westrek
geotechnical services ltd.

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TECHNICAL MEMORANDUM

Date: October 6, 2018

To: Tom Hansen – Emergency Program Coordinator, Operations Management
Columbia Shuswap Regional District

Re: Monitoring Results and Summary Recommendations
Newsome Creek Erosion below Highway 1

1 Introduction

Throughout the spring of 2018, Westrek Geotechnical Services Ltd. (Westrek) monitored the erosion within the Newsome Creek gully downstream of Highway 1, immediately west of Caen Road in Sorrento, BC. The monitoring was requested by the Columbia Shuswap Regional District (CSRD) on behalf of the Shuswap Emergency Program as part of the emergency response during the elevated flows in this period.

An initial field review was completed on the afternoon of May 1, 2018 by Kevin Turner PEng, who represented Westrek. Observations and recommendations for monitoring were provided in a report to the CSRD[1] on May 2, 2018. Subsequent monitoring trips were completed by Kevin Turner and/or Hazel Wong GIT, who also represented Westrek, on May 3, 7, 9, 15, and 26. An aerial reconnaissance of the developed area above Highway 1 was done on May 9. A site visit was also made on June 19 with representatives from Forsite Consultants Ltd., who had been retained by the CSRD to assess danger trees within the gully. Their report has been provided separately.

This memo provides a summary of our observations and assessment of the gully instability, and includes recommendations for addressing the short- and long-term issues. The report is subject to the terms and conditions set out in the *Interpretation and Use of Study and Report and Limitations*, which is attached in Appendix A and incorporated by reference.

[1] Westrek Geotechnical Services Ltd. 2018. *Summary of Field Review and Initial Recommendations, Newsome Creek below Highway 1*. Submitted to the Columbia Shuswap Regional District on May 2, 2018.

2 Background Information

2.1 Setting

Newsome Creek drains the north side of the Black Mountain / Mount Hilliam plateau. The watershed rises to an elevation[2] of about 1500 m, and it has a total catchment area of approximately 18 km^2. The watershed includes two primary sub-basins, drained by the east and west tributary creeks, and a minor tributary on the northwest side (Figure 1). The steep slopes below the edge of the plateau drain onto a gently sloping bench that extends about 5 km to Shuswap Lake. The upper part of the bench lies at approximate elevation 600 m. The east and west tributary creeks merge on the bench near elevation 470 m to form the main channel of Newsome Creek, and the minor tributary joins this main channel at elevation 450 m. Newsome Creek passes below Highway 1 on the lower part of the bench at elevation 395 m and it drains into Shuswap Lake at elevation 350 m.

