



June 22, 2018

Ministry of Transportation and Infrastructure
Vancouver Island District
3rd Floor - 2100 Labieux Road
Nanaimo BC, V9T 6E9

ISSUED FOR USE
FILE: 704-ENG.VGEO03227-03
Via Email: Ryan.Gustafson@gov.bc.ca

Attention: Mr. Ryan Gustafson, P.Eng.

Subject: Rumming Road Erosion Event – Summary of Remediation

1.0 INTRODUCTION

On Monday January 29, 2018, Mr. Ryan Gustafson of the BC Ministry of Transportation and Infrastructure (the Ministry) contacted Tetra Tech Canada Inc. (Tetra Tech) and requested an emergency callout for an erosion event which impacted Rumming Road in Lantzville, BC. Tetra Tech was engaged to provide remediation design of the slope failure and provide geotechnical input during construction.

This letter provides a summary of the remediation of the slope and recommendations for future monitoring / maintenance.

2.0 PROJECT SUMMARY

The remediation of Rumming Road included several aspects:

- Reconstruction of the failed slope;
- Diverting stormwater flow from the Bayview Park Drive catchment area;
 - New culvert placed under the Highway 19;
 - New culvert under Rumming Road at the failure location;
 - New culvert under the railway;
 - New ditching from Highway culvert outlet to Rumming Road culvert;
 - New ditching / channel from railway culvert to ocean outfall; and
- Regrading gully area with sand debris material.

Tetra Tech was engaged to design the slope reconstruction only, however, since it encompassed a requirement to receive stormwater discharge, this had to be considered when designing / constructing the slope. Tetra Tech's scope was limited to the slope remediation on Rumming Road and excluded design / monitoring of the works associated with the stormwater diversion.

It is understood the decommissioning the existing culvert under Rumming Road was not completed during these works.

3.0 SLOPE REMEDIATION

The Ministry's site representative during the work was Ms. Jessica Learn. The Ministry's maintenance contractor (Emcon Services) engaged Parksville Heavy Equipment Ltd. (the Contractor) to complete the remediation contract. Mr. John Christie was the site foreman who, in addition to Ms. Learn, was Tetra Tech's point of contact on site.

3.1 Design

The initial objective of remediating the erosion failure was to reconstruct the slope. The design objective was later changed at the request of the Ministry and the District of Lantzville (the District), which implemented requirement to accept the stormwater discharge from the Bayview Park catchment. The stormwater flows were to be diverted from the old culvert under Ruming Road to a new culvert, to be placed under Ruming Road at the failure location.

With this intent, the design objectives included:

- Removal of disturbed material;
- Prevent fines migration (i.e., piping failures from the native sand);
- Limit long term slope issues;
- Manage surface and groundwater movements; and
- Allow for safe construction methodologies.

Design and construction elements were also affected by site restrictions, including:

- Very poor access;
- Steep grades and near vertical failure zones;
- Stormwater control and diversion;
- Traffic and local residential management; and
- Maintaining safe working conditions.

The design drawings Figures 1 to 7, were provided to the Ministry on March 5, 2018.

3.2 Excavations

The first activity was to develop a safe access procedure for the washed-out area. Tetra Tech prepared this with input from the Contractor, which included Tetra Tech completing WorkSafe BC temporary slope inspections. The next stage of the slope remediation included excavation and removal of all loose sand and debris that had accumulated within the base of the failure and at the toe of the slope. To access the base of the failure, the Contractor excavated a ramp down from Ruming Road, on the east side of the failure. Several trees near the failure shoulders and toe of failure were removed for safety, and some trees at the toe of slope were removed for accessibility of construction equipment.

As the Contractor progressed with excavating the ramp, the loose sand debris material was removed and hauled to the gully area on the south side of Ruming Road. Excavations within the failure base were advanced down to the native dense Quadra sands. At the toe of the failure and along the railway ditch, the loose sand debris material was removed to expose the previous ground surface, prior to the failure. A test pit was completed at the toe which exposed evidence of previous failures with layers of loose colluvial material and organic horizons. Original competent ground was not encountered within the 4.5 m depth the testpit was advanced.

Tetra Tech was onsite during key stages of the excavation to observe that the debris material had been removed, excavation to the dense native Quadra sands occurred, and safety procedures with temporary slopes were being followed.

Field reports from the observation visits are attached with this letter as Appendix B.

3.3 Granular Filter

After the native Quadra sands were exposed, a granular filter was placed to restrict migration of fine material from the Quadra sands, through the reconstructed slope area. The granular filter comprised concrete sand fine aggregate (sourced from Island Aggregate), overlain with 37 mm (1.5") minus crush (sourced from Copcan's Northwest Bay quarry). Both materials were tested for grain size and a gradation compatibility check was completed for filtration of the native Quadra sands.

The filter was placed down the cleaned-out failure and was graded as such to allow the Contractor's articulated rock truck to traverse up and down the failure - as indicated in Figure 4. This was staged in order to haul out the sand debris material at the toe of the slope.

Tetra Tech was onsite daily to observe the placement of the granular filter, which was in general accordance with the design as indicated on Figures 6 and 7. Due to the steep slopes, compaction effort was limited to bucket tampering and track packing with an excavator.

