Sifton Properties Limited

Old Victoria – Grenier Lands &
1645 Hamilton Road
London, Ontario

Geotechnical Investigation - Slope Assessment

Project Name
Old Victoria – Grenier Lands Slope, London, ON

Project Number
KCH-00238640-GE

Prepared By:
exp **Services Inc.**
15701 Robin's Hill Road
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Date
July 2017
Reissued March 2019

Sifton Properties Limited

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Slope Stability Assessment

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1.0 Introduction

1.1 Introduction

This report presents the findings of a Slope Stability Assessment carried out in association with the Old Victoria Area Plan, along the Grenier Property and 1645 Hamilton Road in London, Ontario.

The proposed development is within an area regulated by the Upper Thames River Conservation Authority. As a result, consent from the Conservation Authority is required prior to construction of the proposed addition at the site.

1.2 Terms of Reference

Authorization to proceed with this investigation was received from Phil Masschelein of Sifton Properties Limited by email on May 26, 2017.

The purpose of this investigation was to assess the physical conditions of the slope located along the Grenier property and 1645 Hamilton Road, and based on the results of the investigation provide comments on slope stability and recommendations on development setback limits.

Based on an interpretation of the factual borehole data, a review of the topographic survey by Trueline Services Inc., EXP Services Inc. has provided engineering guidelines for the geotechnical design and construction of the proposed development.

This report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. More specifically, EXP has referenced the Natural Hazards Manual and Technical Guides prepared by the Ontario Ministry of Natural Resources for geotechnical and slope assessment purposes.

If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning geotechnical aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil. Should specific information in this regard be needed, additional testing may be required.

2.0 Methodology

2.1 Review of Previous Investigations

In September 2006, EXP Serivices Inc. (formerly Trow Associates Inc.) prepared a Geotechnical and Hydrogeological Investigation (Trow Reference LNGE00008290A) as part of the Old Victoria Area Planning Study, and included a slope inventory. The work area for the Geotechnical Investigation and slope inventory encompasses the current study area.

In July 2015, EXP Services Inc. prepared a Preliminary Slope Stability Assessment for the current subject site. No boreholes were completed as part of that investigation.

The relevant information from the aforementioned reports has been reviewed and incorporated into the current investigation.

2.2 Site Reconnaissance

A reconnaissance survey of the slope was undertaken by a member of EXP's field engineering staff on July 6, 2017. The MNR Rating Chart was utilized for four slope sections to summarize the site observations and empirically score various elements which contribute to slope stability, to provide an assessment of the potential for slope instabilities at the site. The slopes located within the northern land parcel at 1645 Hamilton Road possessed similar conditions based on past observations and topographic information. Soil and groundwater information from EXP's field program was incorporated into the rating charts.

No evidence of previous sliding or slope failures was observed during EXP's site reconnaissance. No seepage zones were noted in the slope faces along the watercourse. In general, based on the values recorded on the Slope Stability Rating Charts, the site slopes are considered to have a `slight potential' to 'moderate potential' for instability, see Appendix C.

2.3 Review of Topographic Data

The work program for the slope assessment included a review of the topographic survey (actual survey spot elevations) provided by Trueline Services Inc. The topographic survey information was utilized to create cross sections for use in estimating the location of the Erosion Hazard Limit, which defines the development setback limit. Using sound engineering judgement and technical experience, six cross sections (which are considered to be representative of typical site conditions) have been reviewed. Consideration has also been given to incorporate potential slope sections which have a higher potential for slope instability which may be indicated by the presence of more steeply inclined slopes or the localized presence of seepage zones.

Examination of factors of safety using Bishop's Simplified methods were carried out and analyzed by computer methods utilizing the Slope/W computer program. Soil strength parameters used in the analyses were obtained from typical values in literature sources.

Once the stable slope profile is determined, an additional setback for erosion allowance is applied, as required for site specific conditions. This analysis is carried out where there are

changes in the soil and groundwater conditions and where there are significant changes in the slope inclination and surface topography.

3.0 Site and Subsurface Conditions

3.1 Site Description

The site for the proposed development (see Drawing 1) is currently undeveloped located on the north side of Commissioners Road East within the Grenier property of Old Victoria Area and the subsequently acquired property at 1645 Hamilton Road in London, Ontario. A drainage creek traverses the property from south to north, draining northward towards the Thames River. The watercourse was previously identified as 'Watercourse 3' in the Old Victoria Area Planning Study. Photographs are included below as reference.

Photo 1 – Tableland and slope crest at Borehole BH1.

Photo 2 – Drainage Creek Base

The slopes along the watercourse are well vegetated, with a mixture of young and mature trees, and heavy brush. No overturning or bending of the existing trees was observed. This is a sign that significant movement of the soils in the slope has not occurred.

The topography of the tableland was described as inclined slightly towards the watercourse. Relief along the tableland is considered low; the total local relief across the site, from south to north, is estimated at about 20 metres.

3.2 Soil Stratigraphy

In addition to the site reconnaissance, two (2) boreholes were advanced by EXP on July 6, 2017 to provide information on the soil stratigraphy. The stability of each representative slope section was analyzed by computer methods utilizing the Slope/W computer program for the slope profiles. Soil strength parameters used in the analyses were obtained from typical values in literature sources and from the borehole investigation carried out by EXP.

The boreholes were advanced using a subcontracted specialist drilling company using continuous flight, soil sampling and soil testing equipment. The boreholes were terminated at a depth of about 9.6 m below existing grades.

Within the boreholes, Standard Penetration Tests (SPTs) were performed to assess the compactness or consistency of the underlying soils and to obtain representative samples. During the drilling, the stratigraphy in the borehole was examined and logged in the field by EXP geotechnical personnel.

Short-term groundwater level observations within the open boreholes and the natural moisture contents of recovered soil samples are recorded on the borehole logs. Following the drilling, the boreholes were backfilled with the excavated material and bentonite hole plug in order to satisfy the requirements of O. Reg. 903.

Representative samples of the various soil strata encountered at the borehole locations were taken to our laboratory in London for further examination by a geotechnical engineer and laboratory classification testing. Laboratory testing for this investigation comprised of routine moisture content determinations with results presented on the borehole logs found in Appendix B.

It must be noted that the boundaries of the soil indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. A brief description of the stratigraphy encountered at the borehole locations follows.

TOPSOIL/FILL

Topsoil/Fill was contacted at ground surface in each of the boreholes. The topsoil/fill extended to a depth ranging between about 0.9 and 1.4 m below ground surface. Based on the cultivated and agricultural land use throughout the site, areas with blended topsoil and shallow subgrade soils are anticipated. The topsoil/fill were generally described as a dark brown sand silt with trace to some clay and gravel, and in a very loose to compact state, based on drilling resistance.