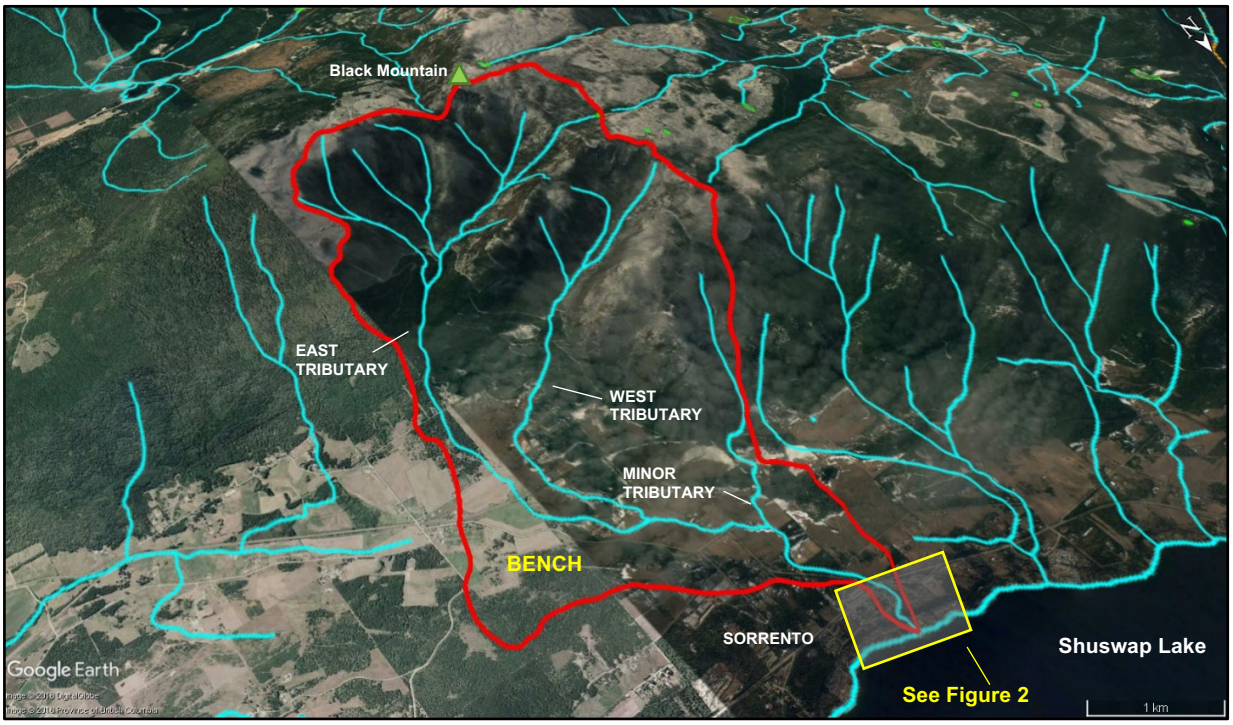

***Figure 1**: Google Earth™ imagery showing the estimated Newsome Creek watershed (red line) looking southeast.*

Newsome Creek passes below Highway 1 via a 1200 mm diameter corrugated metal pipe culvert that is situated at the base of the embankment. In the first 250 m downstream of the culvert, the creek flows through a 15 to 20 m deep gully (Figure 2, next page) with sidewall slopes that range from 75% to over 110% (37^O to 48^O). Several private lots along Caen Road have rear boundaries along the east edge of the gully (see attached civic address map and Photo 6). On the west side, there is a motel and resort adjacent to the highway that includes several cabins, as well as a retreat and conference centre farther to the north. These are accessed by trails and driveways off Passchendaele Road. The creek itself flows within a panhandle lot that contains the retreat and conference centre.

[2] All elevations mentioned in this report are based on the 1:20,000 TRIM dataset provided in Google Earth™.

***Figure 2**: Google Earth™ imagery showing the lower reach of Newsome Creek below Highway 1. The view is to the south and the scale and orientation are noted.*

2.2 Geology

Bedrock mapping by Thompson (2004)[3] indicates that the upland plateau is underlain by the Eocene-aged Kamloops Group volcanic rocks. Rock types include andesitic to dacitic flows and volcanic breccia, with minor sandstone, siltstone, shale, and conglomerate. The steep north-aspect slopes below the plateau are primarily underlain by the Lower Paleozoic-aged Sicamous Formation of the Mt Ida Assemblage, composed of grey limestone with black, argillaceous partings and calcite veins.

Surficial geological mapping by Fulton (1974)[4] indicates that the steep slopes in the upper watershed are primarily bedrock. A broad, coalesced fan covers the upper part of the bench at the outlet of the two main sub-basins. The middle part of the bench is covered with a variety of surficial deposits including hummocky gravel, bog, a lacustrine veneer, and a morainal ridge. The lower part of the bench is mapped as a lacustrine complex of clay, silt, sand, and gravel that represents open water and shoreline deposits. This unit is well-exposed in the eroded gully sidewalls immediately below Highway 1, where a 5 to 8 m thick stratified unit of buff to dark grey silt and clay overlies a thick deposit of dark-grey gravel and sand. The upper part of gravel and sand unit was observed to be locally cemented.

[3] Thompson, R.I. (compiler). 2004. *Geology, Sorrento, British Columbia.* Geological Survey of Canada. Open File 4383. Scale 1:50,000.

[4] Fulton, R.J. 1974. *Surficial geology, Shuswap Lake (west of sixth meridian), British Columbia.* Geological Survey of Canada. Map 1391A. Scale 1:126,720.

2.3 Background

There is an extensive development history on the bench that dates back to the construction of the CP Rail in the late 1800s. The upper part of the bench has been developed for decades. Forest harvesting has occurred above that. Highway 1 was built in the early 1960s and the existing culvert at the Newsome Creek crossing was likely installed at that time. Caen Road was in place by 1974, and by the early 1980s, residences had been built on most of the lots.

The Black Mountain plateau was burned by severe wildfire (Notch Hill Fire – K31483) in 2009. The Ministry of Forests and Range reported[5] that the burn severity within the Newsome Creek watershed was low to moderate, and in localized areas, was high. The report concluded that the risk from flooding was low to very low in the two main tributaries. In the next 1 to 2 years after the wildfire, it appears that much of the salvageable timber was removed from the plateau, but the steep slopes within the upper reaches of the tributary gullies were left unlogged.

The first report of significant erosion in the gully below Highway 1 occurred in the spring of 2017. Kerr Wood Leidal (KWL) investigated and reported[6] that the highway culvert inlet was fully submerged, and severe erosion had occurred along the west bank immediately below the outfall (i.e. adjacent to the 1185 Passchendaele Road property). Bank undercutting and slope failures were also observed along the gully behind 2809 and 2819 Caen Road. Sediment had to be removed from a culvert where Newsome Creek crosses Dieppe Road.

