minor community use lands such as recreational parks and the Oakville Town Hall. East Morrison Creek crosses under Upper Middle Road through a culvert, and under a bridge at Glenashton Drive in the Study Area. Thurber assessed land use based on available data, which should be reviewed and confirmed during subsequent investigations.

---

## **3. BACKGROUND INFORMATION**

---

### **3.1 Topography and Drainage**

The study area is located within the Morrison-Wedgewood Diversion Sub-watershed which falls under the jurisdiction of Conservation Halton (CH). Morrison-Wedgewood Diversion Sub-watershed is in the eastern part of CH's jurisdiction and drains an area of 16 km<sup>2</sup>. It is in the Town of Oakville, Ontario, and drains into the Lower Morrison Creek and Lower Wedgewood Creek Sub-watersheds. (CH, 2023).

The regional topography slopes southerly towards Lake Ontario. The ground elevation along the creek alignment generally falls from elevation 165 m at Postridge Drive to elevation 118 m at the South-Eastern edge of Oakville Town Hall, and the depth of the valley ranges from 4 to 13 m. Overland flow is expected to be influenced by existing topography and local surface water features, and eventually drains into the East Morrison Creek. A topographic site map of the site and surrounding area is shown in Figure 2 of Appendix A.

### 3.2 Physiography

A review of the Physiographic Regions of Southern Ontario indicated that the study area is located within the Physiographic Regions of the Iroquois Plain and South Slope. Based on the information in *The Physiography of Southern Ontario*<sup>1</sup> by Chapman and Putnam (1984), the Iroquois Plain was formed in the late Pleistocene by a body of water known as Lake Iroquois, which emptied eastward at Rome, New York (Chapman and Putnam, 1984). Lake Iroquois was characterized by higher water levels than the present-day Lake Ontario, caused by an ice sheet blocking the present-day St. Lawrence River valley. When the St. Lawrence valley became free of ice, the water level dropped to a level much lower than the present Lake Ontario levels (*Pleistocene Geology of the Hamilton Map-Area*<sup>2</sup>).

The South Slope is characterized by low-lying, fine-grained, undulating ground moraine and knolls. A physiographic region map of the site and surrounding area is shown on Figure 3 of Appendix A.

### 3.3 Regional Geology and Hydrogeology Settings

Geological and hydrogeological conditions were based on publicly available information obtained from the Ontario Geological Survey (OGS) and the Oak Ridges Moraine Groundwater Program (ORMGP).

Based on *Surficial Geology of Southern Ontario*<sup>3</sup> the surficial deposits in the valley are Paleozoic bedrock. Clay to silt-textured glacial till is interpreted on the valley crests west of the creek and South of the site. The surficial geology of the Study Area is shown in Figure 4 of Appendix A.

---

<sup>1</sup> Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

<sup>2</sup> Karrow, P. F., 1959; Pleistocene Geology of the Hamilton Map-Area. Ontario; Toronto, Ontario. Ontario Department of Mines

<sup>3</sup> Ontario Geological Survey, 2010: Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV

According to *Paleozoic Geology of Southern Ontario*<sup>4</sup>, the bedrock underlying the Site consists of the red shale and siltstone of the Queenston Formation. A bedrock geology map is presented in Figure 5 of Appendix A.

### **3.4 MECP Water Well Records Review**

A search of the Ministry of Environment, Conservation and Parks (MECP) well records database conducted for a 500 m radius around the alignment returned a total of ninety-three (93) records (Figure 6 of Appendix A). Based on the MECP well records, the use of the majority of the well records were reported as observation, monitoring and test hole, abandoned, and unknown. Sixteen (16) water supply wells were mostly drilled in the 1950s to 1970s, with the exception of three (3) wells that were completed in 1989, 1991 and 2020. As the study area is typically developed and serviced with municipal water, water supply wells are not expected to be in use.

### **3.5 Existing Water Taking Permits**

A search of MECP's Permit to Take Water (PTTW) and Environmental Activity and Sector Registry (EASR) mapping application in June 2023 returned no active PTTW applications and eleven active EASR water taking registration for construction dewatering within the study area (Figure 6 of Appendix A).

### **3.6 Existing Geotechnical Data**

The following section provides a summary of the available geotechnical reports reviewed in preparation of this report. Reference is made to the reports for additional details, including investigation procedures, laboratory testing results and detailed subsurface conditions, which are not provided herein.

A report titled "Geotechnical Investigation, Pedestrian Bridge and Stair Structure Replacements, McCraney Valley Park" issued July 10, 2012, by Terraprobe Inc. was provided to Thurber. A total of six (6) boreholes were drilled for three (3) proposed bridge repairs (two per bridge) within McCraney Valley, in Reach 36 of the West Morrison Creek, Town of Oakville. The soil stratigraphy observed consisted of a small layer of topsoil or fill underlain by clayey silt, silty clay, shaley till or sandy silt. The overburden soil was underlain by weathered shale bedrock, which was observed at depths of 0.6 to 1.2 m in all six (6) boreholes.

---

<sup>4</sup> Armstrong, D.K. and Dodge, J.E.P., 2007: Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219.

An Environmental Study Report (ESR) titled “Morrison Creek Stabilization” issued October 2016 by Amec Foster Wheeler Environment & Infrastructure a division of Amec Foster Wheeler Americas Limited (AFW) was provided to Thurber. As part of a class EA, AFW completed a geotechnical assessment to evaluate the stability of the slopes and banks of the West Morrison Creek between Upper Middle Road and McCraney Street in the Town of Oakville (Reaches 36 to 38). They observed the valley walls ranged between 4 m and 7 m in height at inclinations of between 2H:1V and 1H:1V or steeper. The creek banks and valley walls were primarily composed of weathered red shale bedrock. Based on the MNR (2002) Slope Rating Chart, the worst-case slopes within the study area have instability ratings of 32, indicating a slight potential for instability.

A report titled “Munn’s Creek Reaches 33 to 35 Erosion Mitigation” issued January 13, 2020, by Terraprobe Inc. was provided to Thurber. A total of seven (7) boreholes were drilled as part of a geotechnical slope stability and streambank erosion risk assessment between Upper Middle Road West and Culham Street in the Town of Oakville (Reaches 33 to 35 of Munn’s Creek). The subsurface stratigraphy encountered was generally a layer of topsoil underlain by fill materials, further underlain by till deposits. Red and grey weathered shale bedrock was inferred beneath the overburden soil at depths of 1.5 m to 5.3 m in all seven (7) boreholes.

A report titled “Taplow Creek Reaches 24 and 25 Valley Wall Erosion Rehabilitation” issued November 21, 2016, by Terraprobe Inc. was provided to Thurber. A total of four (4) boreholes were drilled as part of a geotechnical slope stability and streambank erosion risk assessment at the Northwest quadrant of the intersection of QEW and 4<sup>th</sup> Line, in the Town of Oakville (Reaches 24 and 25 of Taplow Creek). Subsurface stratigraphy consisting of a topsoil layer underlain by fill materials, further underlain by till deposits was observed. Red and grey weathered shale bedrock was inferred beneath the overburden soil at depths of 1.3 m to 1.9 m in all four (4) boreholes.

A report titled “A Soil Investigation for Proposed Residential & Commercial Development” issued January 1995 by Soil-Eng Limited was provided to Thurber. A total of twenty-two (22) boreholes were drilled to support the design and construction of residential and commercial developments between Trafalgar Road, Morrison Creek, and an Ontario Hydro Corridor in the Town of Oakville. The subsurface conditions observed were topsoil underlain by a layer of silty clay till, above shale bedrock of the Queenston Formation which was observed at depths of 1.4 m to 4.3 m. The existing valley slopes were also assessed for instability, which concluded that they were in a stable condition, except for some localized sloughing. The slopes were observed as generally vegetated, 6 to 9 m tall, and with an inclination of 1.1H:1V to 2.7H:1V.

A report titled “Geotechnical Investigation Proposed Petis Gardens Subdivision Property at Glenashton Drive and Eighth Line” issued May 2001 by LANDTEK LIMITED Consulting Engineers was provided to Thurber. Four (4) boreholes were drilled in support of the design and construction of residential developments at the Northwest corner of Glenashton Drive and Eighth Line in the Town of Oakville. The subsurface conditions encountered were topsoil over fill and till deposits, underlain by red shale bedrock of the Queenston formation. The bedrock was encountered at depths of 0.4 to 0.9 m in all boreholes.

### **3.7 Other Technical Reports and Drawings**

The following technical reports and drawings were considered relevant to this investigation.

#### *Glenashton Drive Bridge As-built Drawings*

A review of the as-built drawings for the bridge over East Morrison Creek indicates the current bridge consists of one (1) span of 19.6 m supported on reinforced earth abutments. A 300 mm diameter watermain is suspended in the bridge deck.

Three (3) boreholes were drilled at the current location of the Glenashton Drive bridge, but the information collected was not provided. The drawings indicate the maximum allowable bearing pressure under the abutments is 200 kPa. As part of the bridge construction, a 4.0 m wide channel was constructed from gabion mats and gabion baskets under the bridge for the creek. These channel structures were placed on shale bedrock. A 450 mm and 750 mm thick rip rap layer was installed on the embankment slopes at all four corners. These slopes are specified as 2H:1V inclination.

#### *West Morrison Creek Stabilization Class Environmental Assessment*

An environmental study report issued in October 2016 by Amec Foster Wheeler Environment & Infrastructure a division of Amec Foster Wheeler Americas Limited discussed potential sources of erosion problems and evaluated potential solutions for the West Morrison Creek located between Upper Middle Road and McCraney Street in the Town of Oakville, Ontario. The preferred alternatives that were determined are a combination of creek realignment and protecting the existing creek in-place in the short term. In the long term, pedestrian bridge improvements were recommended.

---

## **4. SUMMARY OF ANTICIPATED SUBSURFACE CONDITIONS**

---

Based on review of the available information, it is anticipated that the subsurface stratigraphy along the creek valley will generally consist of surficial materials (topsoil, fill and/or localized alluvial deposits) underlain by till mantling shale bedrock.

The surficial fill and organic layers encountered in the boreholes were fully penetrated at depths up to 5.3 m below grade near the Study Area.

The tills encountered directly underlying the surficial materials exhibited plastic characteristics. In general, the till was very stiff to hard. Cobbles and boulders were not observed in previous investigations but should be expected throughout the till deposits.

Bedrock was encountered at depths of approximately 0.4 to 5.3 m below grade in boreholes advanced near the site. Generally, bedrock was encountered at shallow depths. The bedrock is expected to consist of red and grey shale of the Queenston Formation.

In general, groundwater seepage was not observed in the boreholes of previous investigations. Where observed, stabilized groundwater level measurements ranged between depths of 1.8 to 5.3 m below grade. Non-stabilized measurements ranged from depths of 1.1 to 5.3 m below grade. In the long term, seasonal fluctuations of the groundwater level should be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation and following the spring freshet.

---

## **5. SLOPE STABILITY HAZARD AND RISK ASSESSMENT**

---

### **5.1 Methodology**

Geotechnical personnel from Thurber visited the site on October 25<sup>th</sup> and 27<sup>th</sup>, 2023 to document the existing conditions along the creek channel in the Study Area. Where exposed, the subsurface conditions in the valley walls were observed, as well as the overall slope height and inclination, presence of seepage and/or sloughing, vegetation density, proximity of the creek to the slope toe, and evidence of previous instability and erosion. The locations and elevations of the slope toes in the Study Area were surveyed with a Trimble R10 GNSS Receiver. At 1359 White Oaks Boulevard and between 1198 and 1208 Lambeth Road, the locations and elevations of the slope crests were also surveyed.

To quantify slope stability hazard, the Study area was divided into seventy-six (76) zones based on geotechnically relevant site features and rated according to the Slope Stability Rating Chart,

Table 4.2 of the Ontario Ministry of Natural Resources' Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNR 2002). Concerning slope instability, a rating of 24 or lower indicates low potential, between 25 and 35 indicates slight potential, and over 35 indicates moderate potential. These zones have been labelled and colour coded as green, yellow, and red respectively in Figures 2 to 5 of Appendix B.

To qualify potential consequences, the Study Area was then further subdivided into one hundred (100) zones based on proximal land use and property parcel data. Thurber assessed land use based on available data, which should be reviewed and confirmed during subsequent investigations. The zones were classified according to the Land Uses Chart, Table 4.3 of the Ontario Ministry of Natural Resources' Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNR 2002):

- Class A – Passive: No buildings near slope; farm field; bush, forest, timberland, woods, wasteland, badlands, tundra.
- Class B – Light: No habitable structures near slope; recreational parks, golf courses, buried small utilities, tile beds, barns, garages, swimming pools, sheds, satellite dishes, dog houses.
- Class C – Active: Habitable or occupied structures near slope; residential, commercial, and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances.
- Class D – Infrastructure and Public Use: Public use structures or buildings, cemeteries, bridges, high voltage power transmission lines, tower, storage/warehousing of hazardous materials, waste management areas.

These zones have also been labelled and colour coded as green, yellow, orange, and red, respectively in Figures 6 to 9 of Appendix B. Classes A and B were considered as lower potential consequences, and classes C and D were deemed as higher potential consequences.

A third set of maps was created which combines the slope instability hazard and potential consequences to visualize the total slope instability risk in the Study Area. The zones are colour coded on a gradient scale where green is lowest risk, and red is highest risk in Figures 10 to 13 of Appendix B.

The assessed ratings are summarized in Tables 1 to 3 in Appendix D.

## 5.2 Existing Slope Instability Hazard Observations and Classification

Out of the seventy-six (76) zones (A1 to A28, B1 to B43 and C1 to C5) assessed in the Study Area, forty-one (41) zones have low potential for instability, twenty-one (21) zones have slight potential for instability, and fourteen (14) zones have moderate potential for instability. The highest slope instability rating was forty-eight (48) in zone B9. The primary mode of slope instability inferred from the observations in the study area is erosion of the toe which results in slope oversteepening. Toe erosion by the creek was observed in all fourteen (14) zones with moderate potential for instability, sixteen (16) of the zones with slight potential for instability, and four (4) of the zones with low potential for instability. Based on site observations and available data, it is inferred that this is the main mode of slope instability in the Study Area.

Based on visual inspection, survey data, and existing topography data from Conservation Halton, valley walls within the Study Area ranged between 4 and 13 m tall, at inclinations of 3H:1V to 1H:1V or steeper. The walls were observed to be comprised of primarily red and grey weathered shale bedrock, locally overlain by till. Vegetation density on the slopes varied from very dense shrubs with mature trees, to bare. Generally, the slopes were populated with mature trees and minimal shrubs. Seepage through the slope face was not observed, and sloughing was observed at some locations, typically where the creek is eroding the toe of the slope. Based off the presence of site features like gullies, table land drainage over the slope was inferred to be minor to active across the site, potentially contributing to erosion. Previous landslide activity was a frequent observation across the Study Area. The creek was observed to generally meander within the valley, resulting in alternating zones with erosion and no erosion at the valley toe.

Out of the twenty-three (23) erosion sites that were identified during the previous Creek Inventory and Assessment Study, one (1) of them (previously defined as Site E-3) did not coincide with zones that Thurber identified as slight or moderate potential for instability. Previous site E-3 is in zone A6-1, which was assessed to have a slope instability rating of 10 to 22, indicating low potential for instability.

While creek erosion mitigation structures such as gabion baskets and rip rap were observed to be installed in the Study Area, the gabion baskets have failed by overturning and bursting in zones A22 and B13 (see photographs 1 and 2 respectively, in Appendix C). Generally, the toe erosion mitigation measures were observed to be intact and functional across the Study Area, although locally, the creek is undercutting the gabion baskets, such as in zone A19 and B17 (see photographs 3 and 4 respectively, in Appendix C). Culverts that drain into the valley were also observed in the Study Area. Those with greater flow volume tended to exhibit greater signs of erosion along the creek and outflow banks. Specifically, the culvert outlet in zone A7 (previous

Site E-6) has failed, and the outlet flow appears to be significantly accelerating creek bank erosion, near the toe of the slope at previous Site E-7 (See photographs 5, 6 and 7 in Appendix C). As of the date of inspection, Thurber assessed zone A7 to have slight potential for slope instability based on the MNR ratings, however, it is noted that the erosion appears to be impacting the structure.

Curved trees, which are evidence of slope creep were observed at every zone with slight or moderate potential for slope instability, and often in the zones with low potential for instability. These trees varied from very young to mature. Potential evidence of displacement of man-made structures at the valley crests was observed at 1359 White Oaks Boulevard and at properties along Lambeth Road. At 1359 White Oaks Boulevard, the curbs of the East portion of parking lot appear to be separating, and the fence posts appear to be migrating down-slope (see photographs 8 to 13 in Appendix C). Between 1198 and 1208 Lambeth Road (zone B2), fence posts also appear to be migrating down-slope (see photograph 14 in Appendix C). No tension cracks were observed in the Study Area.

The preliminary survey data collected indicates the toe of the slope between 1198 and 1208 Lambeth Road (zone B2) is at 118.1 to 119.3 m elevation, and the crest of the slope is at 128.5 to 132.2 m in elevation (11 to 13 m in height). The steepest portion of this slope that was surveyed is at 1208 Lambeth Road, where the slope is 12 to 13 m tall, and the inclination is approximately 1H:1V. The preliminary survey data collected at 1359 White Oaks Boulevard indicates the slope toe is at 124.7 m to 126.8 m elevation and the slope crest is at 135.4 to 137.5 m elevation (10 to 11 m height). The steepest portion of the slope that was surveyed there is approximately 11.3 m tall with an inclination of 1.4H:1V.

Active toe erosion that was observed in the Study Area was often accompanied by sloughing of the slope face, and evidence of previous landslides. Notably, between 1198 and 1208 Lambeth Road (zone B2) moderate to severe sloughing along the whole slope face was observed, burying the gabion baskets installed at the toe (previous Site E-4) (see photographs 15 to 17 in Appendix C). These gabion baskets appeared to be effective at mitigating toe erosion from the creek and were intact, however the additional sloughing observed indicates that the slope is still creeping due to another mode of instability.