3.4 Riprap Armouring

Upon completion of the granular filter placement, the slope reconstruction / armouring began, which included a layer of 450 mm (18") minus blast rock, overlain with class 1000 kg riprap. The design specified that material layers would be placed in a swale like shape to promote water paths to the centre of the slope. This was generally achieved with the 18" blast rock, which was track packed and bucket tampered in place. However, with the larger riprap rock particles there was some geometric difficulty in obtaining a swale like shape in the lower area of the slope, where more rocks were placed to buttress the reconstructed and existing slopes.

As the construction progressed up the fill slope, a swale like shape was developed with a focal point concentrating on the culvert discharge alignment. Within the swale, 18" blast rock was scattered and hand placed to help infill apparent voids and promote water flows further down slope.

3.5 Ditching and Culvert Construction

Tetra Tech recommended that the ditching along Rummung Road be lined with a low permeable material such as a clay fill to prevent seepage into the fill and promote surface drainage. Since there was difficulty in sourcing the material, an alternate solution was provided by the Contractor and the Ministry, which included a geotextile liner with recycled asphalt (RAP) and rock armouring. The intent of this alternate solution was to have the RAP provide a low permeable layer within the ditching with the geotextile liner and rock armouring providing additional protection against erosion. This construction was used in the ditch from the Highway outfall to the Rummung Road culvert inlet, and in the Rummung Road ditch west of the failure.

4.0 RECOMMENDATIONS FOR FUTURE MONITORING

Following the completion of the slope reconstruction, Tetra Tech provides the following recommendations for monitoring and maintaining the slope and drainage course:

- *Monitoring for Ditch Erosion:* During the first winter period of heavy precipitation, the ditching along Rummung Road should be monitored to review how it handles concentrated water flows. This would include the headwall / inlet area of the culvert under Rummung Road. The discharge at the culvert outlet should also be monitored to check water for sediments and rock particles being transported / mobilized by the heavy flows.

- *Downstream Culvert Monitoring:* Monitoring should also include the downstream culvert, under the railway. It is expected that initial discharge will have some turbid water due to the washing fines of the new materials used in construction, however, during the later parts of the first winter months and following seasons, checking the water for signs of excessive material transportation should be completed.
- *Monitoring for Road Settlement:* Because of the deep fill required for this remediation, some settlement of the granular soils is expected to occur over several years. This could be in the order of 1% of the fill heights below the road surface. Some maintenance of the road surface may be required, especially in the transition areas (from existing to remediated areas).
- *Monitoring of the Stormwater Flows on the Remediated Slope:* During a heavy precipitation event, it is recommended that the slope is visited to review how the discharged water flows down the slope face. Water should have a preferred flow path down slope and be dissipating down into the voids part way down the slope. If any water is observed to be flowing to the outer edges of the rock filled slope, some rearrangement of the riprap will be required.
- *Monitoring Performance of the Fill Slope:* Some post construction settlement/movement of the slope is to be expected, however, signs of ongoing or excessive settlement/movement should be monitored after the first winter period. This could likely be observed by signs of depressions in the road shoulder.
- *Retaining Wall East of the Fill Slope:* As a result of the wash-out failure, the property east of the lost part of their retaining wall, constructed partially with lock-blocks and timber cribbing. Effort was made to help stabilize the area, which included removal of the remaining lock-blocks dislodged by the event, and placing large riprap particles up to the timber cribbing section of the retaining wall. Remediating the retaining wall of the property was outside the scope of this project, however, some deformations may occur in that area due to the poor condition of the wall and steepness of the slopes below the wall.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Ministry of Transportation and Infrastructure and their agents. Tetra Tech Canada Inc. (operating as Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Ministry of Transportation and Infrastructure, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

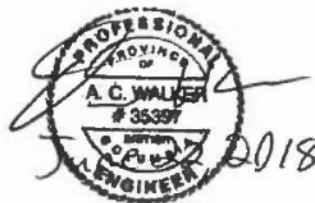
6.0 CLOSURE

We trust this proposal meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.



Prepared by:
Isaac Kitchingman, ASCT.
Geotechnical Technologist - Nanaimo
Direct Line: 250.756.3966 x238
Isaac.Kitchingman@tetratech.com



Reviewed by:
Andrew Walker, P.Eng.
Senior Geotechnical Engineer
Direct Line: 250.756.3966 x241
Andrew.Walker@tetratech.com