SANDY SILT

Below the topsoil/fill in borehole BH2 was a layer of sandy silt extending to a depth of about 1.8 m below ground surface. The sandy silt is described as brown and weathered. The

sandy silt is in a compact state, based on a Standard Penetration Test (SPT) N-value of 17 blows per 300 mm penetration of the split-spoon sampler. Based on laboratory testing, the *in situ* moisture content of the sandy silt was in the range of 15 percent, indicative of very moist conditions.

CLAYEY SILT

Beneath the topsoil/fill at borehole BH1 and the sandy silt at BH2, a native clayey silt glacial was encountered. The clayey silt was generally described as light brown to grey (at depth) with trace to some sand, and occasional dilatant silt seams in the upper 5.6 m. The consistency of the clayey silt was described as firm to very stiff (based on tactical observations, observed drill resistance and SPT N-values ranging between about 6 and 17 blows). Based on laboratory testing, the *in situ* water content of the clayey silt ranges between about 17 and 26 percent, generally indicative of moist to very moist soil conditions.

It should be noted that the predominant natural soil contacted throughout the southern part of the OVAPS area is glacial till. The texture of the till is described as silt with some clay and trace sand and fine gravel. Intermittent wet silt seams, and clay seams were observed within the till, which generally becomes cohesive with depth. The silt till deposits have a compact to dense relative density based on SPT N-values which range from 25 to 46 blows per 300 mm penetration of the spilt-spoon sampler. Moisture contents in the silt till range from 14 to 26 indicative of moist conditions.

SILTY SAND

Beneath the clayey silt, a silty sand layer was encountered. In general, the silty sand was noted to be grey and fine-grained. The silty sand is in a compact to dense state, based on a SPT N-values in the range of about 23 to 31 blows per 300 mm penetration of the split-spoon sampler. The *in situ* moisture content of the silty sand is about 19 percent, generally indicative of wet soil conditions.

3.3 Groundwater Conditions

Details of the groundwater conditions observed within the boreholes are provided on the attached Borehole Logs. Measurement of the water level and moisture contents of selected samples are also recorded on the attached Borehole Logs.

Upon completion of drilling, the open borehole excavations were examined for the presence of groundwater and groundwater seepage.

Short-term groundwater levels and seepage were observed at various depths in the boreholes. Based on these observations and the moisture content of the recovered soil samples, the groundwater observed in the boreholes is contained within the wet silt or sand seams within the clayey silt deposits.

It should be noted that, insufficient time was available for the measurement of the depth to the stabilized groundwater table prior to backfilling the borehole. The depth to the groundwater table may vary in response to climatic or seasonal conditions, and, as such, may differ with high levels occurring in wet seasons. Capillary rise effects should also be anticipated in fine-grained soil deposits.

During our site reconnaissance, the slope condition was examined by exp staff and did not reveal any noticeable seepage zone at the slope face.

4.0 Slope Stability

4.1 General

The purpose of this investigation was to determine a safe setback distance from the existing slope profiles and stream system which traverse the site using the information which is currently available. It is important to mention that specific details regarding the proposed development, layout and site grading have not been examined as part of the current scope of work.

The slope was evaluated using the method prescribed by Ministry of Natural Resources in the Technical Guide for Assessing the Erosion Hazard Limit for River and Stream Systems. The overall Erosion Hazard Limit (Development Setback) for the site slope is determined by evaluating the slope stability, considering surficial seepage and shallow failures, allowance for potential flooding hazards, and an erosion allowance.

Slope Stability Rating Charts have been completed for the referenced cross sections and are attached, see Appendix C. Based on the values recorded on the Slope Stability Rating Charts, the ratings suggests that a slight to moderate potential of slope instability exists.

4.2 Erosion Hazard Limit

As defined by the MNR Technical Guide, based on the type of river and stream system landform (confined or unconfined) the following figure provides guidance on which factors (hazard allowances) should be used in defining the erosion hazard limits.

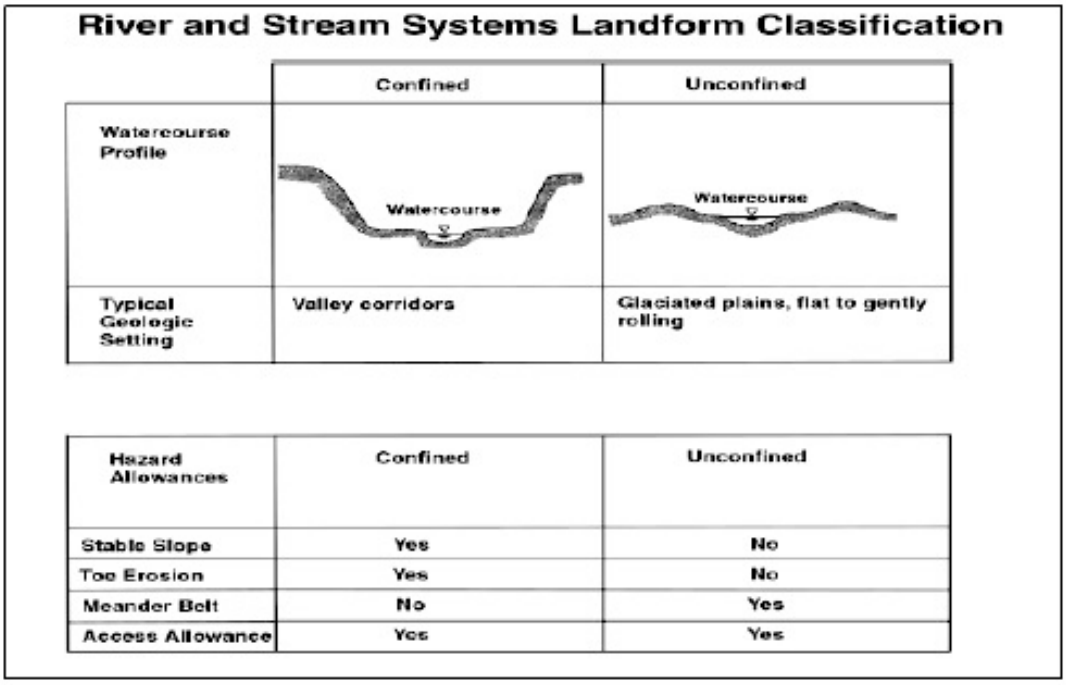


Figure obtained from page 35 of MNR Technical Guide – River and Stream Systems: Erosion Hazard Limit

As defined by the MNR Technical Guide, confined river and stream systems are ones in which the physical presence of a valley corridor containing a river or stream channel, which may or may not contain flowing water, is visibly discernable form the surrounding landscape by either field investigations, aerial photography and or map interpretation. The Erosion Hazard Limit for a confined system consists of the following hazard allowances:

- Toe Erosion Allowance
- Stable Slope Allowance
- Access Allowance

Additional setbacks may also be required based on local Municipal and Conservation Authority requirements.

