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Our File: 015-083

Via Email: steve@dsny.com
jchfor@telus.net

Steve Vestergaard
Suite 750
PO Box 11527
650 West Georgia St
Vancouver, BC V6B 4N7

Dear Sir,

**Re: Geotechnical Field Review of Four Sites
Along the Access Road to Water License Intake on Battani Creek
Lions Bay
British Columbia**

1 Introduction

As requested by Steve Vestergaard (Vestergaard), Westrek Geotechnical Services Ltd. (Westrek) has conducted several geotechnical field reviews of four sites located along the access road to the intake for Water License C064497 on Battani Creek in Lions Bay. The review of these sites forms part of an application for a "Licence to Occupy" by Vestergaard for the portions of the access road on Crown Land, following an alleged trespass. This report does not address the alleged trespass.

An initial review of the access road was completed for Vestergaard by Cordilleran Geoscience Terrain Specialists (Cordilleran) following the alleged trespass. Shelley Higman M.Sc., P.Eng, P.Geo representing the BC Ministry of Forest, Lands and Natural Resource Operations (MFLNRO), also visited the site and developed deactivation plan for the access road, following concerns raised by ministry representatives about the downslope risk to the public should sections of the road or the adjacent slopes fail.

We understand that both reports present measures to mitigate the downslope risk associated with these potential slopes failures. The deactivation plan presented by MFLNRO also eliminates or restricts longterm vehicle access to the water license intake and the Vestergaard properties.

2 Background Information

The following documents were made available to Westrek for review:

- A copy of the "Trespass Notices under Section 59 of the Land Act, dated September 4 & 5, 2014, issued by Murray Watt (MoFLNRO)" report prepared by Cordilleran and dated September 29, 2014.

- A copy of the "Road Deactivation Plan for Alleged Trespass Road Associated with Water Licence C064497 on Battani Creek, Lions Bay, BC – Amended June 12, 2015 to include Deactivation Measures for Alleged Trespass Road on MOTI Property" completed by MFLNRO and dated June 12, 2015.

3 Scope

Using the stationing presented in the MFLNRO June 12, 2015 report, Westrek was asked to review the following sites:

- The reservoir at the water license intake at Sta. 0+000 on the Reservoir Road
- The large fill slope on Driveway 1 from about Sta. 0+025 to Sta. 0+050
- The cribbed fill slopes on the Reservoir Road from about Sta. 0+720 to Sta. 0+750
- The cribbed fill slopes on the Reservoir Road from about Sta. 0+785 to Sta. 0+795

The purpose of this review was to develop conceptual measures to maintain long-term access and use (for the reservoir) and to mitigate the downslope risk to public safety. The measures are conceptual at this stage and require further sub-surface investigations. Westrek has been advised by MFLNRO that this work cannot be completed as Vestergaard does not currently have a "Licence to Occupy" the land (i.e., to complete the investigation could place him in a trespass position).

The longterm stability of the remaining segments of the access road are addressed by Cordilleran in their September 29 report.

4 Site Visits

The following site visits were completed by Westrek:

- On June 30, 2015. Present were Timothy Smith P.Geo, Eng.L representing Westrek, Pierre Friele M.Sc, P.Geo representing Cordilleran, John Howe RPF representing JCH Forestry and Steve Vestergaard.
- On July 8, 2015. Present were Timothy Smith and Gino Fournier P.Eng, RPF representing MFLNRO.
- On July 13, 2015. Present were Timothy, John Howe and Andi Buechi representing Western Geohazard Solutions Inc. (Geobrugg).

5 The Reservoir at the Water Licence Intake

An approximate three to four metre deep reservoir has been excavated into what Westrek has been told is bedrock (pers. Comm. Vestergaard). The presence of bedrock on all sides of the reservoir was not confirmed during our field visit. An S6 stream, referred to as Battani Creek, flows into the excavated reservoir from the east. Coarse, angular shot rock fills are located on the downstream (i.e. west) side of the reservoir. We understand that these fills were generated by the material excavated from the reservoir and the adjacent access road.

The reservoir and/or Battani Creek provide drinking water to several of the adjacent properties in the area.

Several photographs taken by Vestergaard during the construction of the reservoir were made available to Westrek showing some of the original site conditions. The images show bedrock exposed near the outlet of the reservoir; they do not show all sides of this structure however.