Table land drainage or over the slope face was inferred as minor to active in the Study Area and may be contributing locally to slope instability through erosion in zones with little to no vegetation on the slope face.

### **5.3 Total Slope Instability Risk Classification**

As outlined above, the valley slopes within the Study Area were subdivided into one hundred (100) zones to qualify potential consequences of slope instability.

Out of the fifty-nine (59) zones with low potential for slope instability identified in the Study Area, three (3) of them are proximal to land use class A, one (1) is proximal to land use class B, forty-three (43) are proximal to land use class C, and twelve (12) are proximal to land use class D. Due to the low slope instability hazard identified in these zones, they are deemed lower total instability risk.

Out of the twenty-five (25) zones with slight potential for slope instability identified in the Study area, three (3) of them are proximal to land use class A, and three (3) of them are proximal to land use class B. Due to the lower potential consequences in these zones, they are deemed lower total instability risk. Seventeen (17) of these zones are proximal to land use class C, and two (2) of them are proximal to land use class D. Due to the slight slope instability hazard and the higher potential consequences, these zones are deemed moderate total instability risk.

Out of the sixteen (16) zones with moderate potential for slope instability identified in the Study Area, three (3) of them are proximal to land use class A, and two (2) of them are proximal to land use class B. Due to the moderate slope instability hazard and the lower potential consequences, these zones are deemed moderate total instability risk. Eleven (11) zones are proximal to land use class C, and zero (0) are proximal to land use class D. Due to the moderate slope instability hazard and the higher potential consequences, these zones are deemed higher risk.

In total, sixty-four (64) zones are considered lower risk, twenty-five (25) are considered moderate risk: A2, A4, A7, A11-1, A17, A19-1, A20, A22-1, A25-1, A25-3, A27, B3, B6, B7-2, B13, B20, B22, B24, B27, B29, B34, B36, B39, and B42. Eleven (11) zones are considered higher risk: A9, A11-2, A13, A15, A22-2, A23, B2, B9, B11, B17, and B32. Photographs 18 to 42 in Appendix C are of the higher risk zones.

The higher risk zones B2, B32, A11-2, A13, B17, and A22-2 have structures within 25 m of the valley slope crest.

---

## **6. RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS**

---

Based on our desktop review and site inspection of the Study Area, it is recommended that additional investigations are conducted in the twenty-four (24) moderate risk zones, and a detailed geotechnical investigation is conducted in the eleven (11) higher risk zones to determine the soil and bedrock conditions. No additional investigations are recommended for the sixty-five (65) zones identified as lower risk.

The detailed geotechnical investigation in the zones of higher risk should include the following:

- Drilling of boreholes to confirm the soil stratigraphy and bedrock surface elevations, determine the characteristics of the soil and bedrock, and develop geotechnical parameters for slope stability modelling. The boreholes should extend an adequate depth below the creek bed and include recovery of bedrock core samples.
- In particular, the borehole investigation must define the extent and depth of the till deposits, the extent and connectivity of cohesionless sand layers potentially present within the till, and the bedrock surface elevation along the creek alignment. The existing data indicates that the overburden depth and bedrock elevation may vary across the site.
- Precise surveying of slope features to enable accurate digital stability modelling.
- Geotechnical laboratory testing to confirm visual identification and classification of the soils, and to assess geotechnical parameters pertinent to excavation, erosion control, and groundwater control.
- A detailed study to determine where table land drainage over the slope face is contributing to slope instability.

An additional five (5) sites are rated as a moderate potential for instability based on the MNR guidelines, however, are deemed lower risk and may not warrant an intrusive geotechnical investigation, subject to consultations with the Conservation Authority and Town of Oakville.

Additional investigations for the zones of moderate risk should include the following:

- Precise surveying and/or LIDAR of slope features to enable accurate digital slope stability modelling.

- A detailed study to determine where table land drainage over the slope face is contributing to slope instability.
- Visual inspection every five (5) years to monitor slope instability risk and identify any changes that may be increasing the risk level.

Considering the Glenashton Drive bridge is supported on reinforced earth abutments, routine inspections should be carried out and protection measures maintained to ensure erosion does not compromise the structure foundations.

---

## **7. RECOMMENDATIONS FOR POTENTIAL MITIGATION OPTIONS**

---

The primary mode of slope instability inferred within the Study Area is toe erosion from the East Morrison Creek causing slope oversteepening. A potential secondary mode of slope instability is erosion of the valley walls from active table land drainage over the slope face. Slope regression occurs as over-steepened sections of the slope naturally reinstate to a long-term stable slope inclination.

Potential measures to stabilize the slopes, along with the advantages and disadvantages, are outlined below:

1. Ongoing Monitoring: Yearly monitoring of the slopes with investigation and remedial measures undertaken as necessary. Least initial cost. Does not reduce risk in areas of high potential for instability.
2. Regrading of Slopes to Long-Term Stable Inclination: Further regression of slope crest by natural processes is minimized. Does not mitigate future erosion at the toe. Property would be required at the top of the slope to accommodate flatter slopes. Excavation of shale bedrock would be required.
3. Channel Realignment: Realign channel to direct flow away from the toe of slope to prevent erosion. High impact to natural environment. May impact flow patterns in other areas, resulting in additional channel erosion.
4. Toe Protection: Armour stone, rip rap or gabion baskets placed at the toe of slope to mitigate future toe erosion. Natural flattening of over-steepened sections above the wall may still occur. Potential for undermining of the stone or baskets by creek channel erosion.

5. Retaining Wall: A reinforced soil slope (RSS) or other retaining wall system to provide permanent stabilization. Can be constructed to a height necessary to provide long-term stable slope inclination above the top of wall. Access to construction equipment is limited. High potential for disturbance of natural areas. High cost.
6. Purchase Properties at Top of Slope: Allows natural slope regression to continue. Very expensive and disruptive to private landowners.

Based on site observations and the potential advantages/disadvantages discussed above, it is anticipated that provision of toe protection will be the preferred option for slope stabilization in high risk areas. Additional investigation is recommended to confirm the slope conditions and preferred mitigation measures, and to develop geotechnical parameters for design.

---

## 8. SIGNATURES/CLOSURE

---

We trust this report provides the information you require at this time. If you have any questions, please contact the undersigned at your convenience.



Gregory Stanhope, E.I.T.  
Geotechnical Engineer-in-training



Karel Furbacher, P.Eng.  
Senior Geotechnical Engineer



Murray Anderson, M.Eng., P.Eng.  
Review Engineer

Date: April 11, 2025  
File: 37329

---

## 9. REFERENCES

---

Amec Foster Wheeler Environment & Infrastructure a division of Amec Foster Wheeler Americas Ltd. Morrison Creek Stabilization Environmental Study Report (ESR), Town of Oakville, dated October 2016.

Armstrong, D.K. and Dodge, J.E.P. Paleozoic Geology of Southern Ontario: Ontario Geological Survey, Miscellaneous Release Data 219, 2007.

Aquafor Beech Limited, Town of Oakville 2021 Creek Inventory and Assessment, dated May 10, 2022.

Chapman, L.J. and Putnam, D.F. The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Ontario Ministry of Natural Resources, 1984.

Conservation Halton Open Data Hub, CH Contours 1m (2002), published December 16, 2022, accessed 2023.

Conservation Halton Open Data Hub, Rainfall Watershed (20140804), published February 13, 2023, accessed 2023.

Karrow, P. F. Pleistocene Geology of the Hamilton Map-Area. Ontario; Toronto, Ontario. Ontario Department of Mines dated 1959.

Landtek Ltd. Geotechnical Investigation Proposed Petis Gardens Subdivision Property at Glenashton Drive and Eighth Line, Town of Oakville, Ontario, dated May 2001.

Ministry of the Environment, Conservation and Parks. Water Well Record Database and Permit to Take Water Database. 2023.

Ontario Geological Survey. Bedrock Geology of Ontario Seamless Coverage Data Set 6. 2005.

Ontario Geological Survey. Quaternary geology, seamless coverage of the province of Ontario: Ontario Geological Survey, Data Set 14. 1997.

Ontario Geological Survey. Surficial Geology of Southern Ontario, Miscellaneous Release Data 128-REV, 2010.

Ontario Ministry of Natural Resources Technical Guide River & Stream Systems: Erosion Hazard Limit, dated 2002.

R.V. Anderson Associates Ltd. Town of Oakville Glenashton Drive Bridge M.T.C. Structure Site No. 10-351, dated July 1987.

Soil-Eng Limited. A Soil Investigation for Proposed Residential & Commercial Development Part of Lots 11 and 12, Concession 1 SDS, Town of Oakville, dated January 1995.



Terraprobe Inc. Geotechnical Investigation Pedestrian Bridge and Stair Structure Replacements McCraney Valley Park, Town of Oakville, Ontario, dated July 10, 2012.

Terraprobe Inc. Munn's Creek Reaches 33 to 35 Erosion Mitigation, Oakville, Ontario, dated January 13, 2020.

Terraprobe Inc. Taplow Creek Reaches 24 and 25 Valley Wall Erosion Rehabilitation, Town of Oakville, Ontario, dated November 21, 2016.

Toronto and Region Conservation Authority, Watershed Management, Watersheds Map, Updated December 2020, Accessed 2023.



## STATEMENT OF LIMITATIONS AND CONDITIONS

### 1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

### 2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

### 3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

### 4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

### 5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

### 6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

### 7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



**THURBER** ENGINEERING LTD.

## **APPENDIX A**

Site Maps and Figures



- LEGEND**
- SITE
  - STUDY AREA (500 m BUFFER)
  - WATERCOURSE
  - LOCAL ROAD
  - ARTERIAL ROAD/HIGHWAY
  - + RAILWAY
  - WATERBODY



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

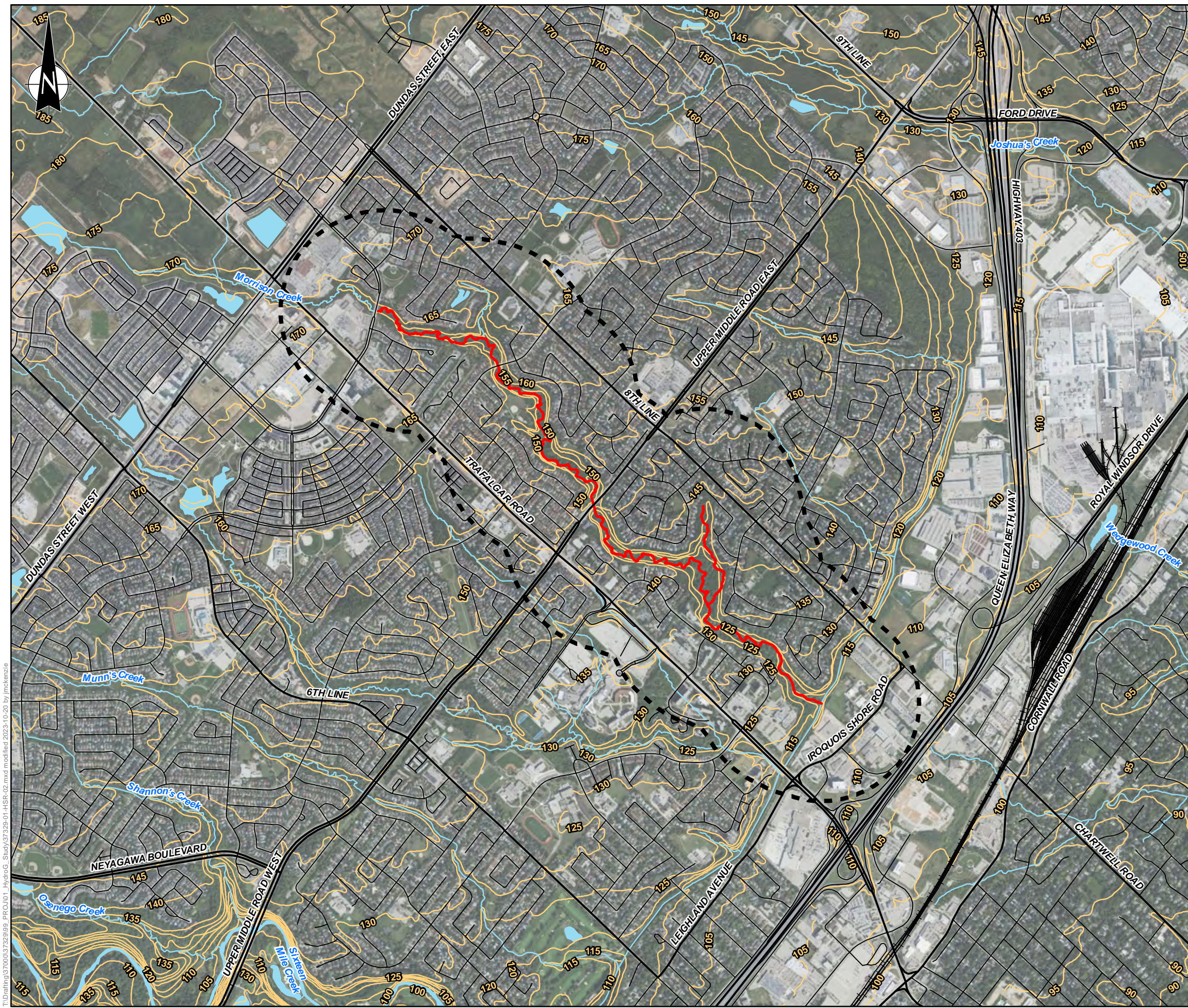
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SITE LOCATION PLAN**

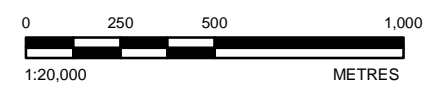
PROJECT No.	<b>37329</b>
ENGINEER	<b>FK</b>
DRAWN	<b>JEM</b>
APPROVED	<b>AH</b>
DATE	<b>2023-10-20</b>
FIGURE No.	<b>1</b>



T:\Drafting\37000\37329\999\_PROJ\01\_HydroG\_Study\37329-01-HSR-01.mxd modified 2023-10-20 by jmkenszie



- LEGEND**
- SITE
  - STUDY AREA (500 m BUFFER)
  - TOPOGRAPHIC CONTOUR, metres
  - WATERCOURSE
  - LOCAL ROAD
  - ARTERIAL ROAD/HIGHWAY
  - RAILWAY
  - WATERBODY



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

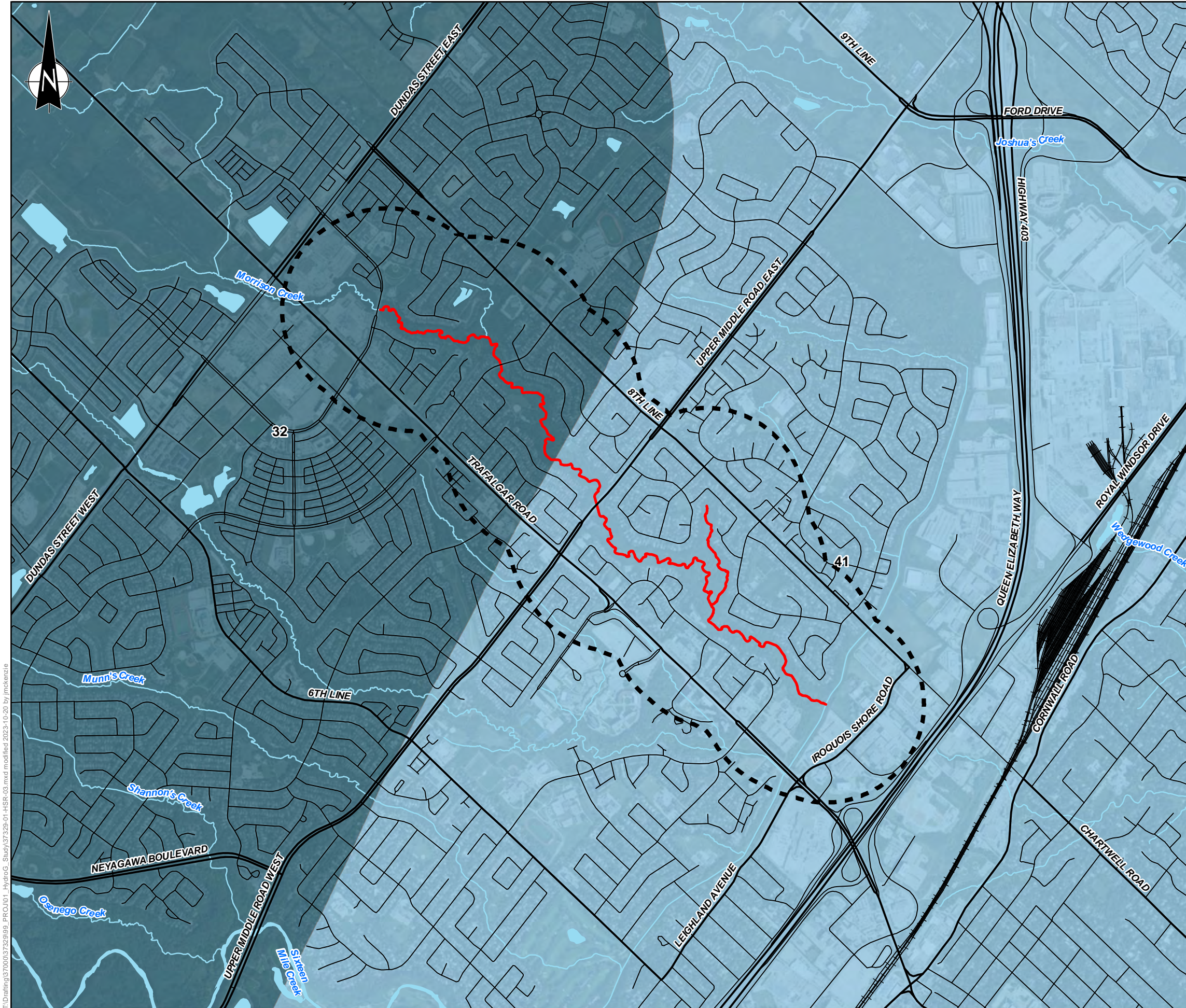
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**TOPOGRAPHY**