The setback distance from the slope crest varies slightly along the slope, based on the overall slope height and inclination, and the type and amount of toe erosion at the base of the slopes. As mentioned in section 2.2, six cross sections (cross sections A, B, C, D, E and F) have been shown on Drawing 1 along the existing slope profile and were used for establishing the location of the Erosion Hazard Limit. Additionally, the inferred location of the top of slope line and top of stable slope line are also provided on Drawing 1 and on cross sectional Drawings 2, 3, 4, 5, 6 and 7.

4.2.1 Toe Erosion Allowance

The extent of potential erosion damage is a function of the competence of the natural subgrade soils, the type and quality of vegetative cover, and the frequency with which the slope is subject to erosive forces. Active erosion of the soil on the face of the riverbank slope is most likely caused by normal or increased flow volumes and velocities moving through the drainage creek. The figure below provides guidance on how to determine a minimum toe erosion allowance for a confined system.

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.

Figure obtained from page 38 of MNR Technical Guide – River and Stream Systems: Erosion Hazard Limit

Where detailed slope stability analyses have not been carried out, the Natural Hazards Manual by Ministry of Natural Resources indicates that a minimum toe erosion allowance of 1 m is recommended where the bankfull width is less than 5 metres and no evidence of active erosion is present.

At present, there is very little water in the tributary. When water is present, the watercourse is marshy in nature, with very low velocity water rather than a stream condition with higher water flow velocities. Signs of active erosion along the watercourse are not present. The predominant soils near the base of the slope are expected to comprise of clayey silt deposits. Since this watercourse contains intermittent and typically low-velocity flows, an

erosion allowance of 2 m is generally considered to be appropriate along the base of this slope.

4.2.1.1 Consideration of Surface Erosion and Piping

The surficial soils on the face of the slope also experience minor long-term erosion due to weathering (wetting/drying and freezing/thawing cycles). The extent of potential erosion damage is a function of the competence of the natural subgrade soils, the type and quality of vegetative cover, and the frequency with which the slope is subject to erosive forces. Serious erosion of the soil on the face of the slope could be caused by run-off water washing over the face of the slope (such as tile drains or redirected surface water which is directed onto existing slopes), as well as human disturbance, both of should be minimized where possible.

Water seepage and shallow groundwater levels can also impact slope stability, by reducing the soil strength. Piping on a slope face can occur where groundwater seepage daylights on the face of the slope. Based on the available information, and the observations during the site reconnaissance work, no seepage zones were observed, which would impact the existing slope stability.

4.2.2 Stable Slope Geometry

The stability of the slope profiles were investigated for a number of conditions. The examinations involve an assessment of the natural slope with and without the influence of perched groundwater the effects of possible construction in proximity to the site slopes. The various types of failures analyzed include shallow slumping failures, medium depth rotational failures near the crest of the slope, and deep rotational failures through the entire height of the slope.

The analyses were undertaken by computer methods utilizing the Slope/W computer program for select slope profiles.

The soil parameters used were conservative to build in an added safety factor for the analyses. The table on the following page summarizes the parameters for the predominant soils which were used in **exp's** evaluation of the stable slope configuration:

Table 1 – Soil Properties

Soil Type	Unit Weight	Cohesion	Angle of Internal Friction
Sandy Silt	19.0 kN/m^3	0 kPa	28^o
Clayey Silt	18.0 kN/m^3	10 kPa	25^o
Silty Sand	20.5 kN/m^3	0 kPa	30^o

In order to determine an appropriate Erosion Hazard Limit setback from the crest of the slope, a minimum factor of safety of 1.4 was used during the computerized stable slope analysis. The following table from the MNR Technical Guide provides guidance on how to select a minimum factor of safety based on the intended land use above or below the slope.

Table 2 – Design Minimum Factor of Safety

	LAND-USES	FACTOR OF SAFETY
A	**PASSIVE**; no buildings near slope; farm field, bush, forest, timberland, woods, wasteland, badlands, tundra	1.10
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	1.20 to 1.30
C	**ACTIVE**; habitable or occupied structures near slope; residential, commercial, and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances	1.30 to 1.50
D	**INFRASTRUCTURE and PUBLIC USE**; public use structures or buildings (i.e., hospitals, schools, stadiums), cemeteries, bridges, high voltage power transmission lines, towers, storage/warehousing of hazardous materials, waste management areas	1.40 to 1.50

Table obtained from page 60 of MNR Technical Guide – River and Stream Systems: Erosion Hazard Limit

After completing the computerized stable slope analysis on each cross section, the minimum calculated factor of safety under the existing conditions was 1.52 for cross sections B and C. The minimum calculated FOS value for cross sections A and D were 1.70 and 1.97 respectively, and for cross sections E and F were 1.90 and 1.57 respectively, all of which are above the 1.4 recommended minimum FOS value. Summarized results are provided in the following table.

Table 3 - Summary of Pertinent Slope Stability Analyses

Cross-Section Condition	Computed Factor of Safety
Slope Section, A-A:	1.70
Slope Section, B-B:	1.52
Slope Section, C-C:	1.52
Slope Section, D-D:	1.97
Slope Section, E-E:	1.90
Slope Section, F-F:	1.57

The findings were in general agreement with observations of the local slope (vegetated and treed slope which is beneficial for protection against shallow slides). The soil conditions encountered in the boreholes were generally found to comprise of firm to very stiff clayey deposits. In determining suitable input soil and groundwater parameters, consideration has been given to incorporating the presence of groundwater within the subsurface soil strata. Local changes and variations in the groundwater level were also considered when carrying out the analyses, to examine possible post-development effects. Changes in the groundwater level may result from a number of causes, included (but not limited to) possible site grading activities, changes to site drainage, use of at-source infiltration, or types of surface cover.

The average inclinations along the existing slope profiles at the investigated cross sections range between about 1H:1V to 3.8H:1V. Based on the soil conditions encountered during the field investigation and based on the results of the computerized slope stability analysis a stable slope line of 2.5H:1V has been applied and should be considered suitable based on the results of the current geotechnical study.

It should be noted that the theoretical calculations for FOS are conservative. Based on the site reconnaissance conducted by EXP, it was observed that the slope face along the riverbank is covered by vegetation (manure trees and heavy shrubs). The trees were generally in an upright state. The deep roots of mature trees assist to reinforce and enhance the stabilization of slopes.

In addition to the stable slope geometry, an emergency access allowance should also be applied. This is described in the following section.

4.2.3 Erosion Access Allowance

The Ontario Government provides planning guidelines for development adjacent to slopes. The 2005 Provincial Policy Statement (PPS Section 3.1.3) requires that an access allowance be included as part of the Erosion Hazard Limit. In accordance with PPS, 6 to 15 m setback is required in addition to the erosion and stability setbacks, which are discussed in the following sections. It is understood that this access allowance is required to ensure that there is a large enough safety zone for people and vehicles to enter and exit an area during an emergency, such as slope failure and flooding.