In the June 12, 2015 Deactivation Plan report, the MFLNRO has proposed a plan to decommission the reservoir and restore the stream channel to as close to the pre-construction condition as possible.

Vestergaard has indicated that he would like to maintain the reservoir and not decommission it.

At the time of our field reviews, it appeared that the reservoir was an excavated basin in bedrock. Additional sub-surface work is required to confirm this, which could include:

- Draining the reservoir to a suitable level so that the bedrock can be mapped to identify the rock mass quality and joint sets present, and to determine if the reservoir is actually surrounded by bedrock.
- Determining the extent of the bedrock on the outside of the reservoir by removing the angular shot rock fill on the sides using an excavator. This work cannot be completed until Vestergaard is granted a "Licence to Occupy"

If the reservoir is not surrounded by competent bedrock, and the shot rock fills are acting like a berm on the face of a dam, then it is likely that this structure would have to be decommissioned and an appropriate and approved design be developed that complies with the Dam Safety Act.

If the reservoir is surrounded by competent bedrock, and no leaks through joint sets or fault zones are detected, and no dam has been created at the outlet, it maybe considered a "dugout" constructed within a stream channel under the "Water Authorization Requirements for Dugouts" policy issued by the BC MFNLRO and BC Ministry of Environment (MOE) in 2013.

If this is the case, Vestergaard is likely to have to apply to both MFLNRO and MOE to modify Water License C064497 to reflect the "dugout". Additional geotechnical work maybe required, however this will determined through consultation with these ministries.

Regardless of the outcome of this work, it is recommended that deflection berms about 1.5 m high be constructed on either side of the reservoir to ensure the stream flow continues down the existing and natural stream channel. This work cannot be undertaken until a "Licence to Occupy" is granted to Vestergaard. The sizing of the berm should be based on the hydrologic characteristics of this Battani Creek.

Additional work to required complete the analysis of the reservoir includes:

- **Map the bedrock to identify the rock mass quality and joint sets present.**
- **Determine if the reservoir is actually surrounded by bedrock and meets the requirements of a "dugout".**

6 The Large Fill Slopes on Driveway 1 from about Sta. 0+025 to Sta. 0+050

A large fill slope has been constructed on the slopes below this segment of Driveway 1 using angular shot rock, likely generated from the adjacent bedrock cut slopes on the road. The fill slopes are about 32 m long (slope distance) at the longest point and range from 80 to 85%. The shot rock ranges in size from 100 mm to up to 1 m wide (across the intermediate axis).

The slopes below the toe of the fill slopes are irregular and broken and vary from 65 to 70%. Highway 99 is located about 200 m downslope.

During the construction of this fill slope, several large boulders continued downslope arresting about 20 m downslope from the toe of the fill slope; they are perched up against several trees and bedrock

humps. Concerns have been raised by the MFLNRO and Cordilleran about the long-term stability of these boulders and whether they could dislodge and continue downslope to Highway 99.

The MFLNRO has proposed that these fill slopes should be pulled back (i.e. heavy to very heavy) and the driveway deactivated. This will result in the loss of use of this road segment. The MFLNRO has also noted that there is a high potential for the larger shot rock boulders to dislodge during deactivation and continue downslope. This could pose a high to very high risk to the public on Highway 99. Temporary rock netting/fencing maybe required. Westrek agrees with this concern raised by MFLNRO.

Vestergaard has indicated that he would like to maintain access on the driveway. In order to achieve this, the fill slopes would have to be deactivated and replaced with either an engineered fill slope or a geosynthetically reinforced soil (GRS) retaining wall.

No detailed design for an engineered slope or GRS wall can be completed at this stage, as Westrek has been advised by MFLNRO that a subsurface investigation to determine the depth to bedrock (i.e. suitable bearing) cannot be undertaken until a "Licence to Occupy" is granted to Vestergaard. Once this occurs, the subsurface investigation can be completed and detailed designs for either option prepared.

In addition to completing a subsurface investigation for these sites, a detailed site survey (using a Total Station survey instrument or equivalent) to create a Digital Elevation Model (DEM) would need to be completed to prepare the detailed design for the GRS wall or engineered fill slope options.

Prior to completing any work at this site (including the MFLNRO deactivation plan), a rock fall catchment system must be installed to arrest any debris dislodged during the pull back of the fill slopes, and the construction of either the engineered fill slope or GRS wall.