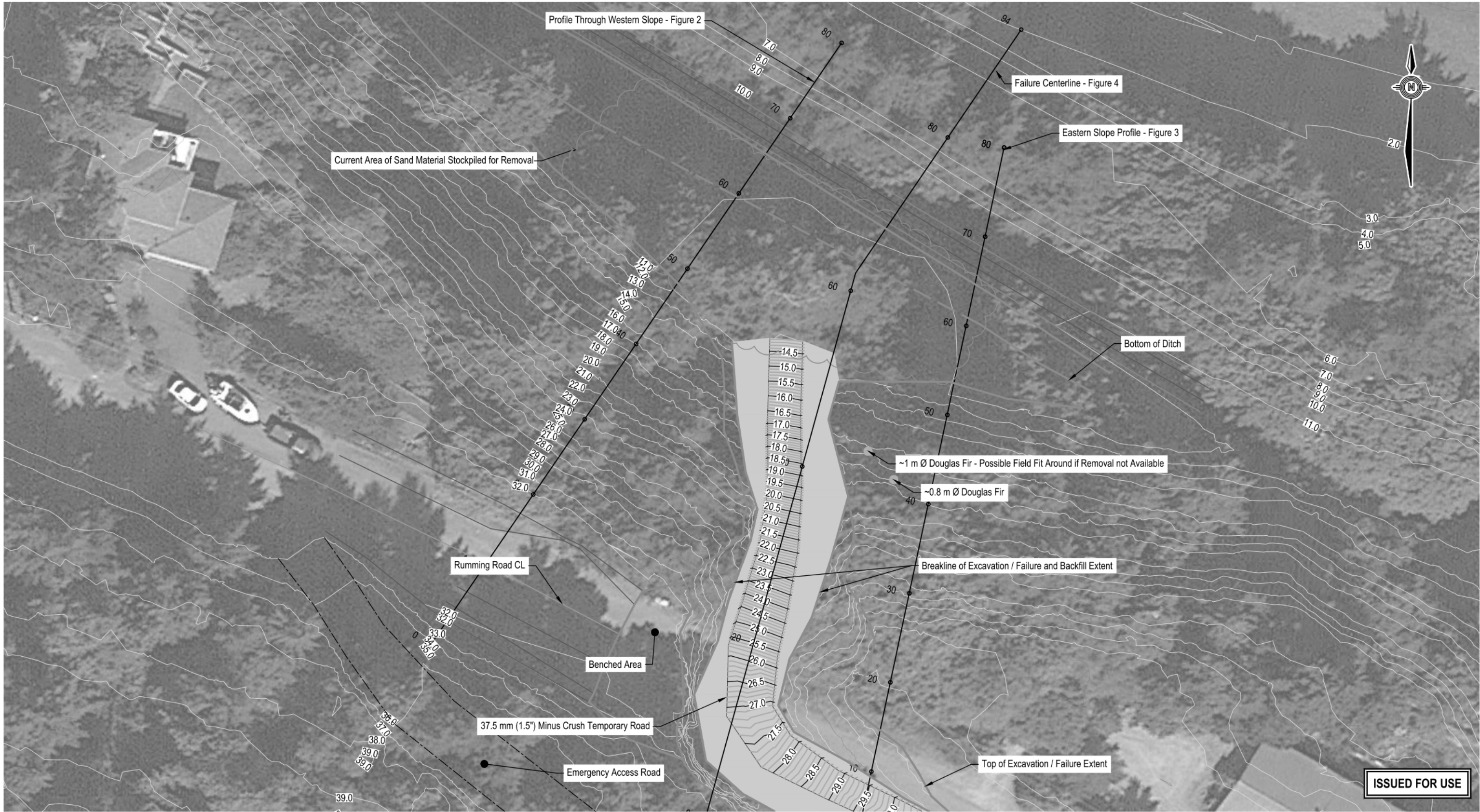
/dr

Attachments: Figures 1 – 7
Appendix A – Tetra Tech's Limitations on the Use of this Document
Appendix B – Field Reports
Appendix C – Schedule A – Summary of Design and Field Review Assignments and Assurance of Field Reviews and Compliance

FIGURES

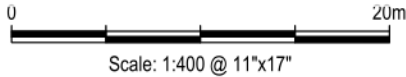
Figure 1 - 7

Q:\Vancouver\Engineering\131\Projects\ENG\VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 1] March 05, 2018 - 9:22:04 am (BY: KITCHINGMAN, ISAAC)



LEGEND

Current Extent of Failure / Work Area



NOTES
Contours based on LIDAR information collected on February 2, 2018.
Survey data of the excavations and temporary road collected on February 16, 2018