Since the subsurface conditions within the study area are generally considered to be geologically stable, we recommend that at a minimum, a planning setback of 6 m be applied to existing slopes.

4.2.4 Erosion Hazard Limit (Development Setback Limit)

As defined by the MNR Technical Guide, the Erosion Hazard Limit for confined systems includes the following 3 elements in determining the setback limits from a geotechnical standpoint:

- Emergency Access Allowance
- Stable Slope Setback
- Toe Erosion Allowance

Ultimately, the Erosion Hazard Limit also defines the development limit for the site. Additional setbacks may also be required based on EIS or studies prepared by others.

The setback distance from the slope crest varies slightly along the slope, based on the overall slope height and inclination, and the type and amount of toe erosion at the base of the slopes. Further, the inferred location of the Erosion Hazard Limit setback line is provided on Drawing 1 for review and consideration.

4.3 UTRCA Generic Regulation

In May 2006, Ontario Regulation 157/06 came into effect in the Upper Thames River Conservation Authority (UTRCA) watershed, which locally implements the Generic Regulation (Development, Interference with Wetlands and Alterations to Shoreline and Watercourses). This regulation replaces the former Fill, Construction and Alteration to Waterways regulations, and is intended to ensure public safety, prevent property damage and social disruption, due to natural hazards such as flooding and erosion. Ontario Regulation 157/06 is implemented by the local Conservation Authority, by means of permit issuance for works in or near watercourses, valleys, wetlands, or shorelines, when required.

Property owners must obtain permission from the UTRCA before beginning any development, site alteration, construction, or placement of fill within the regulated area. Permits are also required for any wetland interference, or for altering, straightening, diverting or interfering in any way with the existing channel of a creek, stream or river.

Proposed development within the study area will be subject to the above referenced Regulation. Consultation with the local Conservation Authority for review of site-specific development plans is recommended in this regard.

4.4 General Comments for Site Works

It is imperative that future development generally not occur within the Erosion Hazard Limit identified at the site. To this end, the following comments are provided and measures are recommended.

1. The surficial soils on the face of the slope experience minor long-term erosion due to weathering (wetting/drying and freezing/thawing cycles). The extent of potential erosion damage is a function of the competence of the natural subgrade soils, the type and quality of vegetative cover, and the frequency with which the slope is subject to erosive forces. Surficial erosion of the soil on the face of the slope could be caused by run-off water washing over the face of the slope, such as tile drains or redirected surface water which is directed onto existing slopes. Where possible, uncontrolled surface water flows over the face of the slope should be minimized, to reduce the risk of surface erosion. Erosion control measures may be required during construction, to reduce the risk of surface water flows from washing out non-vegetated surfaces.

2. Indiscriminate stockpiling of fill or construction materials should be avoided. In the event that stockpiling of material is proposed in the vicinity of the slope crest, a review by the Geotechnical consultant is required.

3. Any buildings and permanent structures associated with the proposed site development must be located outside of the Erosion Hazard Limit, which is identified on the Site Plan. The Cross Section drawings helps identify the location of this line.

4. Water from downspouts and perimeter weeping tile etc. must also be collected in a controlled manner and re-directed away from the slope.

5. Existing vegetation on the slope should be maintained.

6. Building foundations should be founded on the competent soil, set below a line drawn from the erosion setback at the toe of the slope at 2.5H:1V. Review by the Geotechnical consultant is recommended to confirm that the geotechnical requirements for foundation design are satisfied.

Final design drawings including building locations, services etc. should be reviewed by a geotechnical consultant to ensure that the Erosion Hazard Limit is properly interpreted. Geotechnical inspection and testing is recommended during construction to confirm that all recommendations set out will be followed.

5.0 General Limitations

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

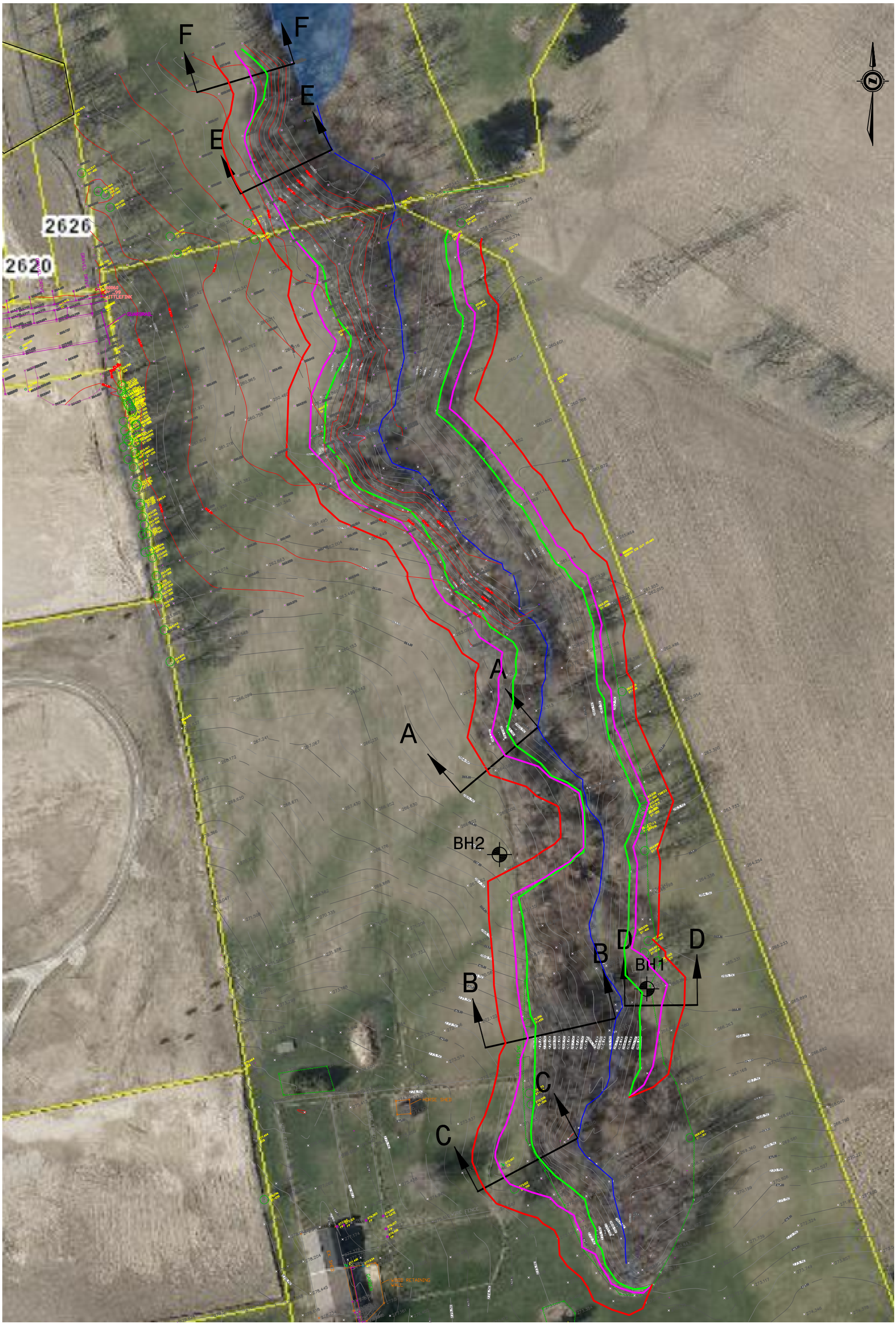
EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in this report.