Geobrugg has proposed a conceptual design to mitigate this risk using an approximate 18 m wide and 3.5 m high catchment fence erected between a 1.5 m diameter Douglas fir tree and 4 m high bedrock bluff. The mesh would be TECCO G65/4 or Spider S4-130.

Once the catchment fence is in place, the deactivation of the fill slope can commence. Once this material has been removed, the design of the GRS wall or an engineered fill slope can be completed.

Due to the location of the "runaway" boulders below the toe of the fill slope, they will not be able to be retrieved during the deactivation of the adjacent fill slope. It is recommended that netting be placed over the debris and pinned to the slope to hold the boulders in place for the long term. Geobrugg has proposed a conceptual design for this using the TECCO G65/4 mesh.

Detailed design engineering will be required to develop the final design for the rock fall catchment measures.

Additional work to required complete the detailed design of the wall or engineered fill slope includes:

- A detailed subsurface investigation to determine the depth to competent bedrock
- A detailed site survey of this road segment once the shot rock fill has been removed

7 The Cribbed Fill Slopes on the Reservoir Road from about Sta. 0+720 to Sta. 0+750 and Sta. 0+785 to Sta. 0+795

In their June 12 report, the MFLNRO recommended heavy and very heavy pull back of the cribbed fill slopes in these segments. As stated in their report, this could reduce the road width to 4 m in several places.

Vestergaard has indicated that he would like to main the full road surface width and improve the stability of the fill slopes, thereby mitigating the downslope risk to public safety. In order to achieve this, Westrek has proposed that the cribbed fills be pulled back and removed, and replaced by installing GRS walls to create a stable fill slope in these segments.

No detailed design for these walls can be completed at this stage, as Westrek has been advised by MFLNRO that a subsurface investigation to determine the depth to bedrock (i.e. suitable bearing) for the walls cannot be undertaken until a "Licence to Occupy" is granted to Vestergaard. Once this occurs, the subsurface investigation can be completed and detailed designs prepared.

Conceptually, the GRS walls at these sites could be as follows:

- At the site from about Sta. 0+720 to Sta. 0+750, the wall could be up to 40 m long and 3 to 5 m high.
- At the site from about Sta. 0+785 to Sta. 0+795, the wall could be up to 25 m long and 3 to 4 m high.

In addition to completing a subsurface investigation for these sites, a detailed site survey to create a DEM would need to be completed to prepare the detail design for these walls.

Additional work to required complete the detailed design of these walls includes:

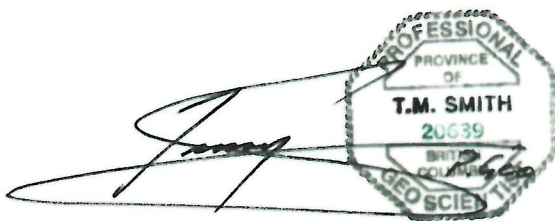
- **A detailed subsurface investigation to determine the depth to competent bedrock**
- **A detailed site survey of these roads segments**

8 Closure

This report contains information relating to the stability of the slopes around four sites on the access road to the licensed water intake described above and the Vestergaard properties. It must be read in conjunction with Appendix A attached.

Yours truly,

Westrek Geotechnical Services Ltd.



Timothy Smith P.Ge, Eng.L
Engineering Geologist
Attachment: Appendix A

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, expressed 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 persons providing information.
- (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.

- (i) In recognition of the relative risks and benefits of the study and report 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, sub-consultants 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 legal fees and costs and disbursements, so that the total aggregate liability of Westrek, its officers, directors, partners, employees, shareholders, owners, sub-consultants and principals shall not exceed the limits of Westrek's insurance for services rendered for this matter. It is intended that this limitation will apply to any and all liability or cause of action however alleged or arising, 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, sub-consultants and principals for loss of income, profit or other consequential damages howsoever arising.
- (ii) 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.
- (iii) Notwithstanding the provisions of the *Limitations Act*, R.S.B.C. 1996 c. 266, amendments thereto, or new legislation enacted in its place, Westrek's liability for any and all claims of the Client shall absolutely cease to exist after a period of two (2) years following the date of:
 - (a) Substantial performance of the services,
 - (b) Suspension or abandonment of the agreement to provide the services to be provided under this agreement, or
 - (c) Termination of Westrek's services under the agreement,

whichever shall occur first, and following such period, the Client shall have no claim whatsoever against Westrek.