PROJECT No.	37329
ENGINEER	FK
DRAWN	JEM
APPROVED	AH
DATE	2023-10-20
FIGURE No.	2



T:\Drafting\37000\37329\999\_PROJ\01\_HydroG\_Study\37329-01-HSR-02.mxd modified 2023-10-20 by jmkenszie



**LEGEND**

- SITE
- STUDY AREA (500 m BUFFER)
- WATERCOURSE
- LOCAL ROAD
- ARTERIAL ROAD/HIGHWAY
- RAILWAY
- WATERBODY
- PHYSIOGRAPIC REGION
- 32, SOUTH SLOPE
- 41, IROQUOIS PLAIN



**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. CHAPMAN, L.J. AND PUTNAM, D.F. 2007. PHYSIOGRAPHY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE--DATA 228.
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

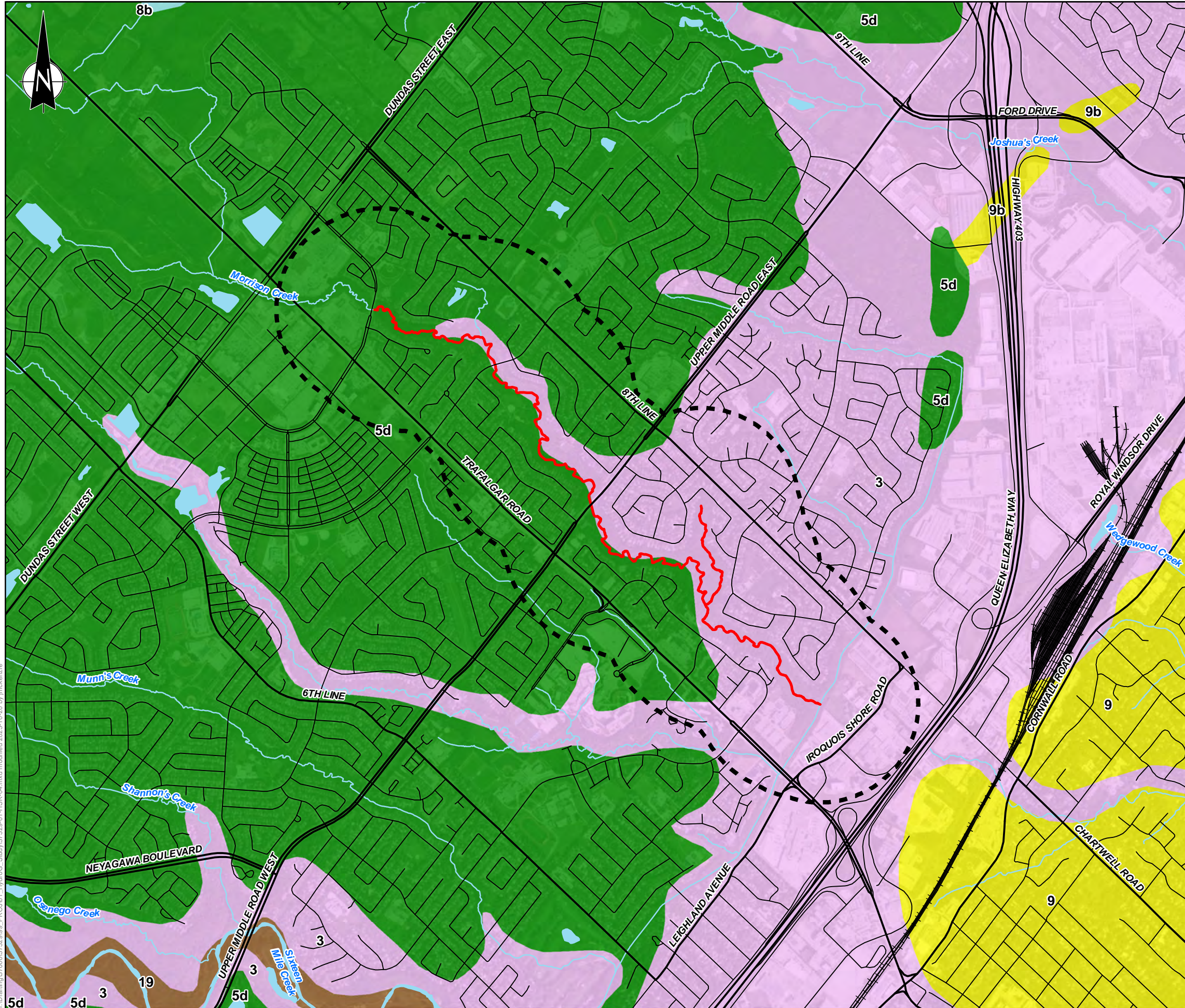
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**PHYSIOGRAPHIC REGIONS**

PROJECT No.	<b>37329</b>
ENGINEER	<b>FK</b>
DRAWN	<b>JEM</b>
APPROVED	<b>AH</b>
DATE	<b>2023-10-20</b>
FIGURE No.	<b>3</b>



T:\Drafting\37000\37329\999 - PRO\001 - HydroG - Study\37329-01-HSR-03.mxd modified 2023-10-20 by jmkentzie



**LEGEND**

- SITE
- STUDY AREA (500 m BUFFER)
- WATERCOURSE
- LOCAL ROAD
- ARTERIAL ROAD/HIGHWAY
- RAILWAY
- WATERBODY

**SURFICIAL GEOLOGY**

- 3. PALEOZOIC BEDROCK
- 5d. TILL: CLAY TO SILT-TEXTURED TILL (DERIVED FROM GLACIOLACUSTRINE DEPOSITS OR SHALE)
- 8b. FINE-TEXTURED GLACIOLACUSTRINE DEPOSITS: SILT AND CLAY, MINOR SAND AND GRAVEL; INTERBEDDED SILT AND CLAY AND GRITTY, PEBBLY FLOW TILL AND RAINOUT DEPOSITS
- 9. COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS: SAND, GRAVEL, MINOR SILT AND CLAY
- 9b. COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS: SAND, GRAVEL, MINOR SILT AND CLAY; LITTORAL DEPOSITS
- 19. MODERN ALLUVIAL DEPOSITS: CLAY, SILT, SAND, GRAVEL, MAY CONTAIN ORGANIC REMAINS



**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. ONTARIO GEOLOGICAL SURVEY, 2010. SURFICIAL GEOLOGY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE--DATA 128-REV.
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

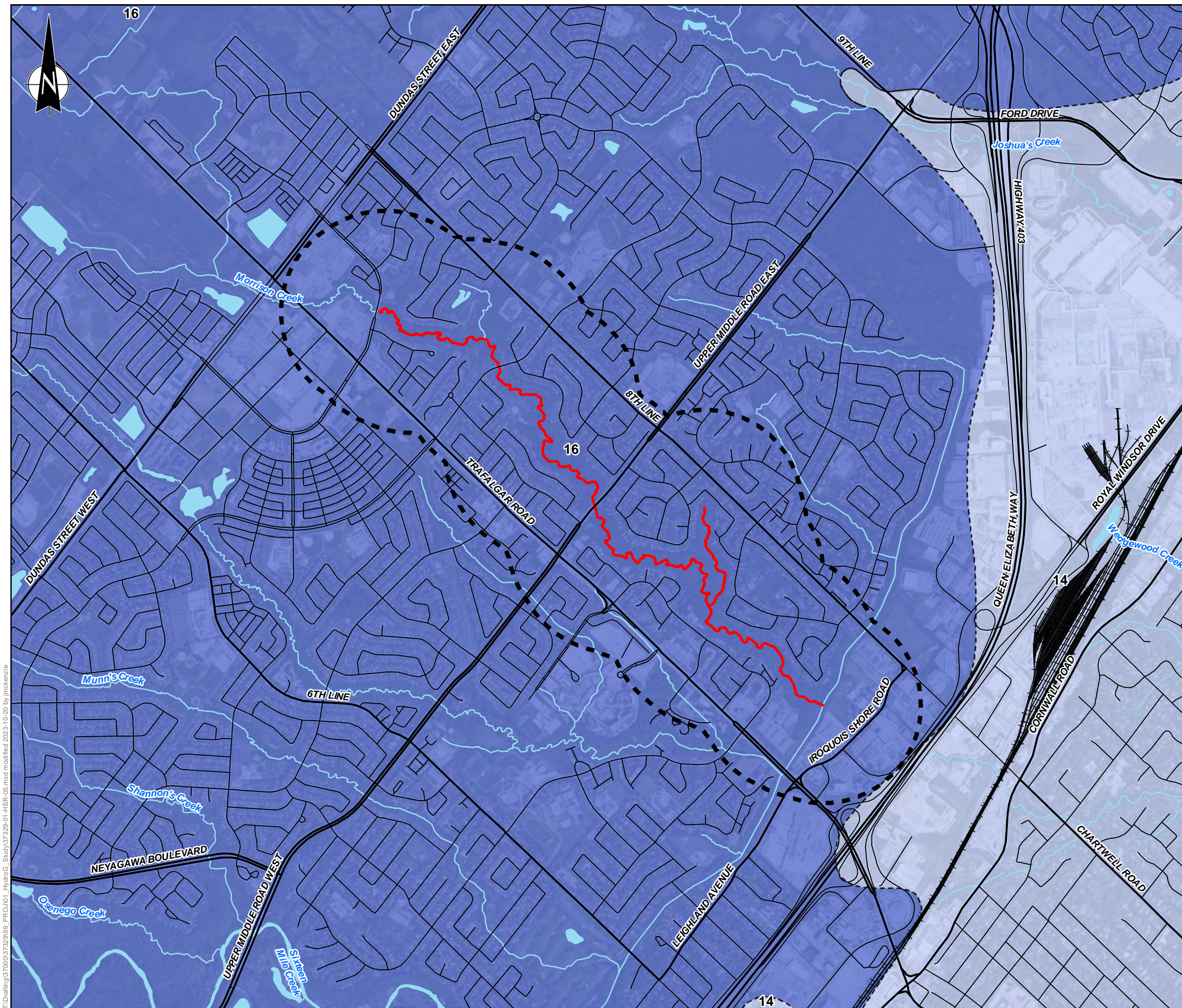
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SURFICIAL GEOLOGY**

PROJECT No.	<b>37329</b>
ENGINEER	<b>FK</b>
DRAWN	<b>JEM</b>
APPROVED	<b>AH</b>
DATE	<b>2023-10-20</b>
FIGURE No.	<b>4</b>



T:\Drafting\37000\37329\999\_PRC\001\_HydroG\_Study\37329-01-HSR-04.mxd modified 2023-10-20 by jmkenszie

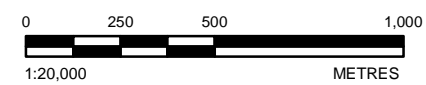


**LEGEND**

- SITE
- STUDY AREA (500 m BUFFER)
- WATERCOURSE
- LOCAL ROAD
- ARTERIAL ROAD/HIGHWAY
- | RAILWAY
- WATERBODY

**BEDROCK FORMATION**

- 16. QUEENSTON FORMATION: SHALE, SILTSTONE, MINOR LIMESTONE AND SANDSTONE
- 14. GEORGIAN BAY FORMATION: SHALE AND LIMESTONE



**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. ARMSTRONG, D.K. AND DODGE, J.E.P. 2007. PALEOZOIC GEOLOGY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE--DATA 219.
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**BEDROCK GEOLOGY**

PROJECT No.	<b>37329</b>
ENGINEER	<b>FK</b>
DRAWN	<b>JEM</b>
APPROVED	<b>AH</b>
DATE	<b>2023-10-20</b>
FIGURE No.	<b>5</b>



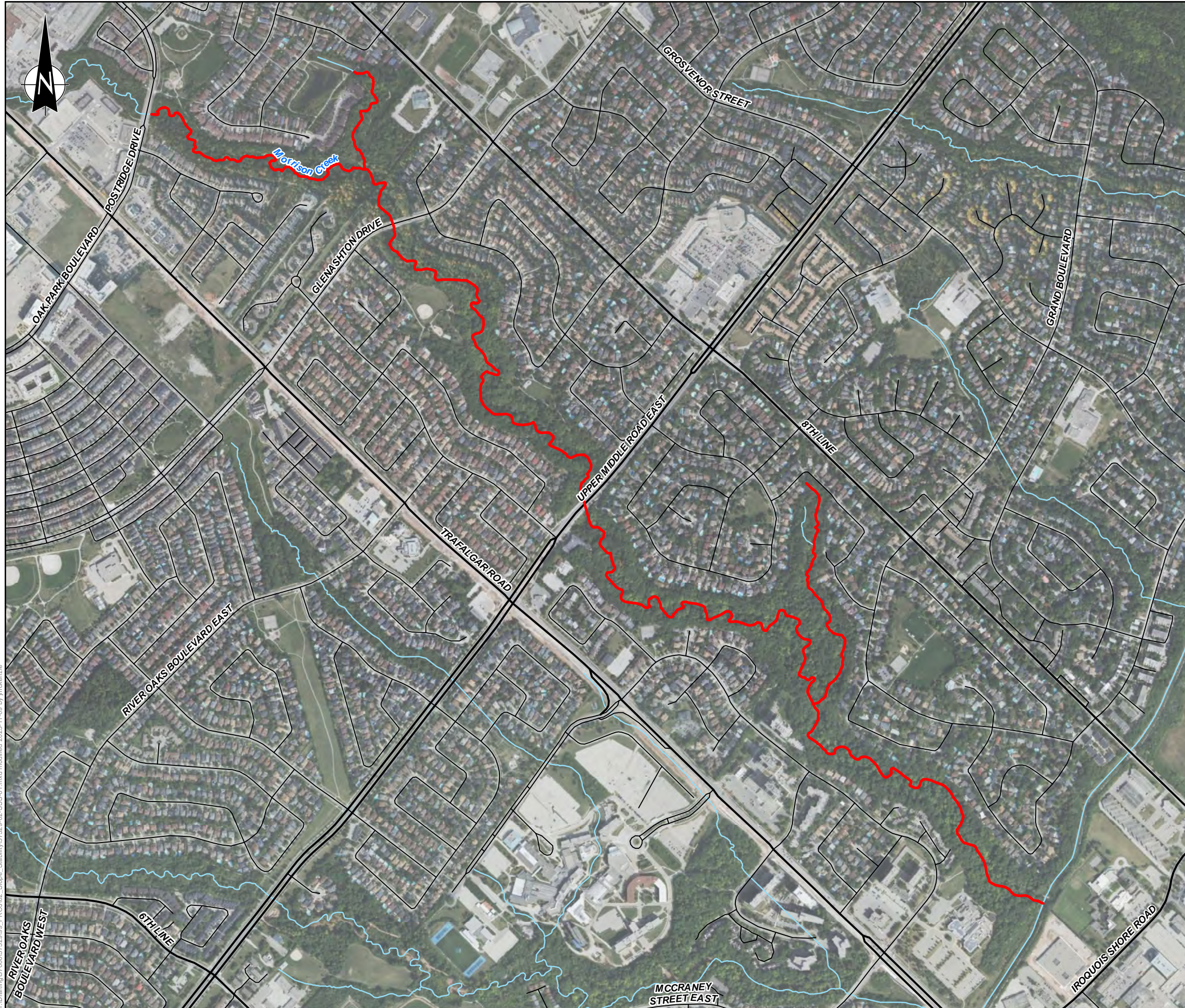
T:\Drafting\37000\37329\999\_PROJ\01\_HydroG\_Study\37329-01-HSR-05.mxd modified 2023-10-20 by jmkensie