We trust that this report is satisfactory to your present requirements and we look forward to assisting you in the completion of this project. Should you have any questions, please contact our office.

All the foregoing and attachments respectfully submitted,

EXP Services Inc.

Appendix A
Drawings



LEGEND

BH1 — Approximate Borehole Location

Top of Slope

Top of Stable Slope

Erosion Hazard Limit

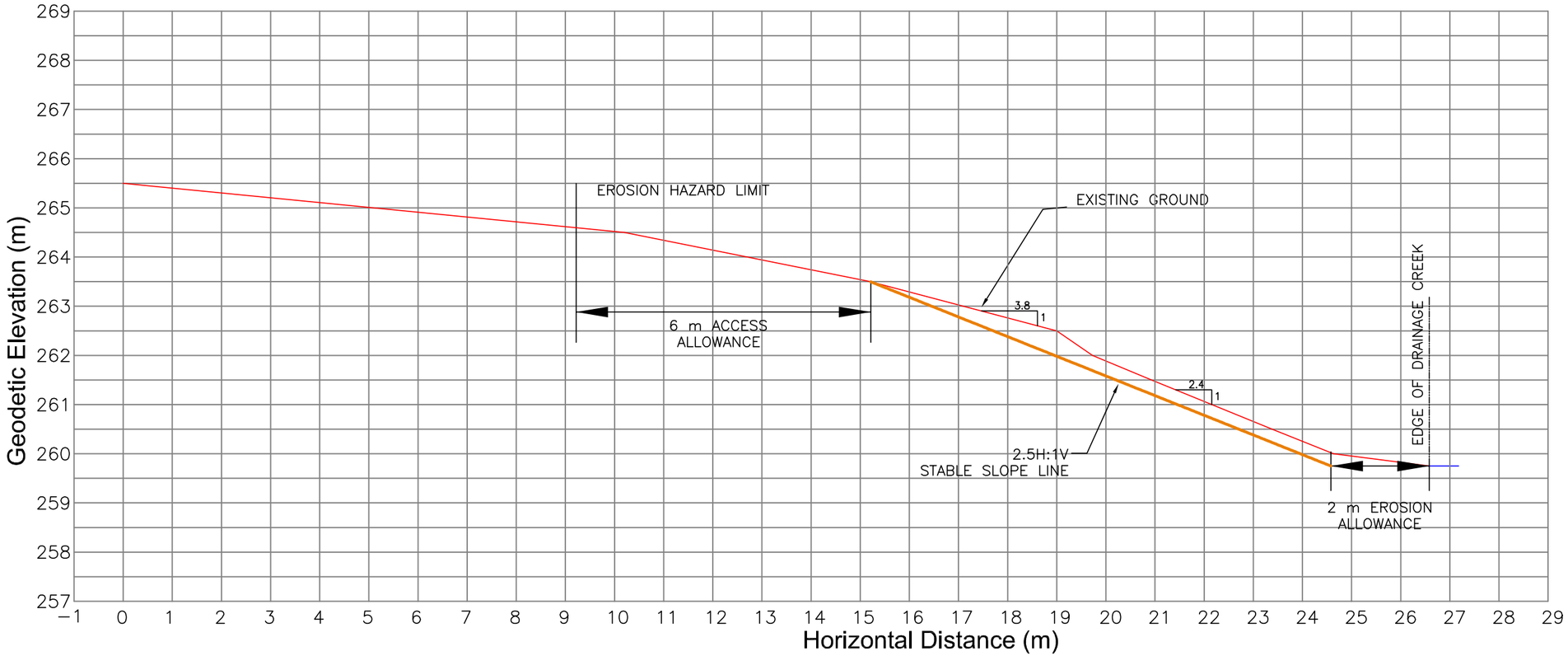
A — A — Slope Cross Section Location

Site plan should be read in conjunction with exp report KCH-00238640-GE

-NOTES-

1. The boundaries and soil types have been established only at test hole locations. Between test holes they are assumed and may be subject to considerable error.
2. Map referenced from City of London Mapping.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	SITE PLAN
	exp Services Inc. 15701 Robin's Hill Road, London, Ontario N5V 0A5
DATE	FEBRUARY 2019
SCALE	1:900
PROJECT NO.	KCH00238640-GE
DWG.	1



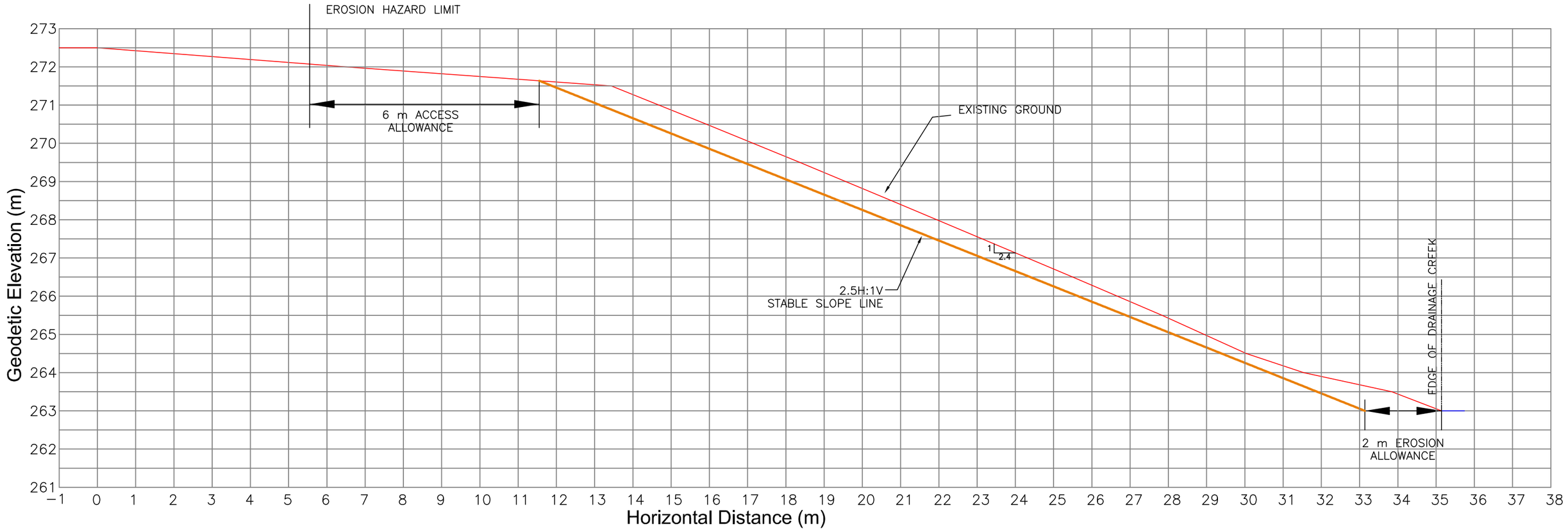
–NOTES–

1. Drawing should be read in conjunction with exp report KCH00238640–GE.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	CROSS SECTION A – A

exp Services Inc.
15701 Robin's Hill Road, London, Ontario N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
JULY 2017	1:100	KCH00238640–GE	2