The creek experienced high stream flow again in 2018. Based on our overview flight, bank erosion and channel destabilization was observed in the east tributary in the upper part of the bench, i.e. above Taylor Road and west of Hannah Road. The east tributary creek avulsed within the wooded section below Taylor Road, which resulted in significant sediment deposition in the field between London Lane and the CP Railway (see attached Photos 1 to 5). Some of the flow from the east tributary was trapped by the railway embankment and was diverted to the west tributary. A review of Google Earth™ imagery suggests this also occurred in the 2017 freshet period as well. Channel instability did not appear to have been as significant between the railway and Highway 1, but this was not checked on the ground by Westrek.

Flow through the Highway 1 culvert on May 1, 2018 is shown on Photo 7. Below the highway, the Caen Road residents reported renewed channel and slope instability and the toppling of trees along the gully. The culvert at Dieppe Road also washed out.

A detailed hydrological analysis has not been undertaken on either peak flow event, but generally the causes of the high stream flow appear to be different. In 2017, the snowpack was low throughout the region, but mild temperatures and moderate rainfall in April and early May resulted in widespread flooding, especially in creeks draining plateaus. The high flow had a relatively short duration, and by early to mid-May it subsided significantly. In 2018, the snow pack was much higher and rainfall in mid- to late-April caused elevated stream flow in the region that persisted throughout May.

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[5] BC Ministry of Forests and Range. 2009. *Notch Hill Fire K31483 Post-Wildfire Risk Analysis*. Unpublished report.

[6] Kerr Wood Leidal. 2017. *Newsome Creek Adjacent to Caen Road, Emergency Site Assessment of Newsome Creek.* Unpublished report to BC Ministry of Forests, Lands and Natural Resource Operations. May 23, 2017. 5 pages.

3 Observations and Monitoring

The following summarizes results of our 2018 monitoring. A site plan showing each lot is presented on Figure 3, following the table. Referenced photographs are attached.

Property	Description and Monitoring Results	Risk Assessment / Recommendations
1185 Passchendaele Road	Shuswap Lake Motel and Resort • Motel office is about 14 m from gully crest (west side). • Access road is set back about 3 m from the gully sidewall. • Gully sidewall slope is near vertical and 6 to 10 m high (Photo 8).	No immediate risk to motel. The owner should continue to monitor the slope and creek undercutting.
1159 Passchendaele Road	No permanent structures are present near the gully crest.	No permanent structures are at risk at this time.
2803 Caen Road	Residence is set back at least 15 m from the gully crest.	No immediate risk to residence.
2805 Caen Road	Residence with small shed. • Residence is setback about 15 m from gully crest. • Shed is setback 2 m from gully crest. • Creek eroded and undercut the toe of the gully sidewall in 2018.	No immediate risk to residence. The shed could be moved if needed. The owner should continue to monitor the slope.
2807 Caen Road	Residence with patio deck. • Residence is at the gully crest. • Deck extends over crest and is supported on the steep gully sidewall (Photo 9). • Sidewall slope has failed in the past (relict). • No active erosion was noted in 2018 (Photo 10).	The residence is potentially at risk due to its proximity to the steep gully sidewall. Risk will increase if the gully sidewall fails and/or erosion occurs at the toe. The owner should continue to monitor the slope. If stability worsens, i.e. if the creek undercuts the slope, measures to protect the house may be needed.
2809 Caen Road	Residence with elevated deck. House has a commercial operation (barber). • Residence is setback about 3 m from the gully crest (Photo 11). • Attached elevated deck is supported by shallow footings about 0.5 m back from the gully crest. • Aggressive creek undercutting caused a shallow landslide in the lower sidewall slope in 2018 (Photos 12, 13).	The risk to the residence is high. The owner should stabilize the slope or move the residence to the front of the property. The owner should continue to monitor the slope.
2817 Caen Road	Empty lot (residence recently burned). • Creek undercut the toe of the gully sidewall in 2018.	No residence is present. The owner should consult a geotechnical engineer / geoscientist to establish a setback before re-building the residence.

Property	Description and Monitoring Results	Risk Assessment / Recommendations
2819 Caen Road	Residence with attached shop (woodworking). • Residence is setback about 14 m from the gully crest. • Shop is set back 2 to 4 m from gully crest and is supported on shallow concrete foundation (Photo 14). • Minor tension cracks present 1.5 m back from gully crest. • Creek aggressively undercut the gully sidewall in 2018, and is now overhung and unstable (Photos 15, 16).	No immediate risk to residence. The risk to the shop is very high. The owner should stabilize the slope or move the shop to a lower risk site on the property. The owner should continue to monitor the slope.
2821 Caen Road	Residence with detached pottery shop that has a shed-covered deck at rear (Photo 17). • Residence is setback about 25 m from gully crest. • Rear wall of shop is set back 1.5 m from the gully crest and is supported on a shallow concrete foundation. • Shed / deck extends over the crest and is supported on piers founded on the steep sidewall slope. • Creek aggressively undercut the gully sidewall in 2018 and the slope is now overhung and unstable. Large cedar tree at the toe is now undercut. (Photos 18, 19).	No immediate risk to residence. The risk to the pottery shop is very high. The owner should stabilize the slope or move the pottery shop to a lower risk site on the property. The owner should continue to monitor the slope.
2823 Caen Road	Residence with a detached shop (3-car garage) with an exterior patio with shed roof, a low gabion wall and wood patio deck on north side. • Residence foundation is setback about 20 m from gully crest. • Garage is 2 m from the gully crest and has a shallow concrete foundation. • Shed is supported on a low, tree-supported timber retaining wall along the crest (Photos 20, 21). • Deck extends out to or slightly over the gully crest and is supported on steep sidewall. • Creek cut down in 2018 but sidewall was not destabilized (Photo 22).	No immediate risk to residence. The risk to the garage is moderate and could increase if erosion and downcutting cause loss of toe support, leading to slope failure. The owner should continue to monitor the slope.