## **APPENDIX B**

Slope Stability Figures



1:100,000

**LEGEND**

-  WATERCOURSE
-  LOCAL ROAD
-  ARTERIAL ROAD/HIGHWAY
-  SITE



**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

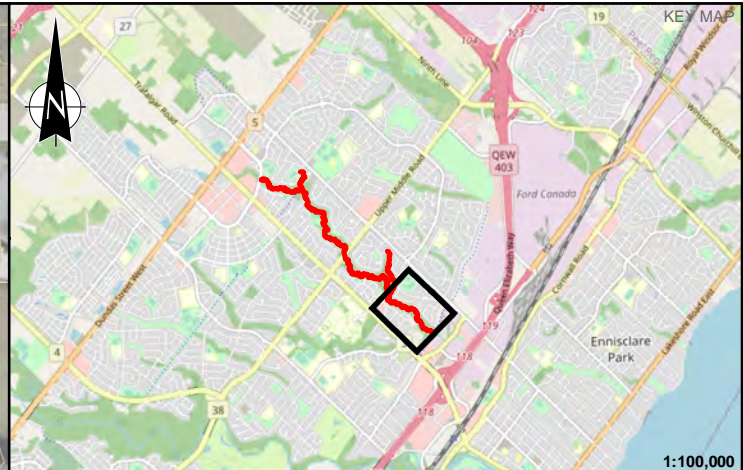
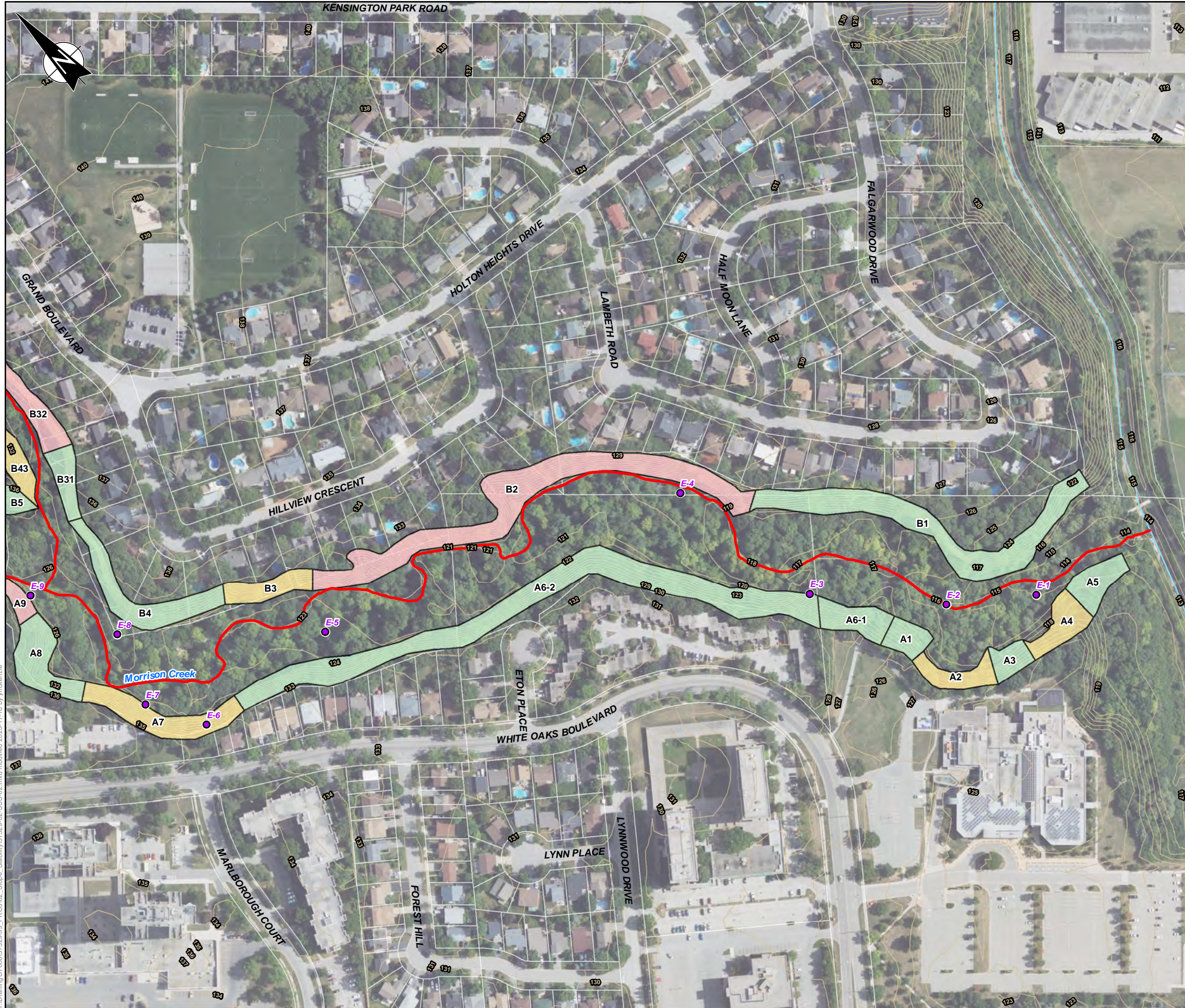
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SITE LOCATION PLAN**

PROJECT No.	<b>37329</b>
ENGINEER	<b>GS</b>
DRAWN	<b>JEM</b>
APPROVED	<b>KF</b>
DATE	<b>2023-11-03</b>
FIGURE No.	<b>1</b>



T:\Drafting\37000\37329\99 - PRO\0102 - Slope Stability\37329-02-SSS-01.mxd modified 2023-11-08 by jmkenszie



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**SLOPE STABILITY RATING (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.2)**

- LOW HAZARD (0 - 24)
- SLIGHT HAZARD (25 - 35)
- MODERATE HAZARD (>35)

**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT: MATRIX SOLUTIONS INC.

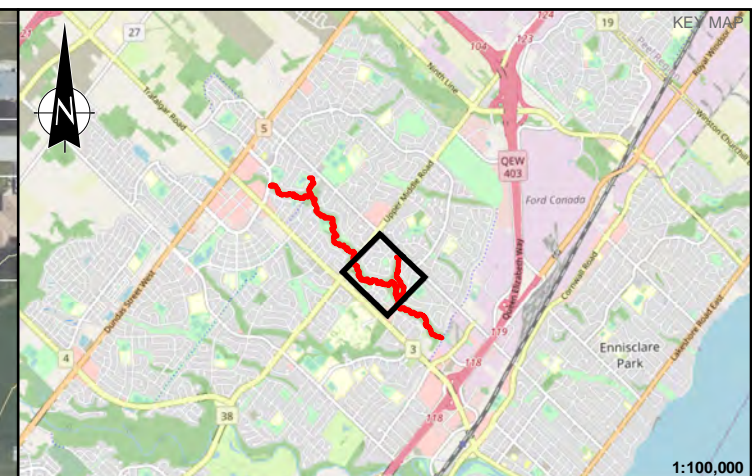
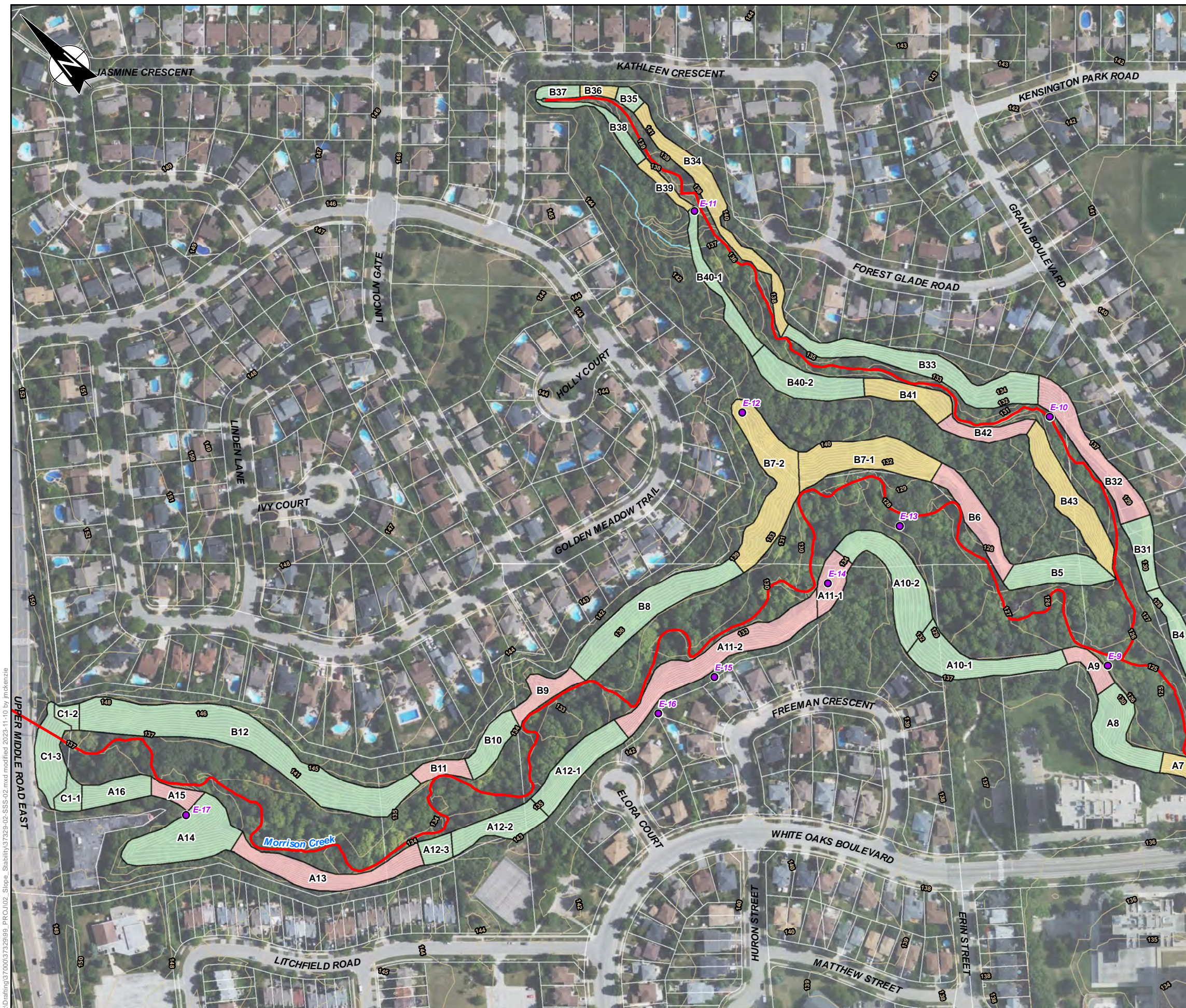
PROJECT: EAST MORRISON CREEK EROSION MITIGATION STUDY

**SLOPE STABILITY SURVEY**

PROJECT No. 37329  
 ENGINEER GS  
 DRAWN JEM  
 APPROVED KF  
 DATE 2023-11-16  
 FIGURE No. 2

0 30 60 120  
 1:2,750 METRES

T:\Drafting\37000\37329\99\_P\ROU\02\_Slope\_Stability\37329-02\_SSS-02.mxd modified 2023-11-16 by jmcKenzie



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**SLOPE STABILITY RATING (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.2)**

- LOW HAZARD (0 - 24)
- SLIGHT HAZARD (25 - 35)
- MODERATE HAZARD (>35)

**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

0 30 60 120  
1:2,750 METRES

T:\Drafting\373229\373229-02-SSS-02.mxd modified 2023-11-10 by jmkenszie

**CLIENT**  
MATRIX SOLUTIONS INC.

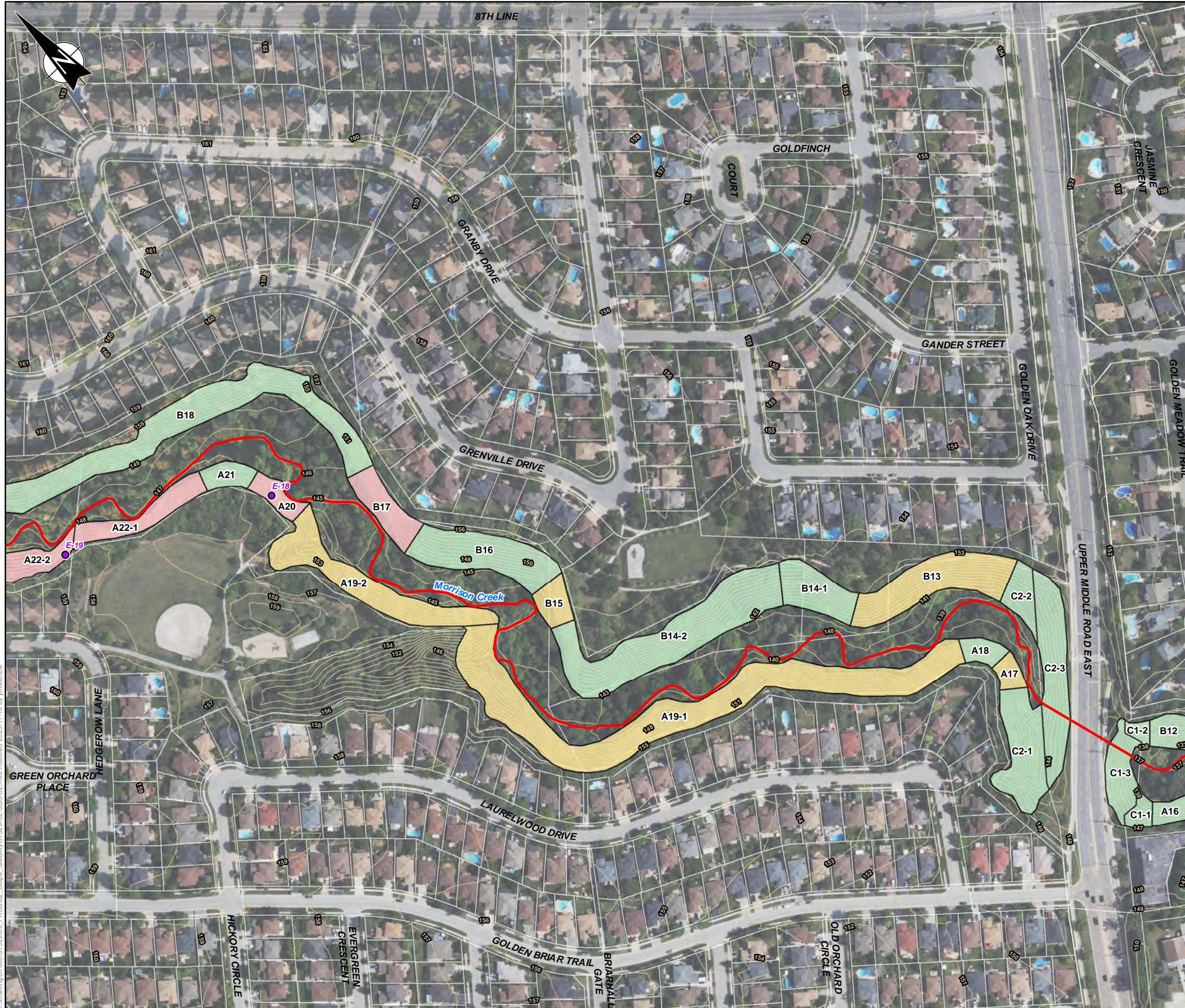
**PROJECT**  
EAST MORRISON CREEK EROSION MITIGATION STUDY

**SLOPE STABILITY SURVEY**

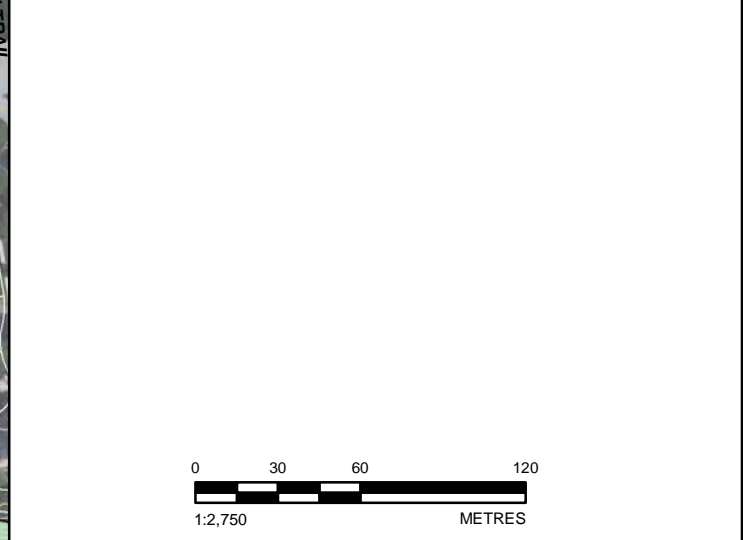
PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	3



**THURBER ENGINEERING LTD.**



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE
- SLOPE STABILITY RATING (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.2)**
- LOW HAZARD (0 - 24)
  - SLIGHT HAZARD (25 - 35)
  - MODERATE HAZARD (>35)



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT  
**MATRIX SOLUTIONS INC.**

PROJECT  
**EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

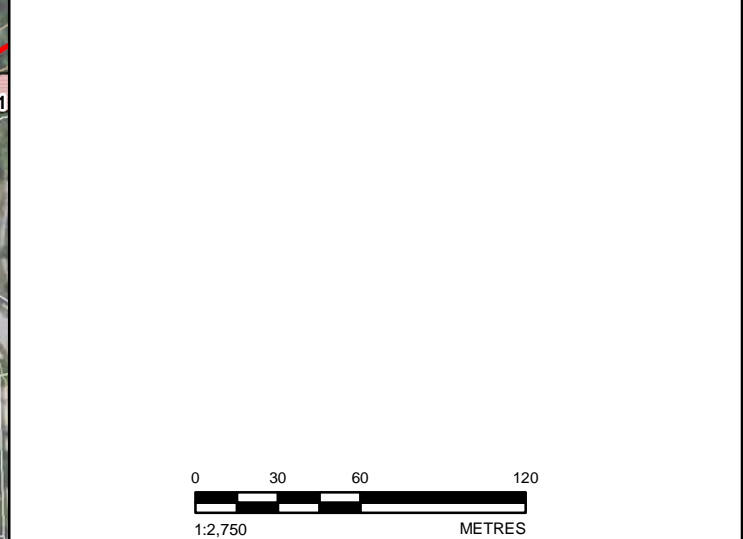
PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	4



T:\Drafting\37000\37329\02\_Slope\_Stability\37329-02\_SSS-02.mxd modified 2023-11-10 by jmckenzie



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE
- SLOPE STABILITY RATING (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.2)**
- LOW HAZARD (0 - 24)
  - SLIGHT HAZARD (25 - 35)
  - MODERATE HAZARD (>35)