−NOTES−

1. Drawing should be read in conjunction with exp report KCH00238640−GE.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	CROSS SECTION B − B
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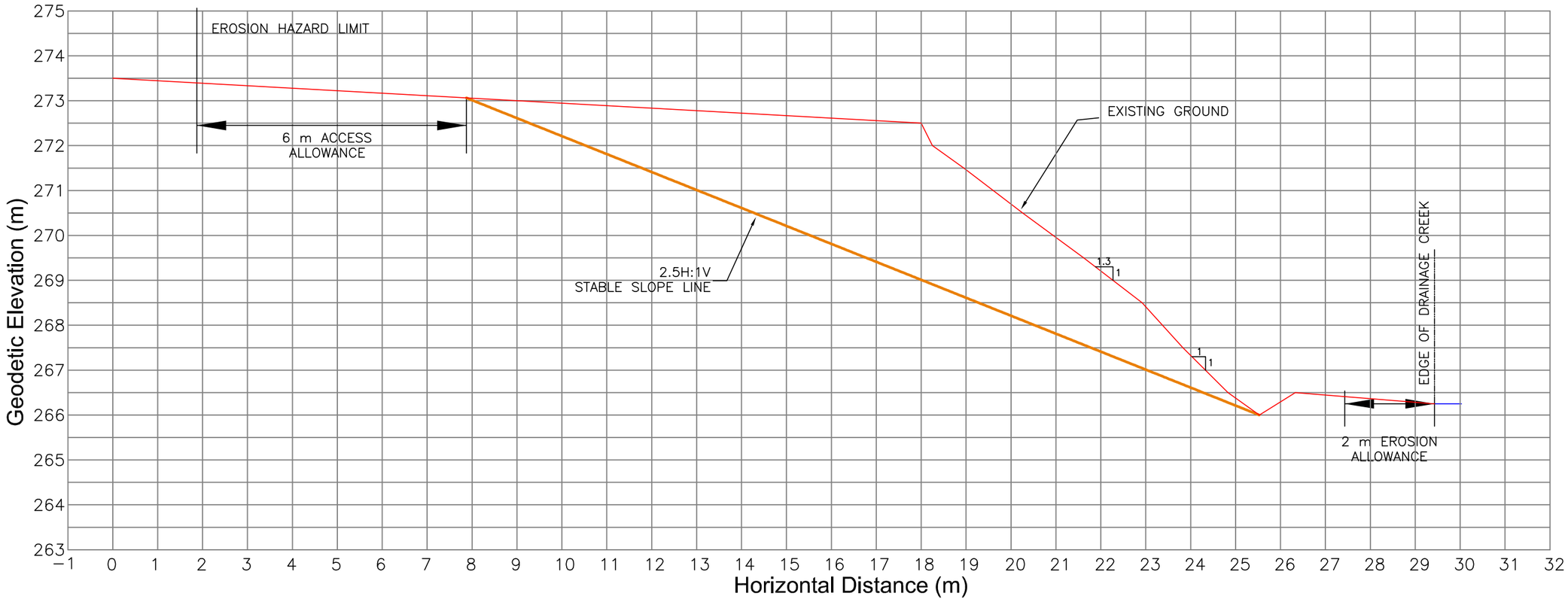
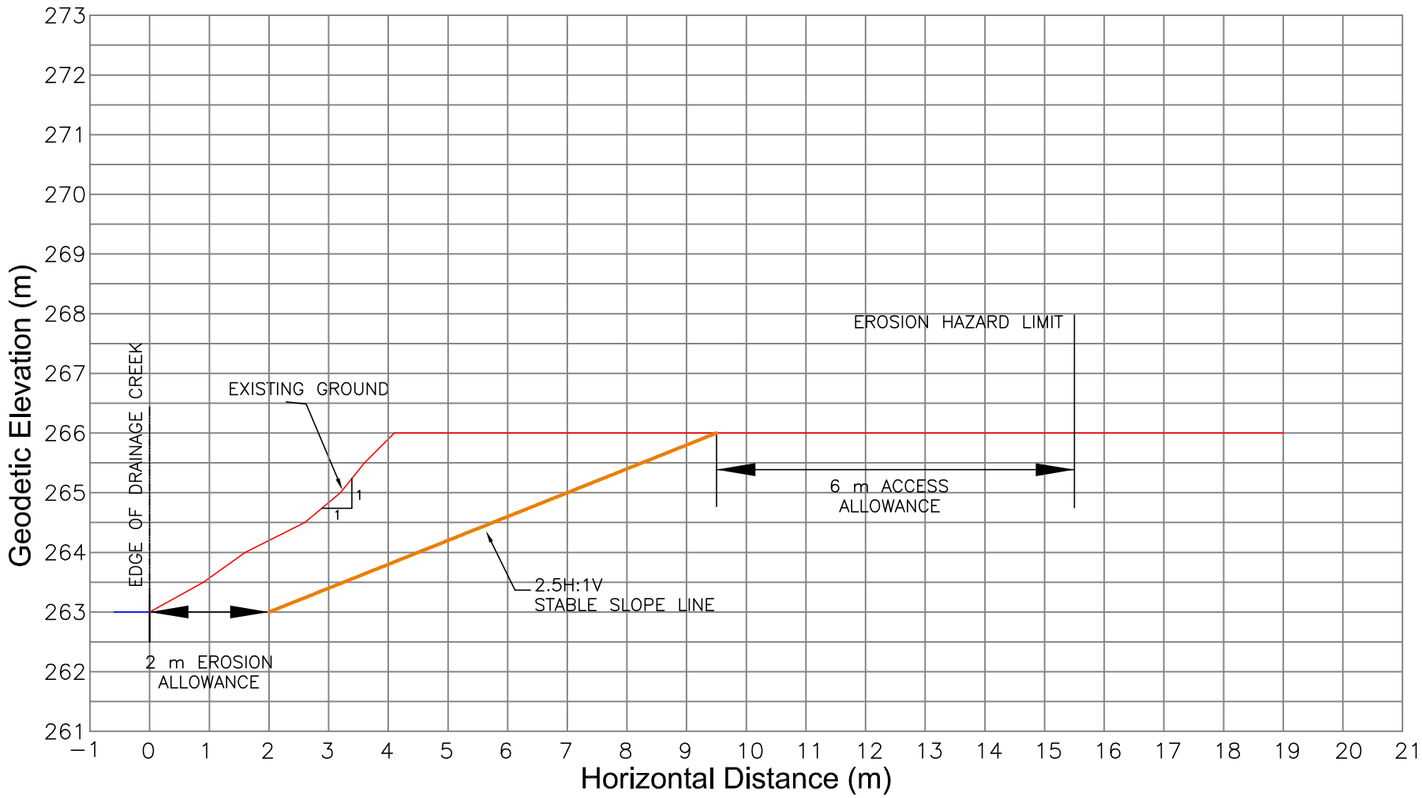
DATE: JULY 2017	SCALE: 1:100
PROJECT NO.: KCH00238640−GE	DWG.: 3