Property	Description and Monitoring Results	Risk Assessment / Recommendations
2825 Caen Road	Residence and secondary structure, and an elevated patio deck with a shed roof (Photo 23). • Residence is about 3 m from gully crest. • Deck is elevated 4 to 5 m and extends 5 m from crest, and is supported on slender piers founded on the very steep sidewall slope. • Rubber tire revetment is present on steep sidewall slope below the residence (Photo 23). • Creek down cut in 2018 but there was little bank instability at the toe (Photos 24, 25).	The residence and secondary structure is at moderate risk. Risk will increase if additional erosion undercuts the toe of the gully sidewall. The owner should continue to monitor the stability of the slope. If stability worsens, i.e. if the creek undercuts the slope, measures to protect the residence may be needed. Regardless, the deck may not be safe for occupancy due to its potentially unstable foundation, and should be evaluated by a structural engineer.
2827 Caen Road	Residence with two out-buildings (a garage and a garden shed). • Residence is about 25 m from the gully crest. • Garage is 1 to 3.5 m from the gully crest. • Garden shed is set back 2 m from gully crest. • Low timber crib retaining wall along gully crest is failing. • Gully sidewall is very steep (Photo 26). Creek down cut during the 2018 event causing loss of toe support (Photos 27, 28).	No immediate risk to residence. Risk to the garage could increase should erosion cause loss of toe support, leading to slope failure. The owner should monitor the stability of the slope. If stability worsens, i.e. if the creek undercuts the slope, measures to protect the residence may be needed. The existing retaining wall should be removed as it is a potential safety issue.
2829 Caen Road	Residence with two out-buildings (a garage(?) and a garden shed). • Residence is setback about 18 m from the gully crest. • Garage is set back 2.5 m from the gully crest (Photo 29). • Garden shed is set back 2 m from the gully crest. • Gully sidewall slope is very steep (Photo 30). • Creek cut down during the 2018 but did not undercut the gully sidewall (Photo 31).	No immediate risk to residence. The out-buildings could be at risk should erosional downcutting cause loss of toe support, leading to slope failure. The owner should monitor the stability of the slope.

***Figure 3**: Properties adjacent to Newsome Creek, below Highway 1 embankment. Source: CSRD mapping website. North is to the top.*

4 Summary and Assessment

The observed channel and sidewall instability along the gully below Highway 1 is related to several factors, as summarized below.

- The recent stream flows in Newsome Creek appear to have been elevated in 2017 and 2018. This has likely been related to the combined effects of the canopy loss in the upper watershed following the 2009 wildfire, and the specific weather patterns that occurred during the past two freshets. The historical channel disturbance within the east tributary creek in the upper part of the bench could also be affecting the magnitude and timing of peak flows. The issues within the watershed upstream of the study area would require a specific hydrotechnical investigation.
- The nature and stratigraphic history of the surficial deposits has also affected the pattern of instability in the gully sidewall. The exposed gravel deposit at the base of the sidewall is highly erodible, and in places there has been significant undercutting of the upper silt/clay unit. The depositional history of the silt / clay particles in the upper unit allow it

to stand at near-vertical slopes until it weathers and/or fails. Failure of this unit can occur as relatively small, shallow landslides where seepage is present, or as large blocks that release and fall into the channel. Both mechanisms can occur suddenly with little advanced sign of movement.

- Bank erosion has caused sediment accumulation and tree toppling that has altered the channel, and as a result, the stream has attacked the gully sidewall in a number of locations. As the channel process evolves, further de-stabilization within the currently affected reach is likely to occur.

Observations suggest that the culvert on Highway 1 crossing is generating a high discharge velocity at the outfall, and this has resulted in the development of a significant scour pool below the outfall and some undercutting of the highway embankment. It is not clear if this has led to the development of the near-vertical bank adjacent to the 1185 Passchendaele Road property or not, or if this feature has developed subsequent to the 2009 wildfire. A more detailed study would be required to assess this with more certainty.