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

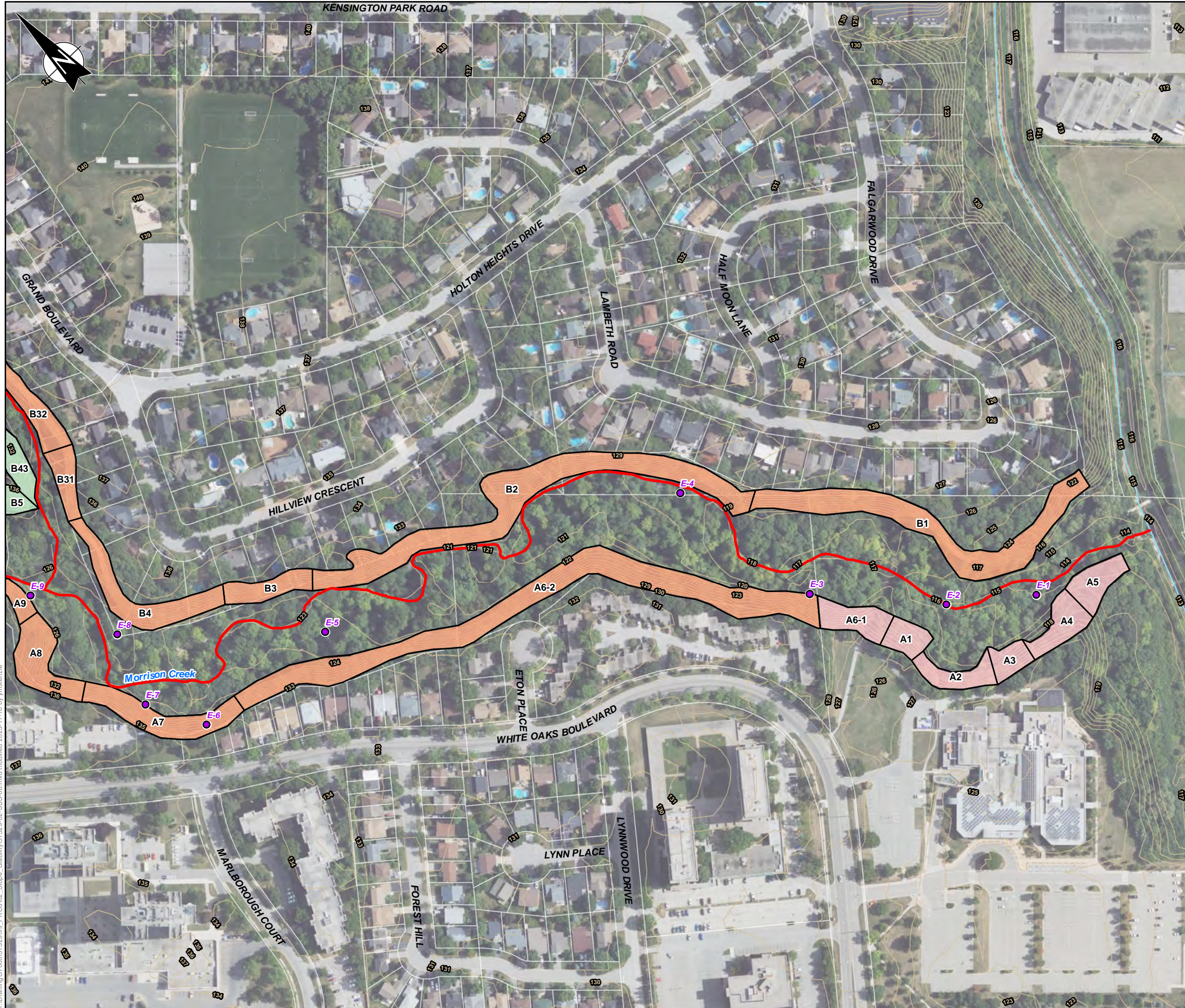
CLIENT  
**MATRIX SOLUTIONS INC.**

PROJECT  
**EAST MORRISON CREEK EROSION MITIGATION STUDY**  
**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	5

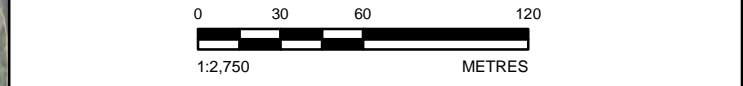


T:\Drafting\37329\37329\_02\_Slope\_Stability\37329-02\_SSS-02.mxd modified 2023-11-10 by jmkencznie



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE

- PROXIMAL LAND USES (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.3)**
- A
  - B
  - C
  - D



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

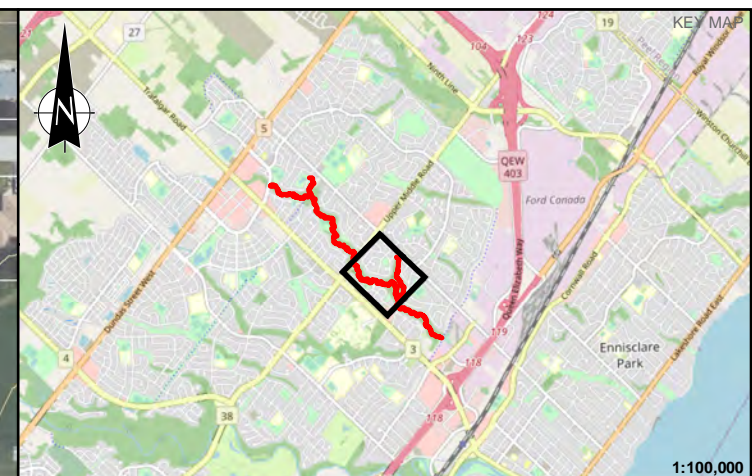
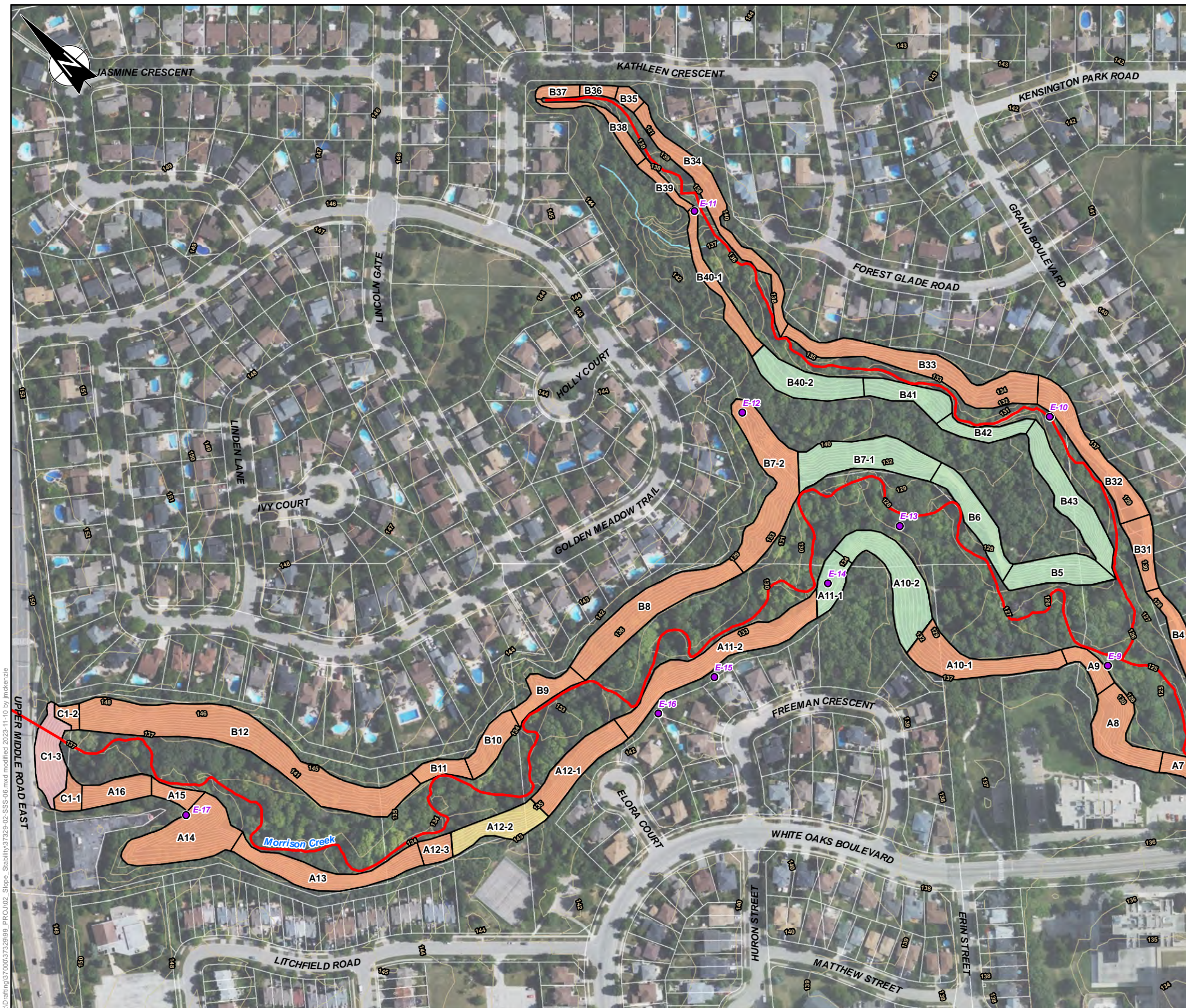
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	6



T:\Drafting\37000\37329\99\_P\ROU\02\_Slope\_Stability\37329-02\_SSS\_06.mxd modified 2023-11-16 by jmkencznie



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**PROXIMAL LAND USES (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.3)**

- A
- B
- C
- D

**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

0 30 60 120  
1:2,750 METRES


T:\Drafting\37000\37328\99\_P\PROJ\02\_Slope\_Stability\37328-02\_SSS\_06.mxd modified 2023-11-10 by jmklenzie

**CLIENT**  
MATRIX SOLUTIONS INC.

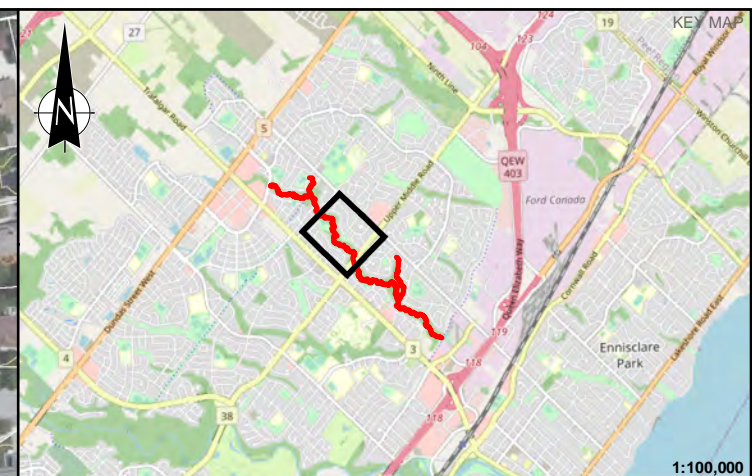
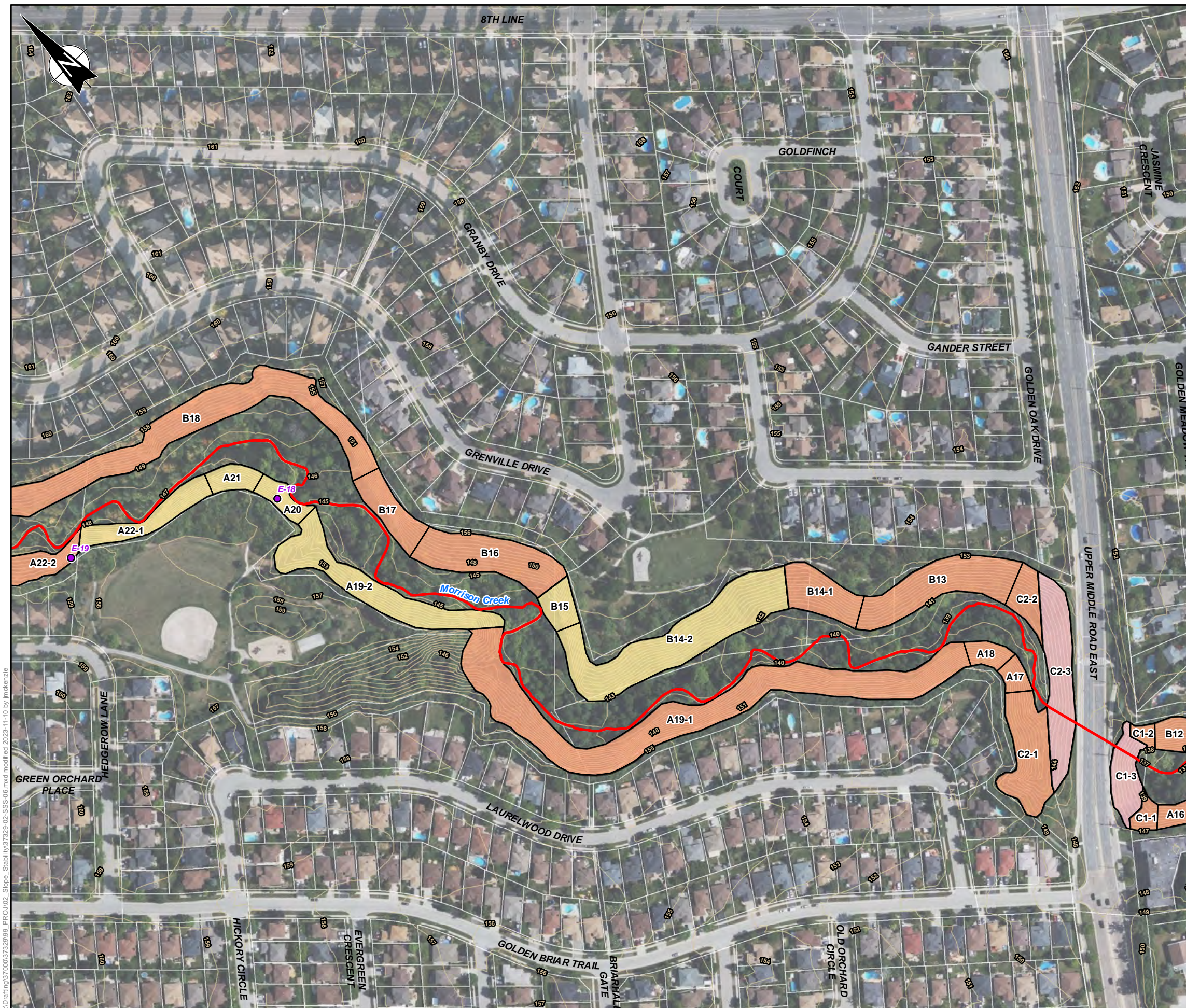
**PROJECT**  
EAST MORRISON CREEK EROSION MITIGATION STUDY

**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	7

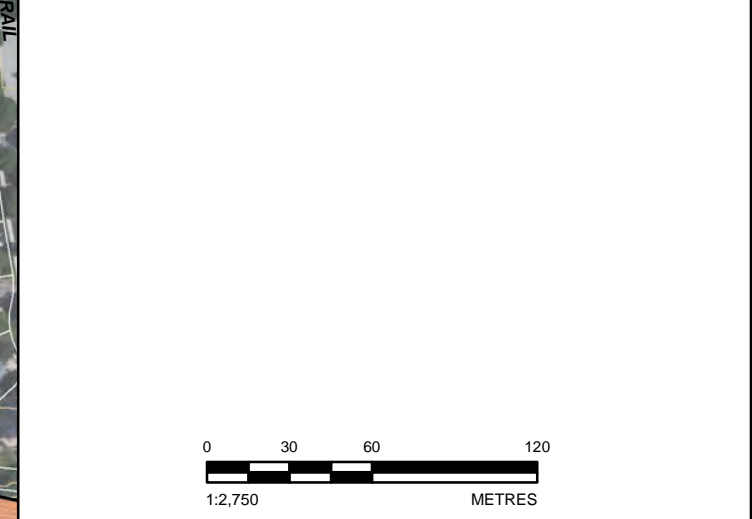


**THURBER ENGINEERING LTD.**



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE

- PROXIMAL LAND USES (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.3)**
- A
  - B
  - C
  - D



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT: **MATRIX SOLUTIONS INC.**

PROJECT: **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-10
FIGURE No.	8



T:\Drafting\37000\37329\99\_PROJ\02\_Slope\_Stability\37329-02\_SSS-06.mxd modified 2023-11-10 by jmcKENZIE



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**PROXIMAL LAND USES (OMNR TECHNICAL GUIDE RIVER & STREAM SYSTEMS: EROSION HAZARD LIMIT TABLE 4.3)**

- A
- B
- C
- D

**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT: **MATRIX SOLUTIONS INC.**

PROJECT: **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No. **37329**

ENGINEER **GS**

DRAWN **JEM**

APPROVED **KF**

DATE **2023-11-10**

FIGURE No. **9**

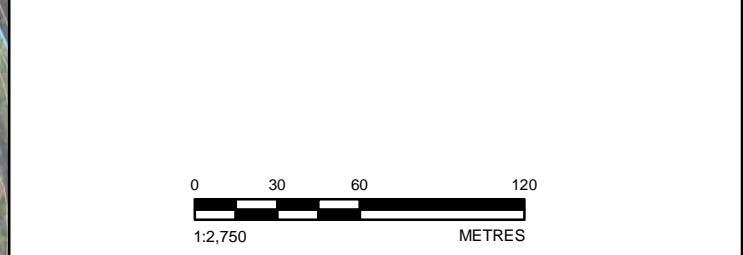


T:\Drafting\37329\37329\_09\_Plan\_Slope\_Stability\37329-02-SS-06.mxd modified 2023-11-10 by jmcKENZIE



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE

- TOTAL QUANTIFIED RISK**
- SLOPE STABILITY HAZARD LOW, LAND USE A
  - SLOPE STABILITY HAZARD LOW, LAND USE B
  - SLOPE STABILITY HAZARD LOW, LAND USE C
  - SLOPE STABILITY HAZARD LOW, LAND USE D
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE A
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE B
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE C
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE D
  - SLOPE STABILITY HAZARD MODERATE, LAND USE A
  - SLOPE STABILITY HAZARD MODERATE, LAND USE B
  - SLOPE STABILITY HAZARD MODERATE, LAND USE C
  - SLOPE STABILITY HAZARD MODERATE, LAND USE D