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RUMMING ROAD FAILURE REMEDIATION
LANTZVILLE, BC

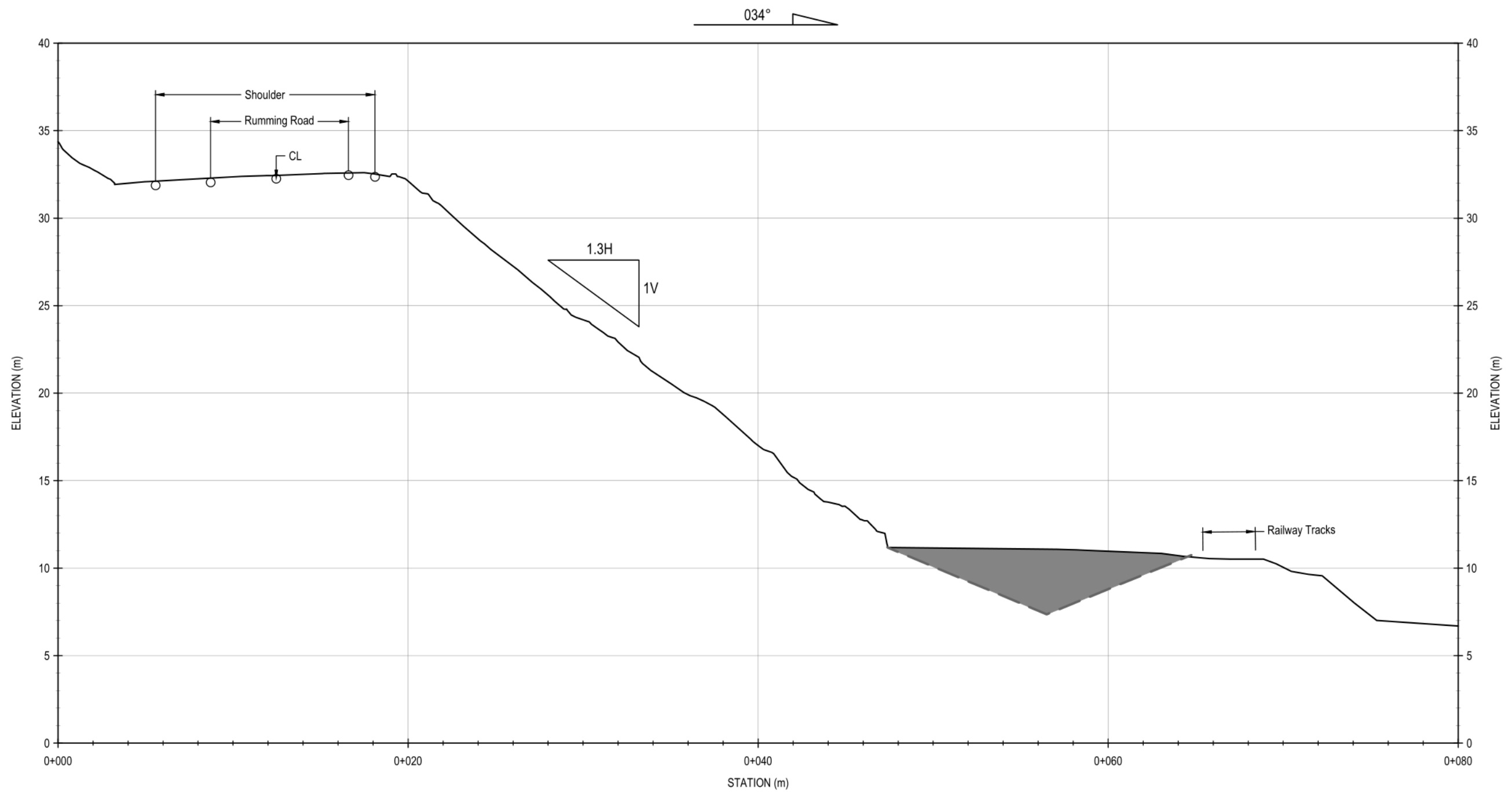
Site Plan

PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0
OFFICE Nanaimo	DATE March 5, 2018		

Figure 1

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Q:\Vancouver\Engineering\131\Projects\ENG-VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 2] March 05, 2018 - 9:22:22 am (BY: KITCHINGMAN, ISAAC)



Western Slope Profile

ISSUED FOR USE

LEGEND

- Ground Profile Post Failure Event - LiDAR Captured February 2, 2018
- Inferred Profile Prior to Failure Event
- Inferred Extent of Waste Sand Material to be Removed

0 10m
Scale: 1:250 @ 11"x17"