KWL reported that severe erosion and bank failures were occurring behind 2809 and 2819 Caen Road in 2017, but by 2018, this had progressed downstream to 2821 Caen Road and was starting to become an issue below 2827 Caen Road. Based on this, it appears that the gully sidewall destabilization is progressing downstream. This process is likely to continue until the forest is restored in the upper watershed and peak flows moderate, and/or until the gully enlarges and establishes a new equilibrium. This could take decades.

Based on our assessment, the risk to the following structures from gully sidewall instability is considered to be high:

- 2809 Caen Road – the residence
- 2819 Caen Road – the woodworking shop
- 2821 Caen Road – the pottery shop
- 2823 Caen Road – the 3-car garage

The risk to the residence at 2807 Caen Road and the garage at 2827 Caen Road is also elevated and it may increase in the future, depending on how the channel affects the sidewall slopes below these lots in the future.

The owners of all permanent structures along Caen Road should consider the options listed in the table above. The stabilization of the channel and sidewall slopes along the gully will be technically challenging and likely very costly, given the steep slopes and depth of the gully, the amount of revetment material required, the lack of access, and constrained working conditions. Bank and channel stabilization projects should be undertaken on entire reaches, not just on a property-by-property basis. An added complication is that the entire reach appears to be within private property, and roles and responsibilities related to this are not clear. Given the uncertainties and high cost of stabilization, the simplest and least costly solution will likely be to move critical structures away from the gully edge. Rule-of thumb geotechnical setbacks for permanent structures on sites like this would typically be 1 to 1.5 times the depth of the gully from the slope crest, depending on the local conditions and circumstances. A geotechnical

engineer or geoscientist with experience in slope instability should be consulted for more specific assessment and advice for each property.

Several of the properties have decks, patios, or outbuildings, i.e. those without permanent foundations, that are also at risk or will become more at risk if gully destabilization continues. Since occupancy of these structures is generally of limited duration, the risk to occupants may be lower; however, owners would need to evaluate their own asset and personal safety exposure and take the necessary steps to reduce the risk if unacceptable.

5 Recommendations

Westrek recommends the following:

1) Residents listed in the table above should be provided with a copy of this report. The owners of properties with structures near the crest of the slope should consider their options to reduce the risk. They should continue to monitor the gully sidewalls for erosion, bank failures, or deformation at the gully crest.

2) An assessment of the natural and development-related disturbance should be undertaken within the tributary creeks above Highway 1. This should include a study of the creek channel to assess its stability and avulsion potential, an evaluation of the hydraulic capacity of each infrastructure crossing, and an assessment of the feasibility of improving the hydrologic function of the stream system.

3) A feasibility study should be undertaken to determine how the gully below Highway 1 could be stabilized.

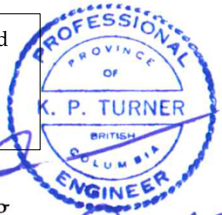
4) The condition of the existing culvert and the adjacent embankment in the Highway 1 crossing stability should be evaluated and stabilized if considered necessary.

6 Closure

If there are any questions concerning this report or if you require further information, please do not hesitate to contact the undersigned.

Westrek Geotechnical Services Ltd.

This document is an electronic copy of the original signed and sealed report. It has been provided for convenience. Westrek has retained the original signed / sealed report on file. Please contact Westrek if an authenticated document is required.



Oct 6, 2018

Hazel Wong GIT
Junior Geologist

Kevin Turner PEng
Senior Geotechnical Engineer

Attached: Appendix A *Interpretation and Use of Study and Report and Limitations*
CSRD property map – Caen Road area
Photographs

APPENDIX A
INTERPRETATION AND USE OF STUDY AND REPORT AND LIMITATIONS

1. STANDARD OF CARE.

This study and Report have been prepared in accordance with generally accepted engineering and geoscience practices. No other warranty, express or implied, is made. Geological and geotechnical studies and reports do not include environmental consulting unless specifically stated in the report.

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 us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

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

3. BASIS OF THE REPORT.

The Report has been prepared for the specific site, development, design objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are 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 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 OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report or any portion thereof, available to any party without our written permission. Any uses, which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. Westrek accepts no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT.

(i) Nature and Exactness of Soil and Description: Classification and identification of soils, rocks, geological units, and engineering estimates 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 and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilising the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising 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 all persons making use of such documents or records should be aware of, and accept, this risk. 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. Where 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.

(ii) 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 us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations or fraudulent acts of any persons providing representations, information and instructions.

(iii) To avoid misunderstandings, Westrek should be retained to work with the other design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to engineering issues. Further, Westrek should be retained to provide field reviews during the construction, consistent with generally accepted practices.