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT **MATRIX SOLUTIONS INC.**

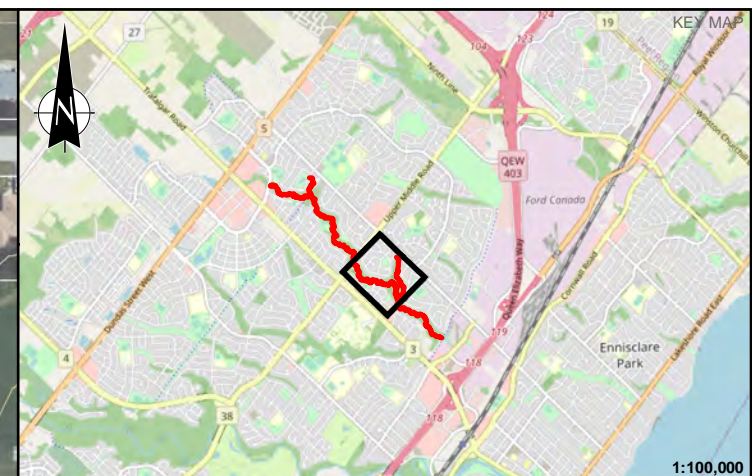
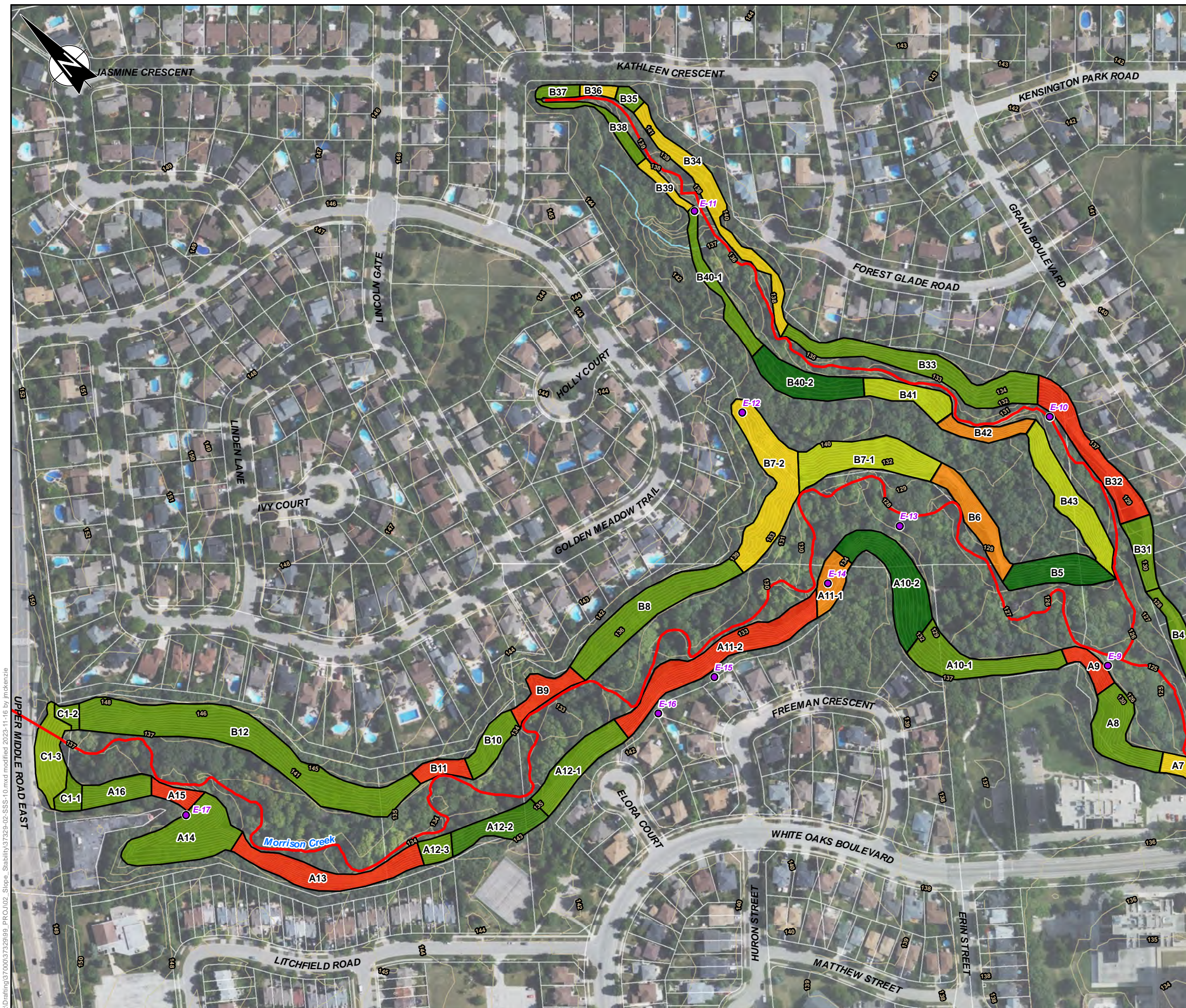
PROJECT **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-16
FIGURE No.	10



T:\Drafting\37000\37329\99\_P\ROU\02\_Slope\_Stability\37329-02-SS-10.mxd modified 2023-11-16 by jmcKenzie



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**TOTAL QUANTIFIED RISK**

- SLOPE STABILITY HAZARD LOW, LAND USE A
- SLOPE STABILITY HAZARD LOW, LAND USE B
- SLOPE STABILITY HAZARD LOW, LAND USE C
- SLOPE STABILITY HAZARD LOW, LAND USE D
- SLOPE STABILITY HAZARD SLIGHT, LAND USE A
- SLOPE STABILITY HAZARD SLIGHT, LAND USE B
- SLOPE STABILITY HAZARD SLIGHT, LAND USE C
- SLOPE STABILITY HAZARD SLIGHT, LAND USE D
- SLOPE STABILITY HAZARD MODERATE, LAND USE A
- SLOPE STABILITY HAZARD MODERATE, LAND USE B
- SLOPE STABILITY HAZARD MODERATE, LAND USE C
- SLOPE STABILITY HAZARD MODERATE, LAND USE D


**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

0 30 60 120  
1:2,750 METRES

T:\Drafting\373228199\_P\PROJ\02\_Slope\_Stability\373228199-02\_SSS-10.mxd modified 2023-11-16 by jmklenzie

CLIENT	MATRIX SOLUTIONS INC.
PROJECT	EAST MORRISON CREEK EROSION MITIGATION STUDY
	<b>SLOPE STABILITY SURVEY</b>
PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-16
FIGURE No.	11

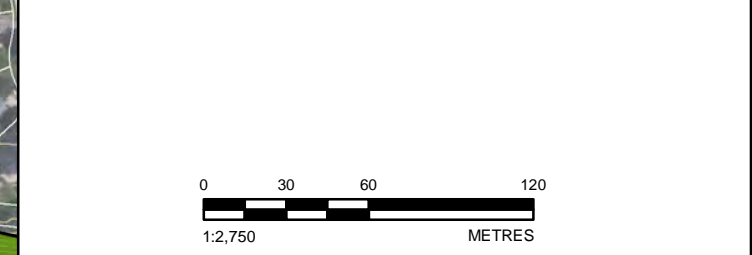


**THURBER ENGINEERING LTD.**



- LEGEND**
- EROSION SITE (NOTED BY OTHERS)
  - WATERCOURSE
  - TOPOGRAPHIC CONTOUR, metres
  - SITE

- TOTAL QUANTIFIED RISK**
- SLOPE STABILITY HAZARD LOW, LAND USE A
  - SLOPE STABILITY HAZARD LOW, LAND USE B
  - SLOPE STABILITY HAZARD LOW, LAND USE C
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE A
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE B
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE C
  - SLOPE STABILITY HAZARD SLIGHT, LAND USE D
  - SLOPE STABILITY HAZARD MODERATE, LAND USE A
  - SLOPE STABILITY HAZARD MODERATE, LAND USE B
  - SLOPE STABILITY HAZARD MODERATE, LAND USE C
  - SLOPE STABILITY HAZARD MODERATE, LAND USE D



- NOTES**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
  2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
  3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
  4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT  
**MATRIX SOLUTIONS INC.**

PROJECT  
**EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No. **37329**

ENGINEER **GS**

DRAWN **JEM**

APPROVED **KF**

DATE **2023-11-16**

FIGURE No. **12**



T:\Drafting\37000\37329\99\_PROJ\02\_Slope\_Stability\37329-02\_SSS-10.mxd modified 2023-11-16 by jmcKENZIE



**LEGEND**

- EROSION SITE (NOTED BY OTHERS)
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- SITE

**TOTAL QUANTIFIED RISK**

- SLOPE STABILITY HAZARD LOW, LAND USE A
- SLOPE STABILITY HAZARD LOW, LAND USE B
- SLOPE STABILITY HAZARD LOW, LAND USE C
- SLOPE STABILITY HAZARD LOW, LAND USE D
- SLOPE STABILITY HAZARD SLIGHT, LAND USE A
- SLOPE STABILITY HAZARD SLIGHT, LAND USE B
- SLOPE STABILITY HAZARD SLIGHT, LAND USE C
- SLOPE STABILITY HAZARD SLIGHT, LAND USE D
- SLOPE STABILITY HAZARD MODERATE, LAND USE A
- SLOPE STABILITY HAZARD MODERATE, LAND USE B
- SLOPE STABILITY HAZARD MODERATE, LAND USE C
- SLOPE STABILITY HAZARD MODERATE, LAND USE D

0 30 60 120  
1:2,750 METRES

**NOTES**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ON
2. IMAGERY: © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT: **MATRIX SOLUTIONS INC.**

PROJECT: **EAST MORRISON CREEK EROSION MITIGATION STUDY**

**SLOPE STABILITY SURVEY**

PROJECT No.	37329
ENGINEER	GS
DRAWN	JEM
APPROVED	KF
DATE	2023-11-16
FIGURE No.	13



T:\Drafting\37329\37329\_02\_Slope\_Stability\37329-02\_SSS-10.mxd modified 2023-11-16 by jmkenczisz



**THURBER** ENGINEERING LTD.

## **APPENDIX C**

Site Photographs

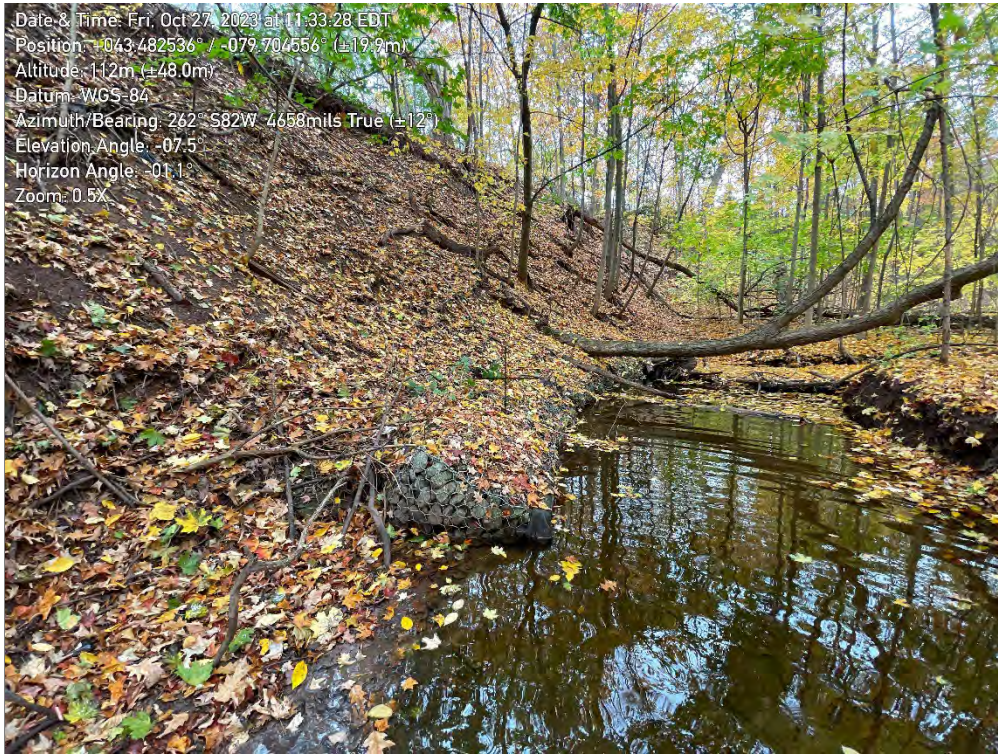


Photo 1. View of failed gabion baskets in Zone A22-1 of the East Morrison Creek, looking Southwest.



Photo 2. View of failed gabion baskets in Zone B13 of the East Morrison Creek, looking Northwest.



**Photo 3. View of undercut gabion baskets in Zone A19-2 of the East Morrison Creek, looking Northwest.**



**Photo 4. View of undercut gabion baskets in Zone B17 of the East Morrison Creek, looking Southeast.**

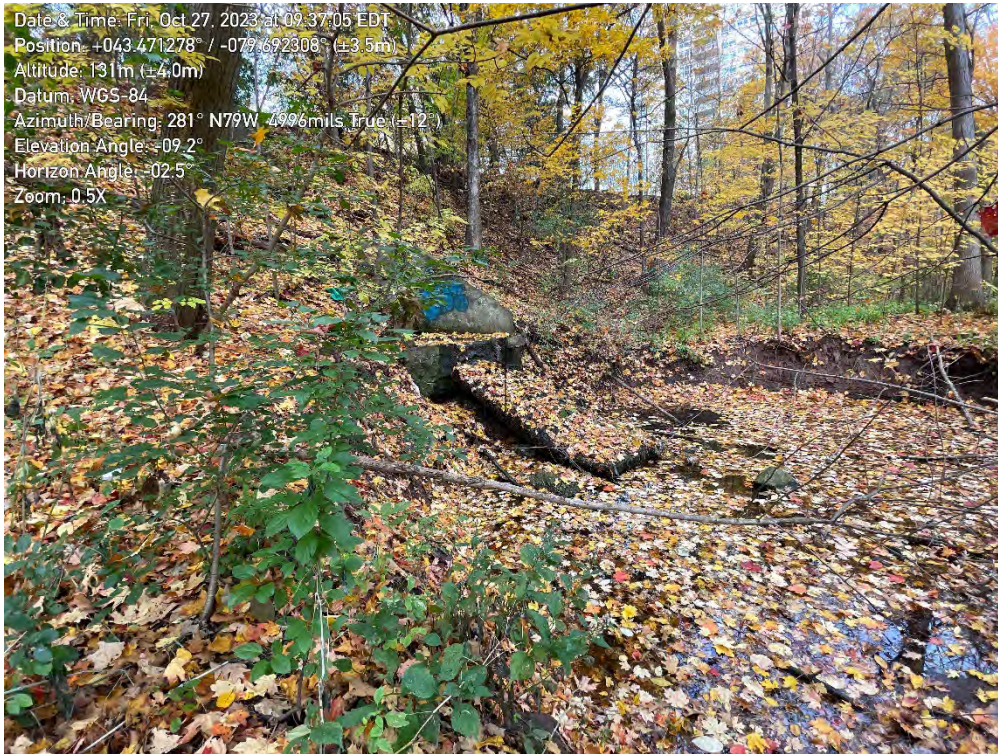


Photo 5. View of failed outflow culvert in Zone A7 of the East Morrison Creek, looking Northwest.



Photo 6. View of failed outflow culvert in Zone A7 of the East Morrison Creek, looking Southwest.



Photo 7. View of eroded slope in Zone A7 of the East Morrison Creek, looking Southwest.

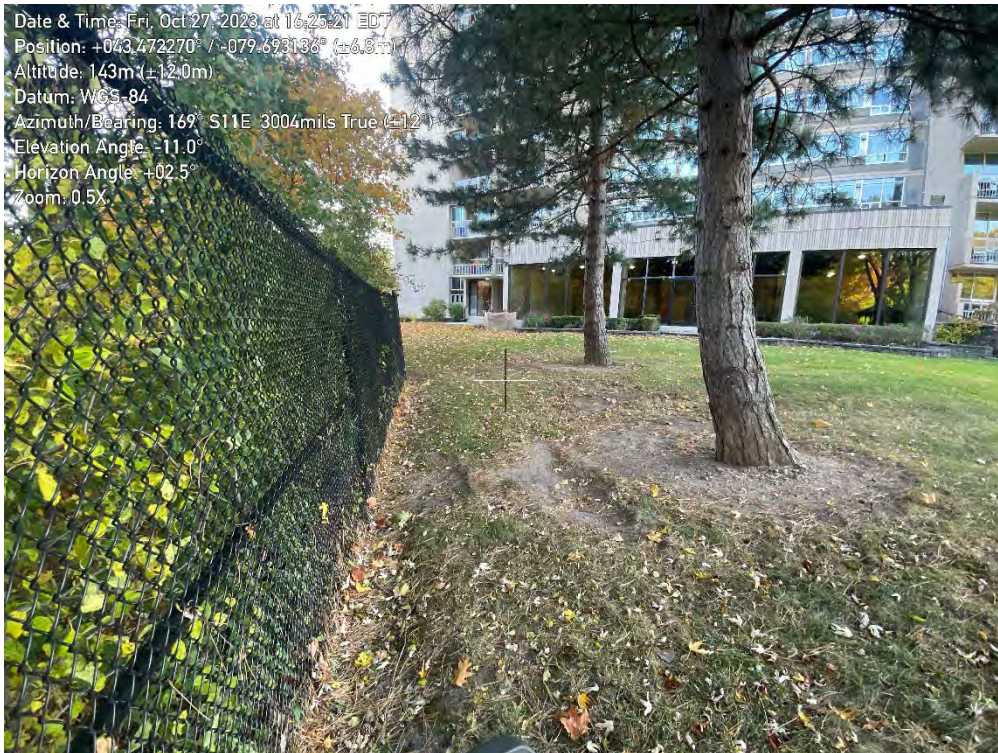


Photo 8. View of slope crest in Zone A8 at 1359 White Oaks Boulevard, looking Southeast.