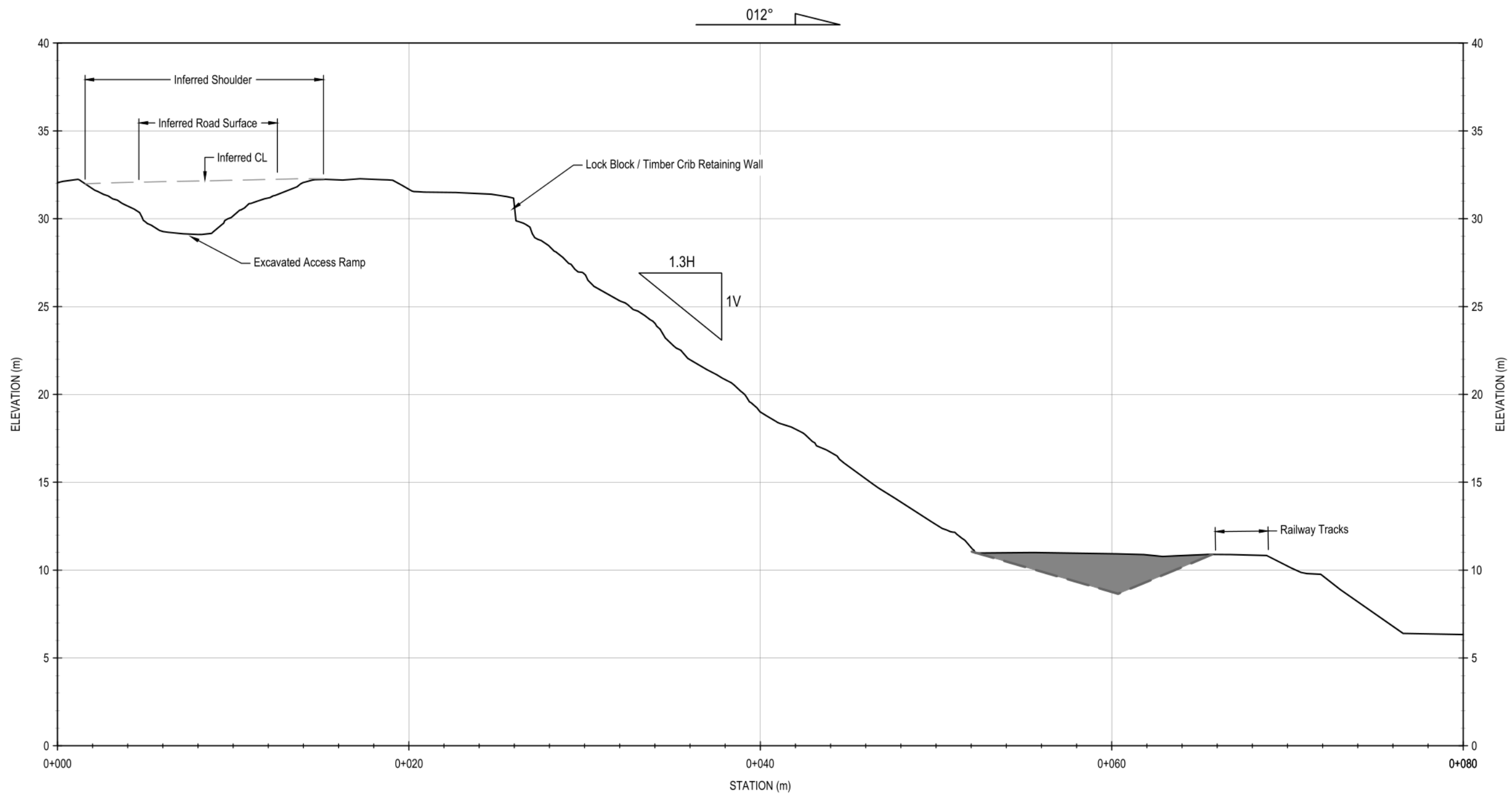
RUMMING ROAD FAILURE REMEDIATION
LANTZVILLE, BC

Western Slope Profile

PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0
OFFICE Nanaimo	DATE March 5, 2018		

Figure 2

Q:\Vancouver\Engineering\131\Projects\ENG-VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 3] March 05, 2018 - 9:22:53 am (BY: KITCHINGMAN, ISAAC)



Eastern Slope Profile

ISSUED FOR USE

LEGEND

- Ground Profile Post Failure Event - LiDAR Captured February 2, 2018
- Inferred Profile Prior to Failure Event
- Inferred Extent of Waste Sand Material to be Removed

0 10m

Scale: 1:250 @ 11"x17"



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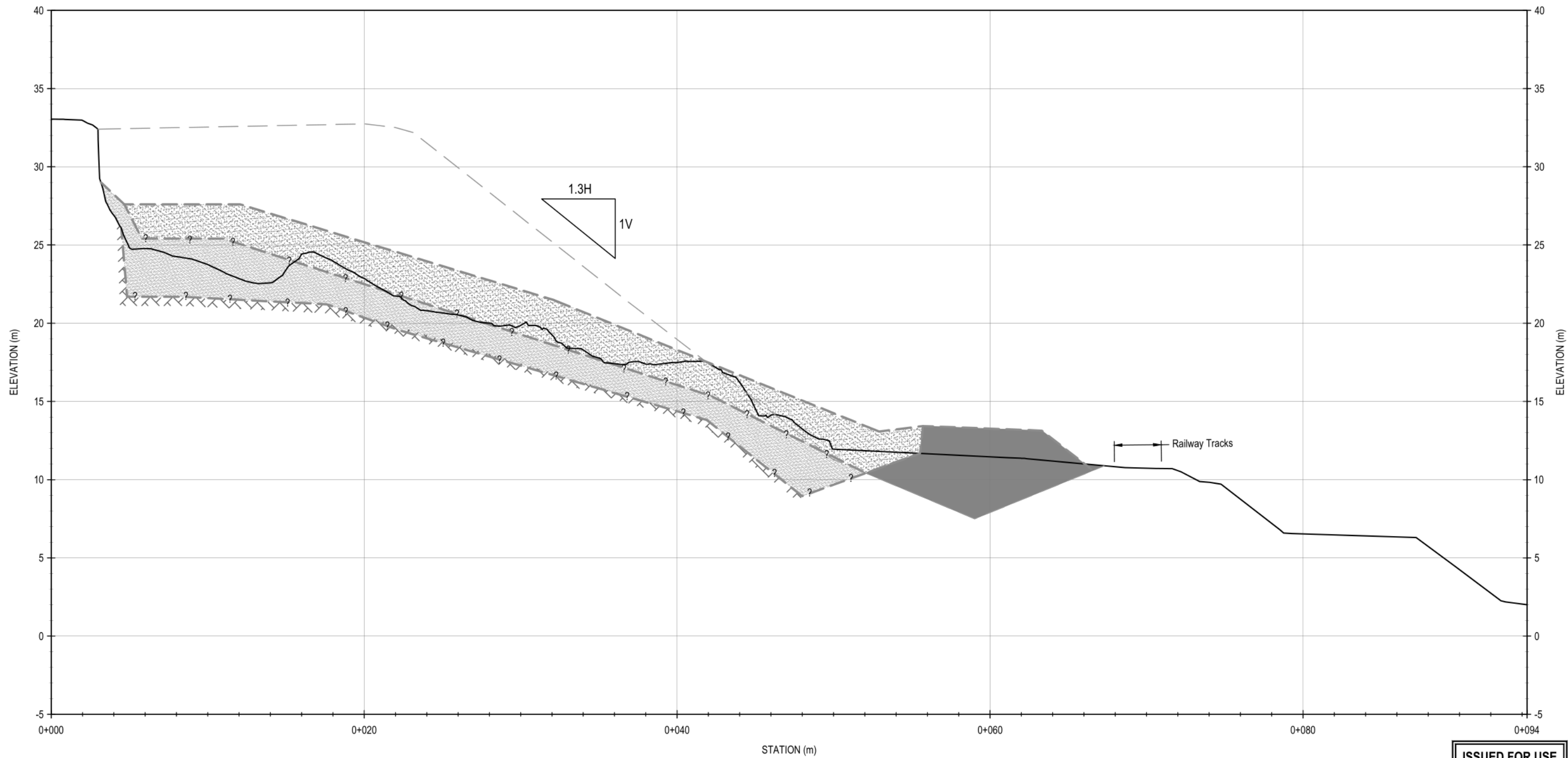
RUMMING ROAD FAILURE REMEDIATION
LANTZVILLE, BC