6. LIMITATIONS OF LIABILITY.

Westrek's liability will be limited as follows:

(a) In recognition of the relative risks and benefits of the Services to be provided to the Client by Westrek, the risks have been allocated such that the Client agrees, to the fullest extent permitted by law, to limit the liability of Westrek, its officers, directors, partners, employees, shareholders, owners, subconsultants and principals for any and all claims, losses, costs, damages of any nature whatsoever or claims expenses from any cause or causes, whether arising in contract or tort including negligence, including legal fees and costs and disbursements (the "Claim"), so that the total aggregate liability of Westrek, its officers, directors, partners, employees, shareholders, owners, subconsultants and principals:

i. if the Claim is satisfied by the re-performance of the Services proven to be in error, shall not exceed and shall be limited to the cost to Westrek in re-performing such Services; or

ii. if the Claim cannot be satisfied by the re-performance of the Services and:

1. if Westrek's professional liability insurance does not apply to the Claim, shall not exceed and shall be limited to Westrek's total fee for services rendered for this matter, whichever is the lesser amount. The Client will indemnify and hold harmless Westrek from third party Claims that exceed such amount; or

2. if Westrek's professional liability insurance applies to the Claim, shall be limited to the coverage amount available under Westrek's professional liability insurance at the time of the Claim. The Client will indemnify and hold harmless Westrek from third party Claims that exceed such coverage amount. Westrek shall maintain professional liability insurance in the amount of $2,000,000 per occurrence, $2,000,000 in the aggregate, for a period of two (2) years from the date of substantial performance of the Services or earlier termination of this Agreement. If the Client wishes to increase the amount of such insurance coverage or duration of such policy or obtain other special or increased insurance coverage, Westrek will cooperate with the Client to obtain such coverage at the Client's expense.

It is intended that this limitation will apply to any and all liability or cause of action however alleged or arising, including negligence, unless otherwise prohibited by law. Notwithstanding the foregoing, it is expressly agreed that there shall be no claim whatsoever against Westrek, its officers, directors, partners, employees, shareholders, owners, subconsultants and principals for loss of income, profit or other consequential damages howsoever arising, including negligence, liability being limited to direct damages.

(b) Westrek is not responsible for any errors, omissions, mistakes or inaccuracies contained in information provided by the Client, including but not limited to the location of underground or buried services, and with respect to such information, Westrek may rely on it without having to verify or test that information. Further, Westrek is not responsible for any errors or omissions committed by persons, consultants or specialists retained directly by the Client and with respect to any information, documents or opinions provided by such persons, consultants or specialists, Westrek may rely on such information, documents or opinions without having to verify or test the same.

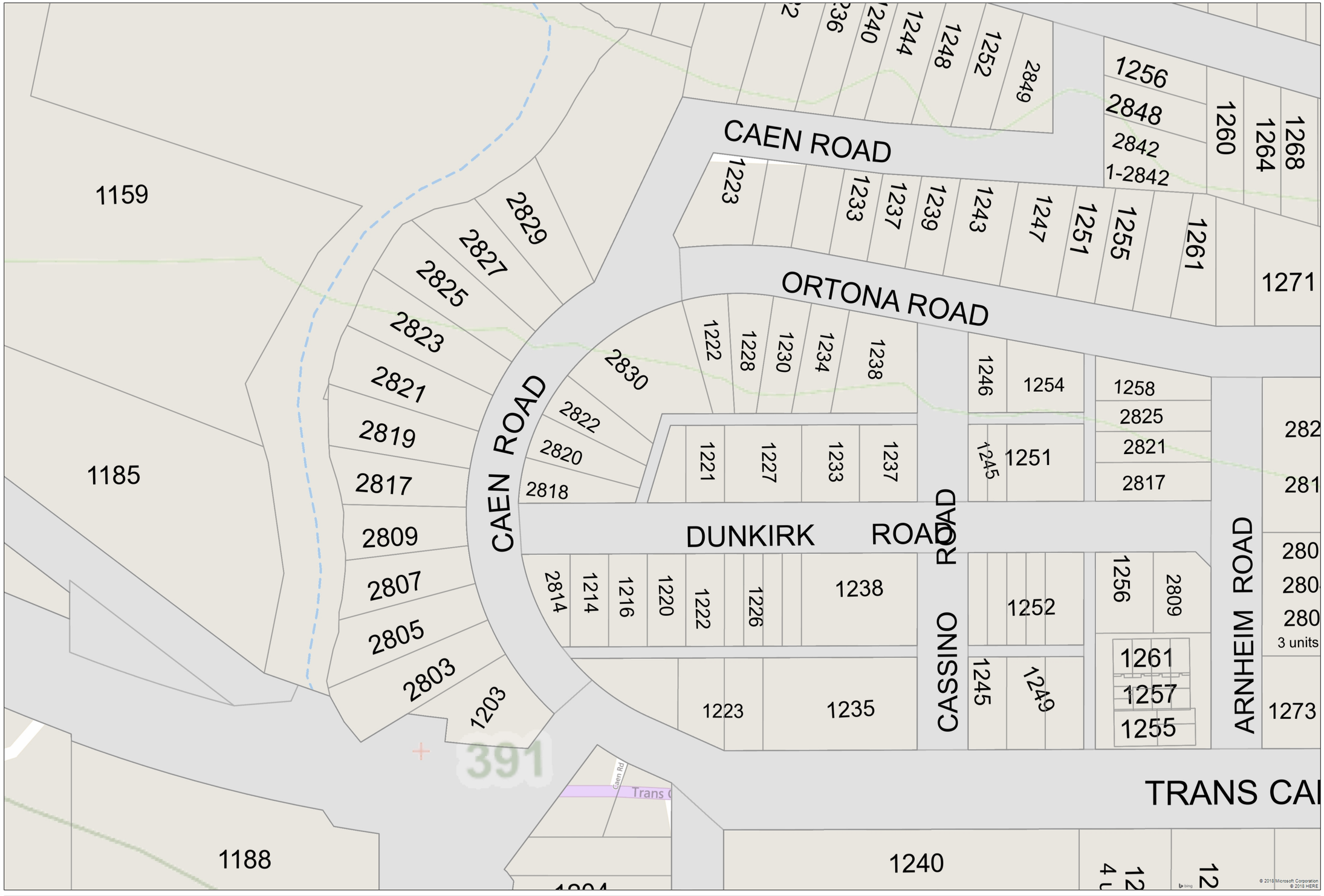
(c) Notwithstanding the provisions of the Limitation Act, R.S.B.C. 2012 c. 13, amendments thereto, or new legislation enacted in its place, Westrek's liability for any and all claims, including a Claim as defined herein, of the Client or any third party shall absolutely cease to exist after a period of two (2) years following the date of:

i. Substantial performance of the Services,

ii. Suspension or abandonment of the Services provided under this agreement, or

iii. Termination of Westrek's Services under the agreement,

whichever shall occur first, and following such period, the Client shall have no claim, including a Claim as defined herein, whatsoever against Westrek.



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114.7 0 57.33 114.7 Meters

The information on this map was compiled by the CSRD for regulatory and internal reference purposes only. No representation or warranty is made as to the accuracy of the information.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

CSRD Mapping

Columbia Shuswap Regional District
555 Harbourfront Dr NE
Salmon Arm, BC V1E 4P1

Legend

- Park Locations
- Regional Districts
  - Columbia Shuswap
  - Other Regional Districts
- Hydrant Use
- Properties
- Property Hooks
- Spot Heights
- 20m Contours
  - Index
  - Intermediate
- Detailed Roads
- Railway and Other Roads
  - Railway
  - Road Island; Road Island
  - Unconstructed Road
- Wetlands
- Lakes Rivers
- Streams Large Scale
  - Definite
  - Indefinite or Intermittent
  - Altered or Unverified
  - Ditch
- CSRD Trails
- Park Boundaries
- Provincial Lake Access Points

May 07, 2018

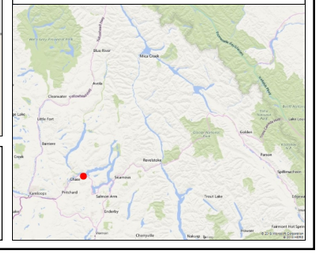

Photo 1 – *View looking south up the east tributary creek south of (above) Tayler Road and west of Hannett Road. The wildfire burned area in the upper slopes can be seen in the background. [May 9, 2018]*

Photo 2 – *View looking south at the bank instability and channel disturbance (arrow) within the east tributary creek south of (above) Taylor Road and west of Hannett Road (the road on the left side of the creek). [May 9, 2018]*

Photo 3 - *View looking north (downstream) at the channel disturbance below Taylor Road crossing near Hannett Road. [May 9, 2018]*

Photo 4 – *View looking northwest at an area with considerable sediment deposition along the east tributary creek between London Lane (foreground) and the CP Railway. Deposition is visible upstream of London Lane in the left side of the photograph [May 9, 2018]*

Photo 5 – *View looking east over the sediment deposition above the CP Railway. At the time, the east tributary appears to have been partially diverted to the west tributary (arrow). [May 9, 2018]*

Photo 6 – *View looking south at the Newsome Creek gully below Highway 1. Caen Road is to the immediate left (east) and the location of the washed out crossing on Dieppe Road is shown with the arrow. [May 9, 2018]*

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Photo 7 – *View of culvert outlet (1200 mm diameter) in Highway 1. Note the scour in the embankment to the immediate right. [May 1, 2018]*