**Photo 9. View of slope crest in Zone A8 at 1359 White Oaks Boulevard, looking Southeast.**



**Photo 10. View of separating parking lot curbs at 1359 White Oaks Boulevard, slope crest of Zone A7, looking Northwest.**



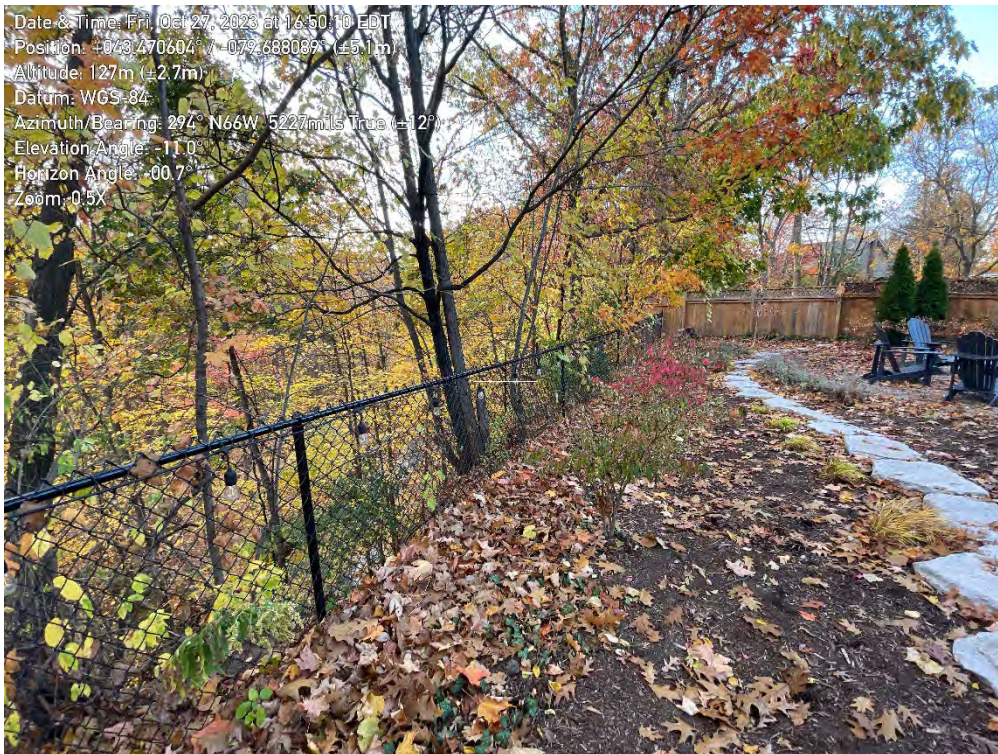
**Photo 11. View of separating parking lot curbs at 1359 White Oaks Boulevard, slope crest of Zone A7, looking Southeast.**



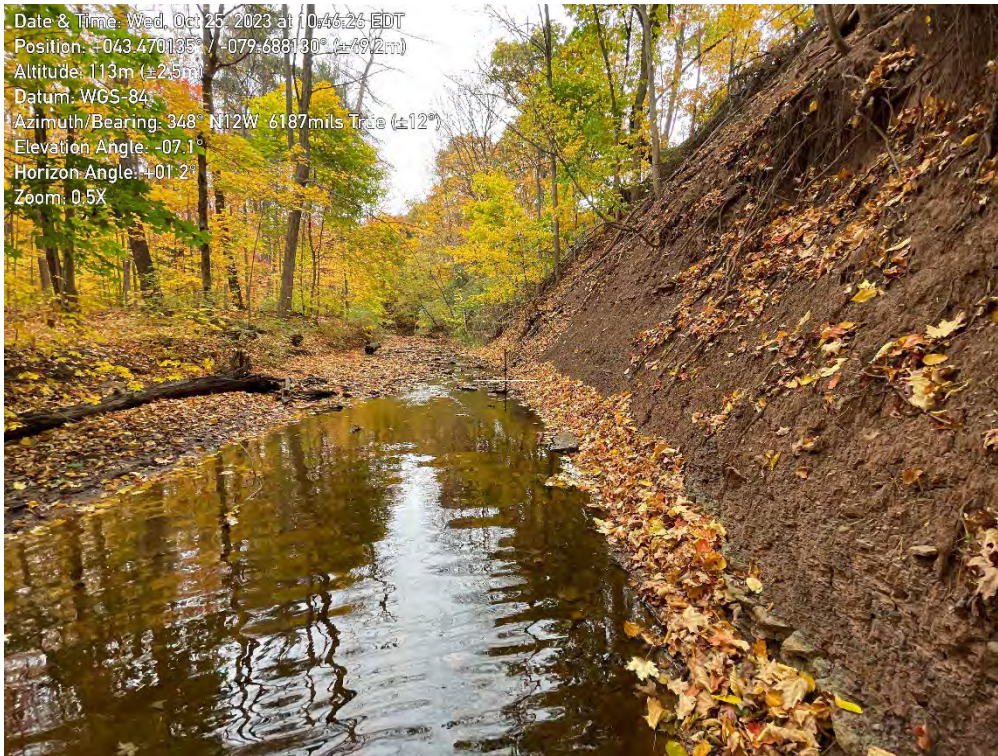
**Photo 12. View of separating parking lot curbs at 1359 White Oaks Boulevard, slope crest of Zone A7, looking Northeast**



**Photo 133. View of separating parking lot curbs at 1359 White Oaks Boulevard, slope crest of Zone A7, looking Northwest.**



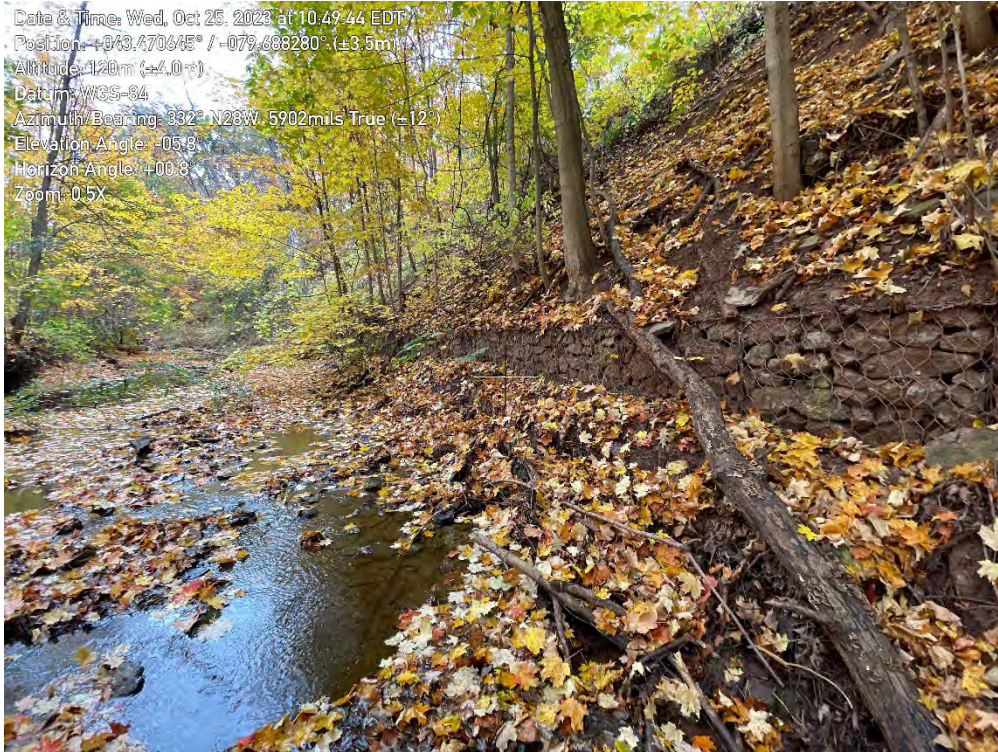
**Photo 144. View of slope crest in Zone B2 at 1208 Lambeth Road, looking Northwest.**



**Photo 155. View of the slope face in Zone B2 of the East Morrison Creek, looking Northwest.**



**Photo 166. View of the buried gabion baskets in Zone B2 of the East Morrison Creek, looking Southeast.**



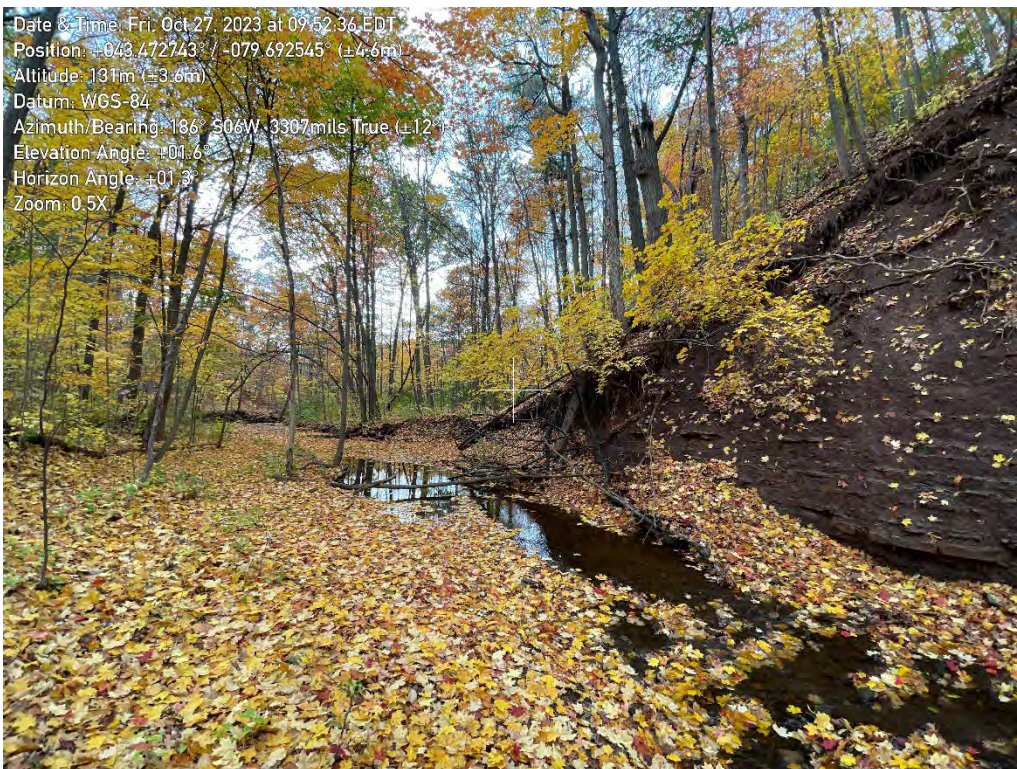
**Photo 177. View of the buried gabion baskets in Zone B2 of the East Morrison Creek, looking Southeast.**



**Photo 188. View of erosion in Zone A9 of the East Morrison Creek, looking Northwest. Trimble R10 in photo is 2-meters tall.**



**Photo 199. View of erosion in Zone A9 of the East Morrison Creek, looking Southwest. Trimble R10 in photo is 2-meters tall.**



**Photo 20. View of erosion in Zone A9 of the East Morrison Creek, looking Southwest.**

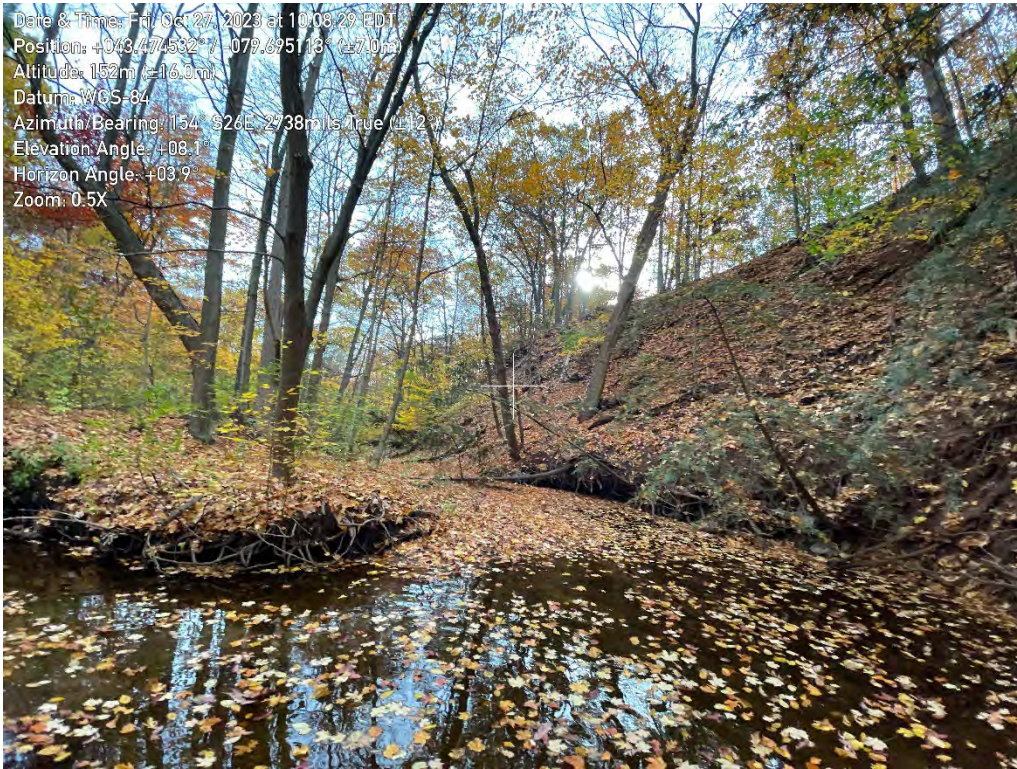


Photo 21. View of valley wall slope in Zone A11-2 of the East Morrison Creek, looking Southeast.



Photo 22. View of valley wall slope in Zone A11-2 of the East Morrison Creek, looking Southeast.



Photo 23. View of valley wall slope in Zone A11-2 of the East Morrison Creek, looking Southwest.



Photo 24. View of erosion in Zone A11-2 of the East Morrison Creek, looking Southwest. Trimble R10 in photo is 2-meters tall.



Photo 25. View of valley wall slope in Zone A13 of the East Morrison Creek, looking Northwest.

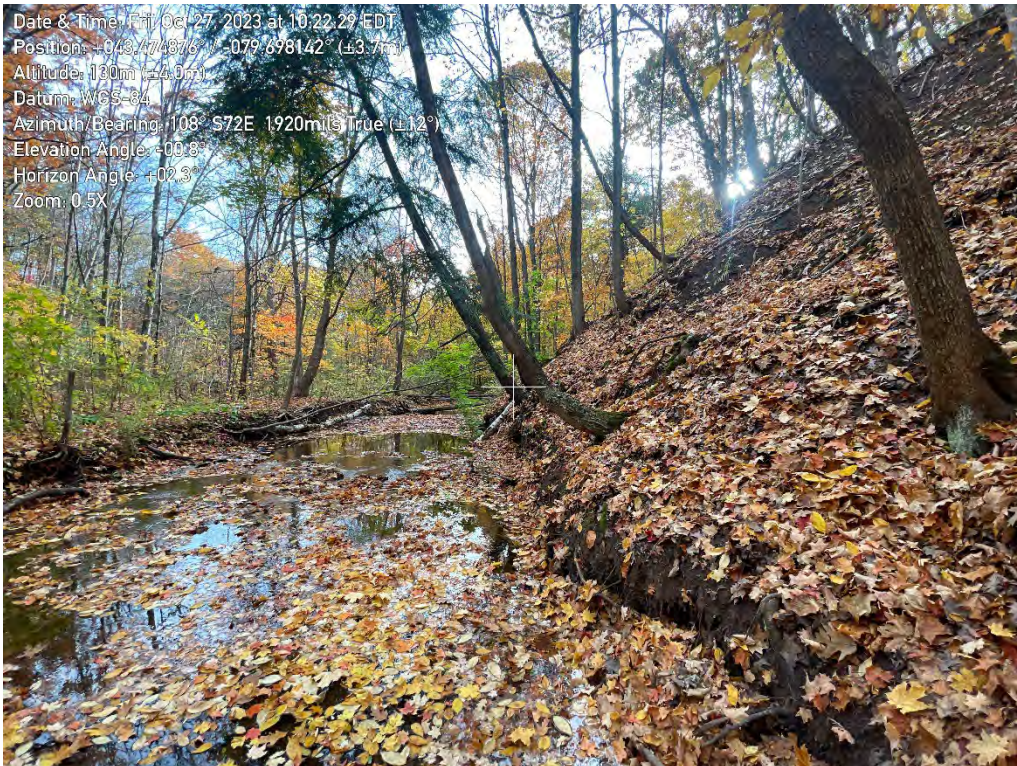


Photo 26. View of valley wall slope in Zone A13 of the East Morrison Creek, looking Southeast.



Photo 27. View of erosion in Zone A13 of the East Morrison Creek, looking Northwest.



Photo 28. View of erosion in Zone A13 of the East Morrison Creek, looking Northwest.

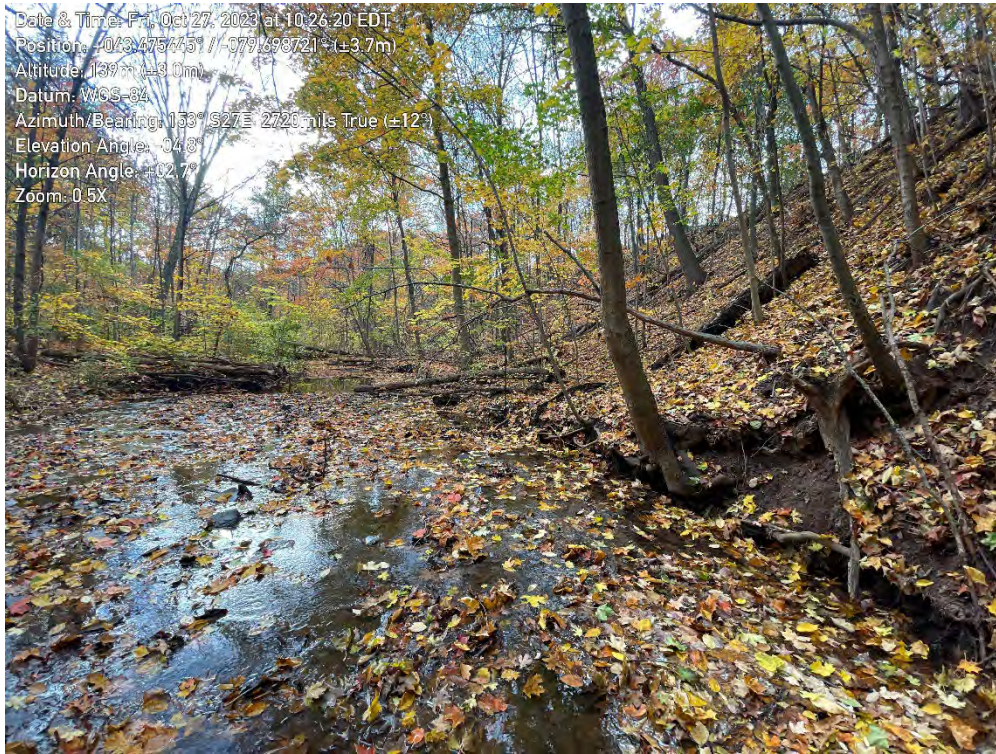


Photo 29. View of valley wall slope in Zone A13 of the East Morrison Creek, looking Southeast.