Eastern Slope Profile

PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0
OFFICE Nanaimo	DATE March 5, 2018		

Figure 3

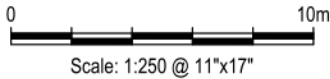
Q:\Vancouver\Engineering\131\Projects\ENG-VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 4] March 05, 2018 - 9:23:08 am (BY: KITCHINGMAN, ISAAC)



Failure CL

ISSUED FOR USE

LEGEND	
	Ground Profile Post Failure Event - LiDAR Captured February 2, 2018
	Inferred Profile Prior to Failure Event
	Temporary Access Road / Current Construction Profiles
	Inferred Extent of 37.5 mm (1.5") Minus Crush Placed for Temporary Works
	Inferred Extent of Concrete Sand Fine Aggregate Placed for Temporary Works
	Inferred Extent of Waste Sand Material to be Removed
	Undisturbed Native Quadra Sand



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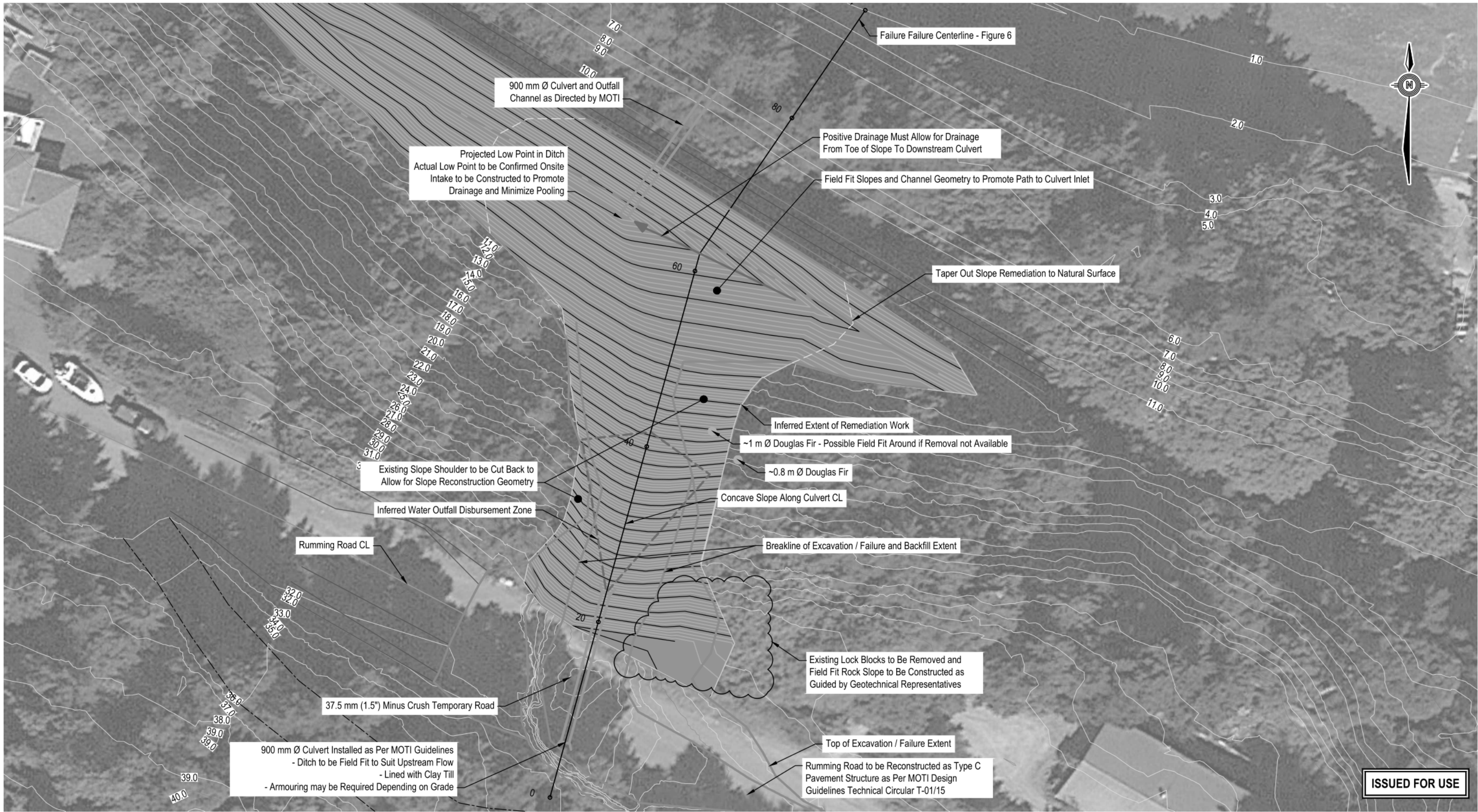
RUMMING ROAD FAILURE REMEDIATION