−NOTES−

1. Drawing should be read in conjunction with exp report KCH00238640−GE.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	CROSS SECTION C − C
	exp Services Inc. 15701 Robin's Hill Road, London, Ontario N5V 0A5
DATE: JULY 2017	SCALE: 1:100
PROJECT NO.: KCH00238640−GE	DWG.: 2



—NOTES—

1. Drawing should be read in conjunction with exp report KCH00238640-GE.

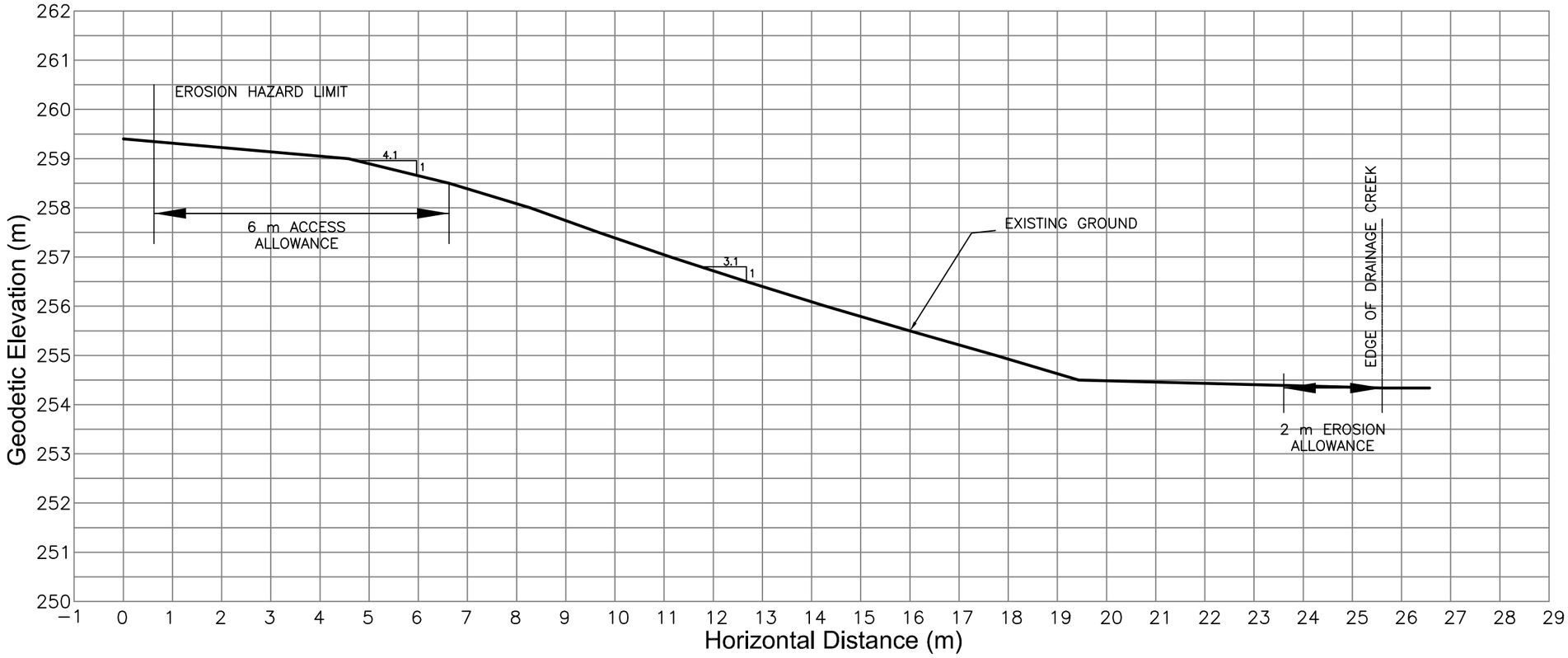
CLIENT: SIFTON PROPERTIES LIMITED

PROJECT: GRENIER LANDS SLOPE ASSESSMENT

TITLE: CROSS SECTION D – D

exp Services Inc.
15701 Robin's Hill Road, London, Ontario N5V 0A5

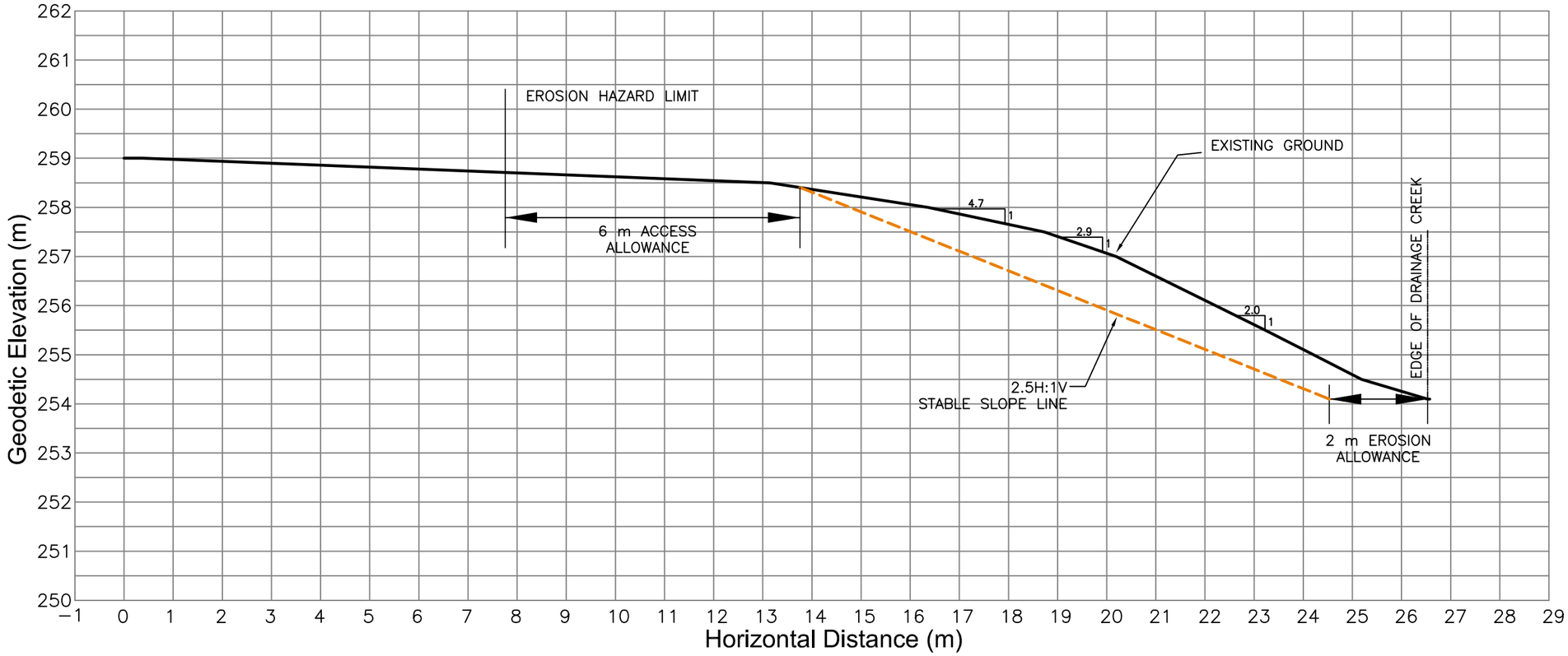
DATE: JULY 2017 | SCALE: 1:100 | PROJECT NO.: KCH00238640-GE | DWG.: 5



—NOTES—

1. Drawing should be read in conjunction with exp report KCH00238640-GE.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	CROSS SECTION E – E
	exp Services Inc. 15701 Robin's Hill Road, London, Ontario N5V 0A5
DATE: FEBRUARY 2019	SCALE: 1:100
PROJECT NO.: KCH00238640-GE	DWG.: 6



–NOTES–

1. Drawing should be read in conjunction with exp report KCH00238640–GE.

CLIENT	SIFTON PROPERTIES LIMITED
PROJECT	GRENIER LANDS SLOPE ASSESSMENT
TITLE	CROSS SECTION F – F
	exp Services Inc. 15701 Robin's Hill Road, London, Ontario N5V 0A5
DATE: FEBRUARY 2019	SCALE: 1:100
PROJECT NO.: KCH00238640–GE	DWG.: 7

Appendix B
Borehole Logs

BOREHOLE LOG

BH1
Sheet 1 of 1

CLIENT **Sifton Properties Limited** PROJECT NO. **KCH-00238640-GE**
PROJECT **Grenier Lands Slope Stability** DATUM
LOCATION **1964 Commissioners Rd E, London, ON** DATES: Boring **July 6, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	0.2	**TOPSOIL** - 240 mm							
		FILL - sandy silt, dark brown, some clay, trace to some gravel, trace to some topsoil inclusions, loose to compact, moist			SS	S1	425	5	19
1					SS	S2	250	15	16
	1.4								
		CLAYEY SILT - light brown, trace to some sand, firm to stiff, moist to very moist - occasional dilatant silt seams to 5.6 m bgs			SS	S3	400	6	20
2									
					SS	S4	350	8	20
		- becoming grey near 2.6 m bgs							
3					SS	S5	450	6	19
					SS	S6	450	9	21
4									
					SS	S7	450	9	21
5									
					SS	S8	450	8	25
6									
7									
					SS	S9	450	12	27
8									
	8.6								
		SILTY SAND - grey, fine grained, compact, wet		▽					
9					SS	S10	450	23	19
	9.6								
10		**End of Borehole at 9.6 m bgs.**							

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by exp before use by others. Borehole Log must be read in conjunction with exp Report KCH-00238640-GE.
2) Borehole open to 9.1 m bgs and groundwater encountered near 9.1 m bgs upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH2
Sheet 1 of 1

CLIENT **Sifton Properties Limited** PROJECT NO. **KCH-00238640-GE**
PROJECT **Grenier Lands Slope Stability** DATUM
LOCATION **1964 Commissioners Rd E, London, ON** DATES: Boring **July 6, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	0.2	**TOPSOIL** - 180 mm					
		FILL - sandy silt, dark brown, trace clay, trace to some gravel, trace topsoil inclusions, very loose, moist	SS	S1	400	3	20
	0.9						
1		**SANDY SILT** - brown, weathered, compact, very moist	SS	S2	175	17	15
	1.8		SS	S3	300	13	18