Photo 30. View of erosion in Zone A13 of the East Morrison Creek, looking Southwest.



Photo 320. View of erosion in Zone A15 of the East Morrison Creek, looking Northwest.

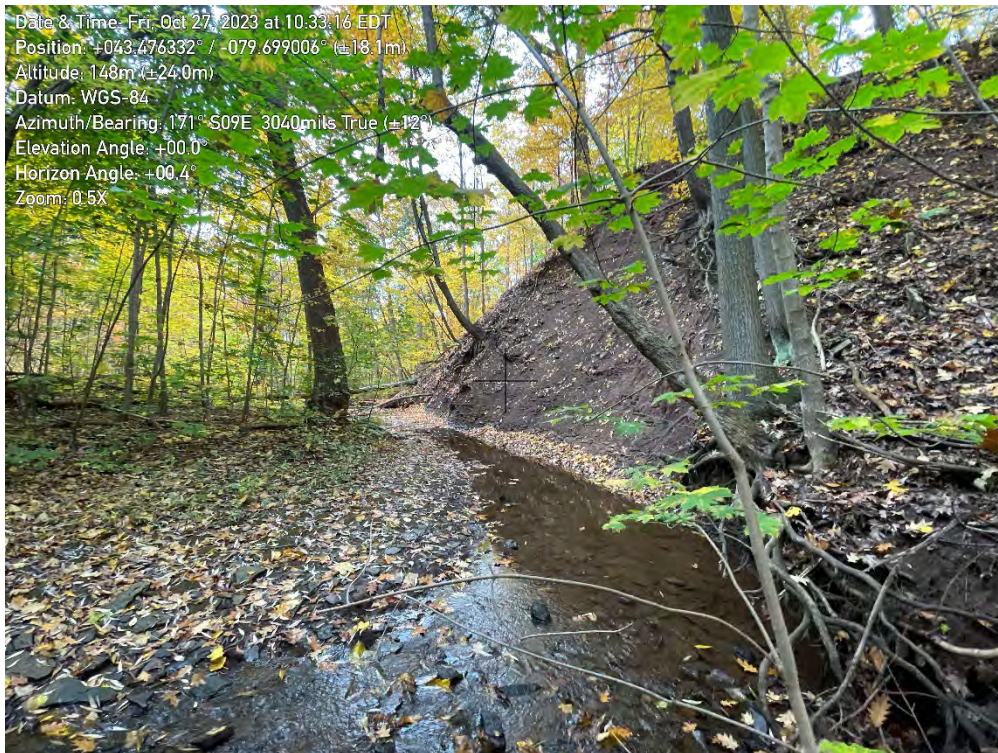


Photo 32. View of erosion in Zone A15 of the East Morrison Creek, looking Southeast.



Photo 33. View of valley wall slopes in Zone A22-2 of the East Morrison Creek, looking Northwest.



Photo 34. View of valley wall slopes in Zone A22-2 of the East Morrison Creek, looking Northwest.



Photo 35. View of valley wall slopes in Zone A22-2 of the East Morrison Creek, looking Southeast.



Photo 36. View of erosion in Zone A23 of the East Morrison Creek, looking Southeast.

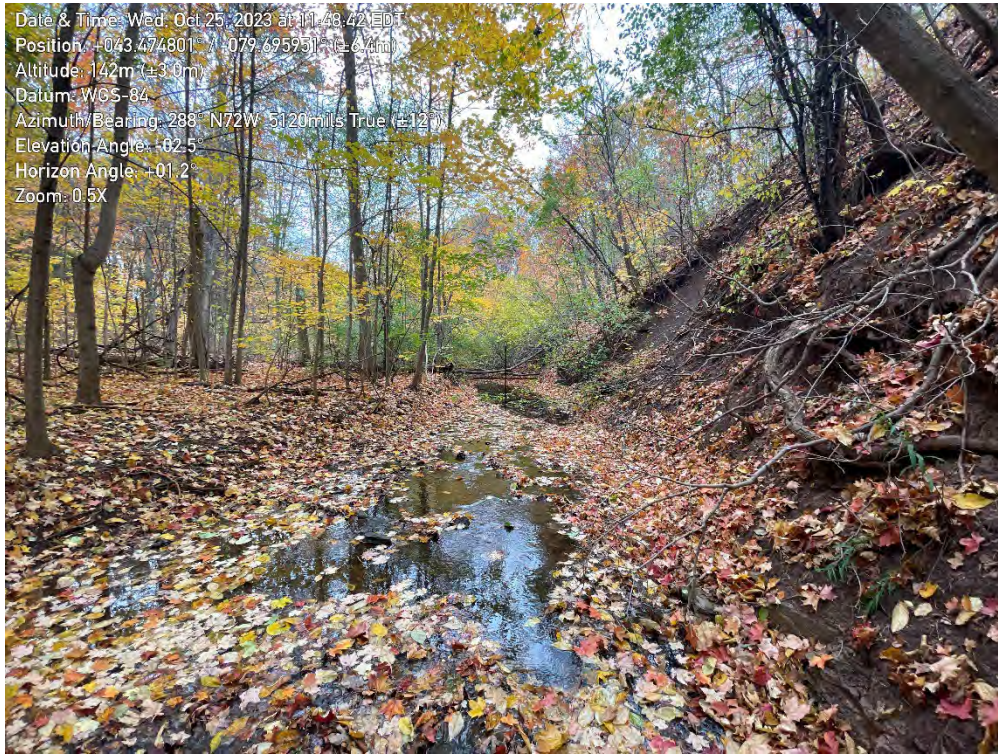


Photo 37. View of erosion in Zone B9 of the East Morrison Creek, looking Northwest.



Photo 38. View of erosion in Zone B9 of the East Morrison Creek, looking Northeast.

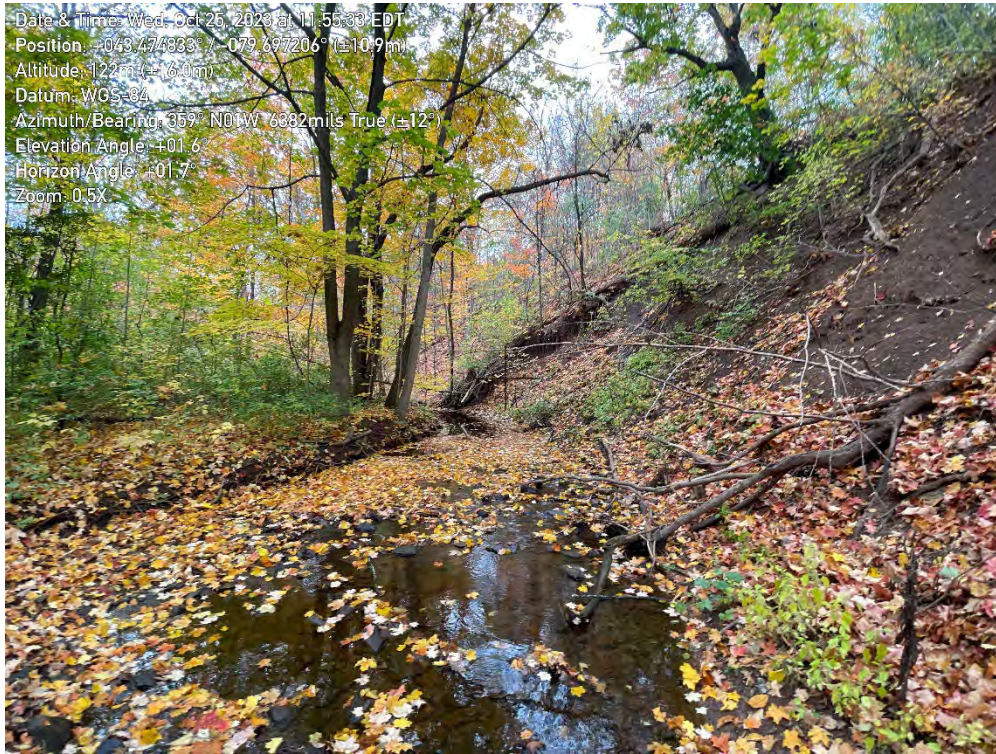


Photo 39. View of erosion in Zone B11 of the East Morrison Creek, looking Northwest.



Photo 40. View of erosion in Zone B11 of the East Morrison Creek, looking Southeast.

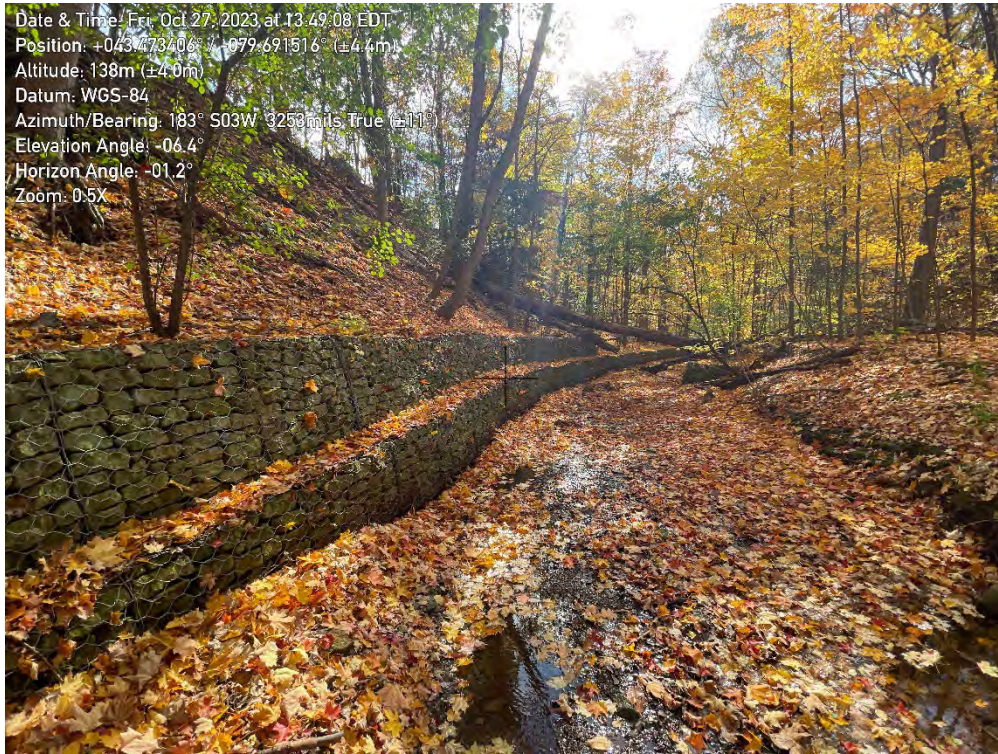


Photo 421. View of valley wall slope in Zone B32 of the East Morrison Creek, looking Southwest.



Photo 42. View of valley wall slope in Zone B32 of the East Morrison Creek, looking Northeast.



## **APPENDIX D**

Slope Instability Hazard, Land Use, and Total Risk Tables



**East Morrison Creek Slope  
MNR Instability Potential & Land Use Classification and Total Risk Ratings**

**Table 1 - Zone A**

Zone	Slope Instability Rating		Land Use Classification		Total Risk Designation
	Rating	Instability	Class	Use	
A1	22	Low	D	Infrastructure & Public Use	MODERATE
A2	24	Slight	D	Infrastructure & Public Use	MODERATE
A3	20	Low	D	Infrastructure & Public Use	LOW
A4	34	Slight	D	Infrastructure & Public Use	MODERATE
A5	10	Low	D	Infrastructure & Public Use	LOW
A6-1	22	Low	D	Infrastructure & Public Use	LOW
A6-2	22	Low	C	Active	LOW
A7	24 to 34	Slight	C	Active	MODERATE
A8	20	Low	C	Active	LOW
A9	42	Moderate	C	Active	HIGH
A10-1	4 to 20	Low	C	Active	LOW
A10-2	4 to 20	Low	A	Passive	LOW
A11-1	36 to 40	Moderate	A	Passive	MODERATE
A11-2	36 to 40	Moderate	C	Active	HIGH
A12-1	12 to 18	Low	C	Active	LOW
A12-2	12 to 18	Low	B	Light	LOW
A12-3	12 to 18	Low	C	Active	LOW
A13	44	Moderate	C	Active	HIGH
A14	14	Low	C	Active	LOW
A15	42	Moderate	C	Active	HIGH
A16	16	Low	C	Active	LOW
A17	28	Slight	C	Active	MODERATE
A18	16	Low	C	Active	LOW
A19-1	30	Slight	C	Active	MODERATE
A19-2	30	Slight	B	Light	LOW
A20	44	Moderate	B	Light	MODERATE
A21	12	Low	B	Light	LOW
A22-1	38	Moderate	B	Light	MODERATE
A22-2	38	Moderate	C	Active	HIGH
A23	40	Moderate	C	Active	HIGH
A24-1	12	Low	C	Active	LOW
A24-2	12	Low	B	Light	LOW
A24-3	12	Low	C	Active	LOW
A25-1	30	Slight	C	Active	MODERATE
A25-2	30	Slight	B	Light	LOW
A25-3	30	Slight	C	Active	MODERATE
A26	14	Low	C	Active	LOW
A27	26 to 34	Slight	C	Active	MODERATE
A28	2 to 10	Low	C	Active	LOW



**East Morrison Creek Slope  
MNR Instability Potential & Land Use Classification and Total Risk Ratings**

**Table 2 - Zone B**

Zone	Slope Instability Rating		Land Use Classification		Total Risk Designation
	Rating	Category	Classification	Activity	
B1	12 to 20	Low	C	Active	LOW
B2	44	Moderate	C	Active	HIGH
B3	24	Slight	C	Active	MODERATE
B4	12 to 18	Low	C	Active	LOW
B5	18	Low	A	Passive	LOW
B6	38	Moderate	A	Passive	MODERATE
B7-1	26	Slight	A	Passive	LOW
B7-1	26	Slight	C	Active	MODERATE
B8	14	Low	C	Active	LOW
B9	40	Moderate	C	Active	HIGH
B10	20	Low	C	Active	LOW
B11	48	Moderate	C	Active	HIGH
B12	12 to 18	Low	C	Active	LOW
B13	30	Slight	C	Active	MODERATE
B14-1	8	Low	C	Active	LOW
B14-2	8	Low	B	Light	LOW
B15	28	Slight	B	Light	LOW
B16	16	Low	C	Active	LOW
B17	38	Moderate	C	Active	HIGH
B18	20	Low	C	Active	LOW
B19	20	Low	C	Active	LOW
B20	24	Slight	C	Active	MODERATE
B21	14	Low	C	Active	LOW
B22	30	Slight	C	Active	MODERATE
B23	14 to 20	Low	C	Active	LOW
B24	34	Slight	C	Active	MODERATE
B25	14 to 18	Low	B	Light	LOW
B26	20	Low	C	Active	LOW
B27	26	Slight	C	Active	MODERATE
B28	8	Low	C	Active	LOW
B29	24	Slight	C	Active	MODERATE
B30	16 to 22	Low	C	Active	LOW
B31	20	Low	C	Active	LOW
B32	40	Moderate	C	Active	HIGH
B33	20	Low	C	Active	LOW
B34	24 to 26	Slight	C	Active	MODERATE
B35	8	Low	C	Active	LOW
B36	34	Slight	C	Active	MODERATE
B37	8	Low	C	Active	LOW



**East Morrison Creek Slope  
MNR Instability Potential & Land Use Classification and Total Risk Ratings**

**Table 2 - Zone B**

Zone	Slope Instability Rating		Land Use Classification		Total Risk Designation
B38	16	Low	C	Active	LOW
B39	24	Slight	C	Active	MODERATE
B40-1	12	Low	C	Active	LOW
B40-2	12	Low	A	Passive	LOW
B41	24	Slight	A	Passive	LOW
B42	38	Moderate	A	Passive	MODERATE
B43	26 to 34	Slight	A	Passive	LOW



**East Morrison Creek Slope  
MNR Instability Potential & Land Use Classification and Total Risk Ratings**

**Table 3 - Zone C**

<b>Zone</b>	<b>Slope Instability Rating</b>		<b>Land Use Classification</b>		<b>Total Risk Designation</b>
C1-1	16	Low	C	Active	LOW
C1-2	16	Low	C	Active	LOW
C1-3	16	Low	D	Infrastructure & Public Use	LOW
C2-1	22	Low	C	Active	LOW
C2-2	22	Low	C	Active	LOW
C2-3	22	Low	D	Infrastructure & Public Use	LOW
C3-1	18	Low	C	Active	LOW
C3-2	18	Low	D	Infrastructure & Public Use	LOW
C3-3	18	Low	C	Active	LOW
C3-4	18	Low	D	Infrastructure & Public Use	LOW
C4-1	18	Low	D	Infrastructure & Public Use	LOW
C4-2	18	Low	C	Active	LOW
C4-3	18	Low	D	Infrastructure & Public Use	LOW
C4-4	18	Low	C	Active	LOW
C5	16	Low	D	Infrastructure & Public Use	LOW