LANTZVILLE, BC

Profile Through Failure Centerline

PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0	Figure 4
OFFICE Nanaimo	DATE March 5, 2018			

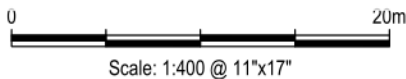
Q:\Vancouver\Engineering\131\Projects\ENG_VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 5] March 05, 2018 - 9:23:33 am (BY: KITCHINGMAN, ISAAC)



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LEGEND

- Current Extent of Slide Failure / Work Area
- Inferred Extent of Remediation Work



NOTES
Contours based on LIDAR information collected on February 2, 2018.
Survey data of the excavations and temporary road collected on February 16, 2018

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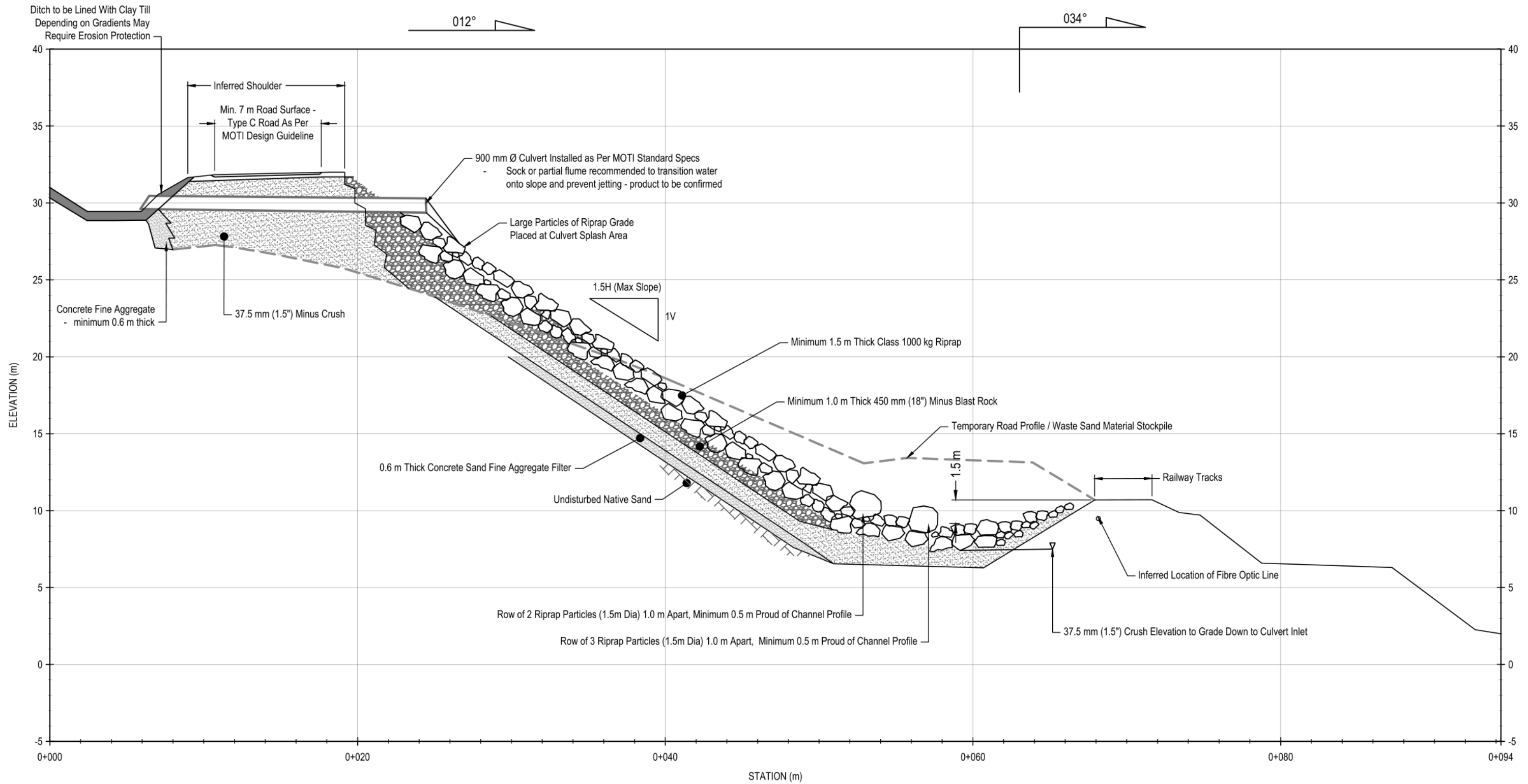
RUMMING ROAD FAILURE REMEDIATION
LANTZVILLE, BC