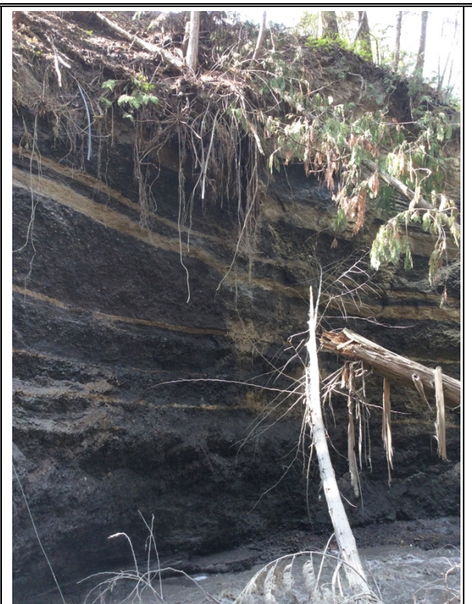

Photo 8 – *View looking downstream at the 10 m high, near-vertical silt/clay deposit adjacent to 1185 Passchendaele Road. [May 1, 2018]*

Photo 9 – 2807 Caen Road: *view looking upstream along the gully crest at the patio deck, which is supported on the steep sidewall slope. [May 7, 2018]*

Photo 10 – 2807 Caen Road: *view looking down the slope at the reach upstream from this property. [May 7, 2018]*

Photo 11 – 2809 Caen Road: *view looking upstream along the gully crest at the very steep slope below the elevated deck. The house is about 3 m back from the crest. A shallow debris slide occurred below this area (see Photo 12). [May 7, 2018]*

Photo 12 – 2809 Caen Road: *view looking upstream at the bank instability. The elevated deck is visible in the background. A small debris slide (arrow) that occurred early in May 2018 is shown with the arrow. [May 26, 2018]*

Photo 13 – 2809 Caen Road: *view looking downstream at the gravel deposit (below the lowest tan-coloured line) that eroded throughout May 2018 and undercut the bank. [May 26, 2018]*

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Photo 14 – 2819 Caen Road: *view looking downstream (north) along the gully crest at the southwest corner of the shop (~2 m setback). Photo 15 shows the slope to the lower left of the corner of the photo. [May 3, 2018]*

Photo 15 – 2819 Caen Road: *view looking downstream (northeast) at the undercut bank and failing slope above, adjacent to the shop building (in the background). See also Photo 16. [May 9, 2018]*

Photo 16 – 2819 Caen Road: *view looking upstream (south) at the sand and gravel deposit that eroded throughout May 2018 and undercut the bank. [May 26, 2018]*

Photo 17 – 2821 Caen Road: *view looking downstream (north) along the gully crest behind the pottery shop (1.5 m setback). See also Photo 21, which shows the other side of the property. [May 7, 2018]*

Photo 18 – 2821 Caen Road: *view looking upstream (south) at the undercutting bank below the pottery shop. Note the creek has cut a channel in behind the roots of a large cedar tree (arrow), as shown in the closer view in Photo 19. [May 26, 2018]*

Photo 19 – 2821 Caen Road: *view looking upstream (southeast) at the sand and gravel deposit that eroded throughout May 2018 and undercut the bank. Undercut bank is about 3 m high. Roots supporting the cedar tree are on the right side. [May 26, 2018]*

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Photo 20 – 2823 Caen Road: *view looking upstream (south) along the gully crest at the west side of the shop (~2 m setback). Note the fenced shed extends out to the crest (see Photo 21) and the gabion retaining wall and external patio deck in the lower right. [May 1, 2018]*

Photo 21 – 2823 Caen Road: *view looking upstream along the gully crest at the retaining wall that is supporting the shed roof. The patio extending out behind the pottery shop at 2821 Caen Road can be seen in the background. [May 1, 2018]*

Photo 22 – 2823 Caen Road: *view looking upstream (south) along the creek showing the downcutting that is occurring along this reach. [May 9, 2018]*

Photo 23 – 2825 Caen Road: *view looking downstream (northeast) at the slope below the residence on this lot. Note the rubber tire retaining wall below the house. The elevated deck is shown with the arrow. [May 26, 2018]*

Photo 24 – 2825 Caen Road: *view looking upstream (southwest) from the elevated deck at the creek below this lot. The creek is downcutting through this reach. [May 3, 2018]*

Photo 25 – 2825 Caen Road: *view looking downstream (north) along the downcutting creek channel below this lot. [May 3, 2018]*

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Photo 26 – 2827 Caen Road: *view looking downstream (northeast) at the slope below the out-building at the rear of the property. The top of the debris slide is shown with an arrow and can be seen in Photo 27. [May 1, 2018]*

Photo 27 – 2827 Caen Road: *view looking upstream (south) showing the undercutting and debris slide shown with arrow in Photo 26. [May 3, 2018]*

Photo 28 – 2827 Caen Road: *view looking downstream at the channel downcutting below the north side of the lot. [May 7, 2018]*

Photo 29 – 2829 Caen Road: *view looking upstream (south) along the gully crest at the west side of the property. [May 1, 2018]*

Photo 30 – 2829 Caen Road: *view looking downstream (northwest) from the gully crest showing the creek downcutting. [May 1, 2018]*

Photo 31 – 2829 Caen Road: *view looking downstream (north) along the creek channel showing the creek downcutting. Note the bank failures farther downstream. [May 26, 2018]*

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