2		**CLAYEY SILT** - light brown, trace to some sand, stiff to very stiff, moist to very moist - occasional dilatant silt seams to 5.6 m bgs	SS	S4	125	17	17
3		- becoming grey near 2.9 m bgs	SS	S5	350	11	17
4							
5			SS	S6	450	8	23
6							
			SS	S7	450	10	22
7							
8			SS	S8	450	9	26
	8.6						
9		**SILTY SAND** - grey, fine grained, dense, wet	SS	S9	450	31	19
	9.6						
10		**End of Borehole at 9.6 m bgs.**					

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by exp before use by others. Borehole Log must be read in conjunction with exp Report KCH-00238640-GE.
2) Borehole open to 8.8 m bgs and dry upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

Appendix C
Slope Stability Rating Charts

Appendix D
Limitations and Use of Report

LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the slope investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of exp may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by exp. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and exp's recommendations. Any reduction in the level of services recommended will result in exp providing qualified opinions regarding the adequacy of the work. Exp can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the borehole results contained in the Report. The number of boreholes necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to exp to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to exp by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. Exp has relied in good faith upon such representations, information and instructions and accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to exp.

STANDARD OF CARE

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, expressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to exp by its client ("Client"), communications between exp and the Client, other reports, proposals or documents prepared by exp for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions expressed in the Report, reference must be made to the Report in its entirety. Exp is not responsible for use by any party of portions of the Report.

USE OF 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 in whole or in part without the written consent of exp. Any use of the Report, or any portion of the Report, by a third party are the sole responsibility of such third party. Exp is not responsible for damages suffered by any third party resulting from unauthorised use of the Report.

REPORT FORMAT

Where exp has submitted both electronic file and a hard copy of the Report, or any document forming part of the Report, only the signed and sealed hard copy shall be the original documents for record and working purposes. In the event of a dispute or discrepancy, the hard copy shall govern. Electronic files transmitted by exp have utilized specific software and hardware systems. Exp makes no representation about the compatibility of these files with the Client's current or future software and hardware systems. Regardless of format, the documents described herein are exp's instruments of professional service and shall not be altered without the written consent of exp.