Slope Reconstruction Plan

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OFFICE Nanaimo	DATE March 5, 2018		

Figure 5

Q:\Vancouver\Engineering\131\Projects\ENG-VGEO03227-03 - Running Road Slide Remediation\Running Road Remediation.dwg [FIGURE 6] March 05, 2018 - 9:28:47 am (BY: KITCHINGMAN, ISAAC)



Failure CL

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LEGEND

- Ground Profile Post Failure Event - LiDAR Captured February 2, 2018
- Inferred Profile Prior to Failure Event
- Temporary Access Road / Current Construction Profiles
- 450 mm (18") Minus Blast Rock
- 37.5 mm (1.5") Minus Crush
- Concrete Sand Fine Aggregate
- Undisturbed Native Quadra Sand

0 10m
Scale: 1:250 @ 11"x17"



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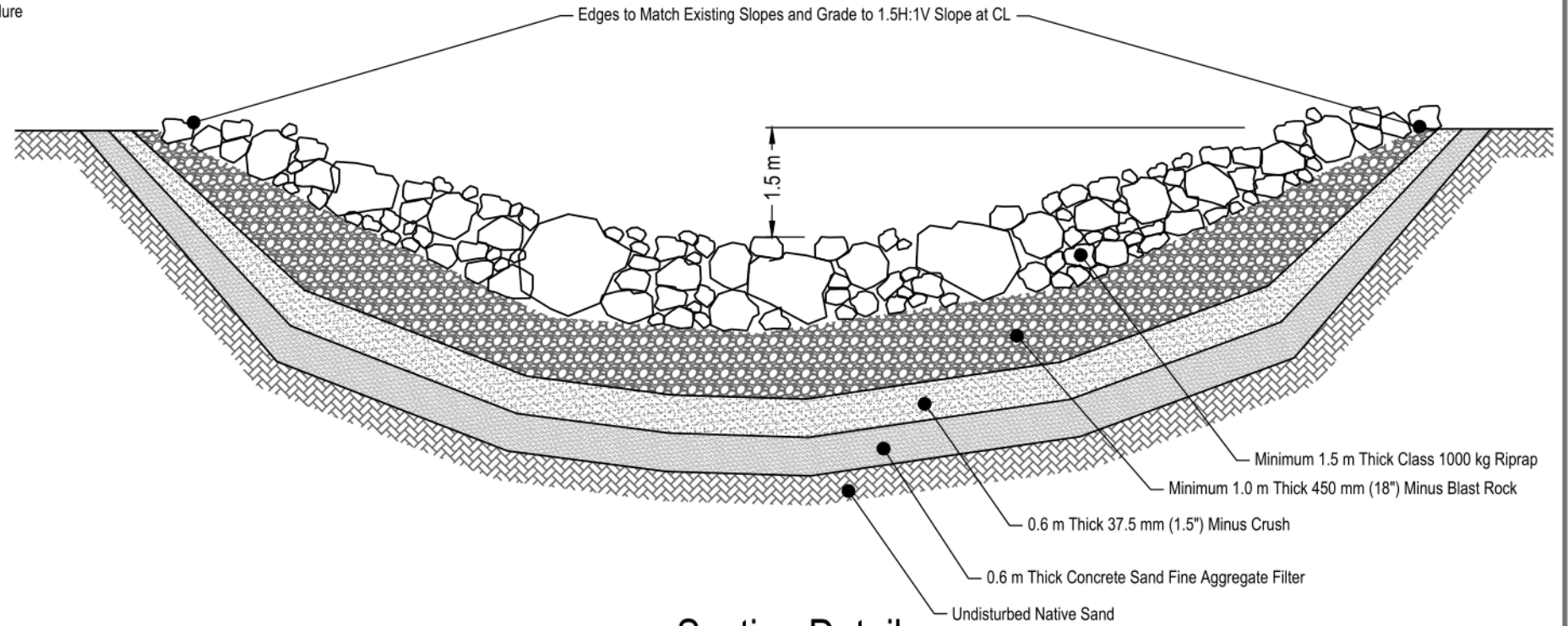
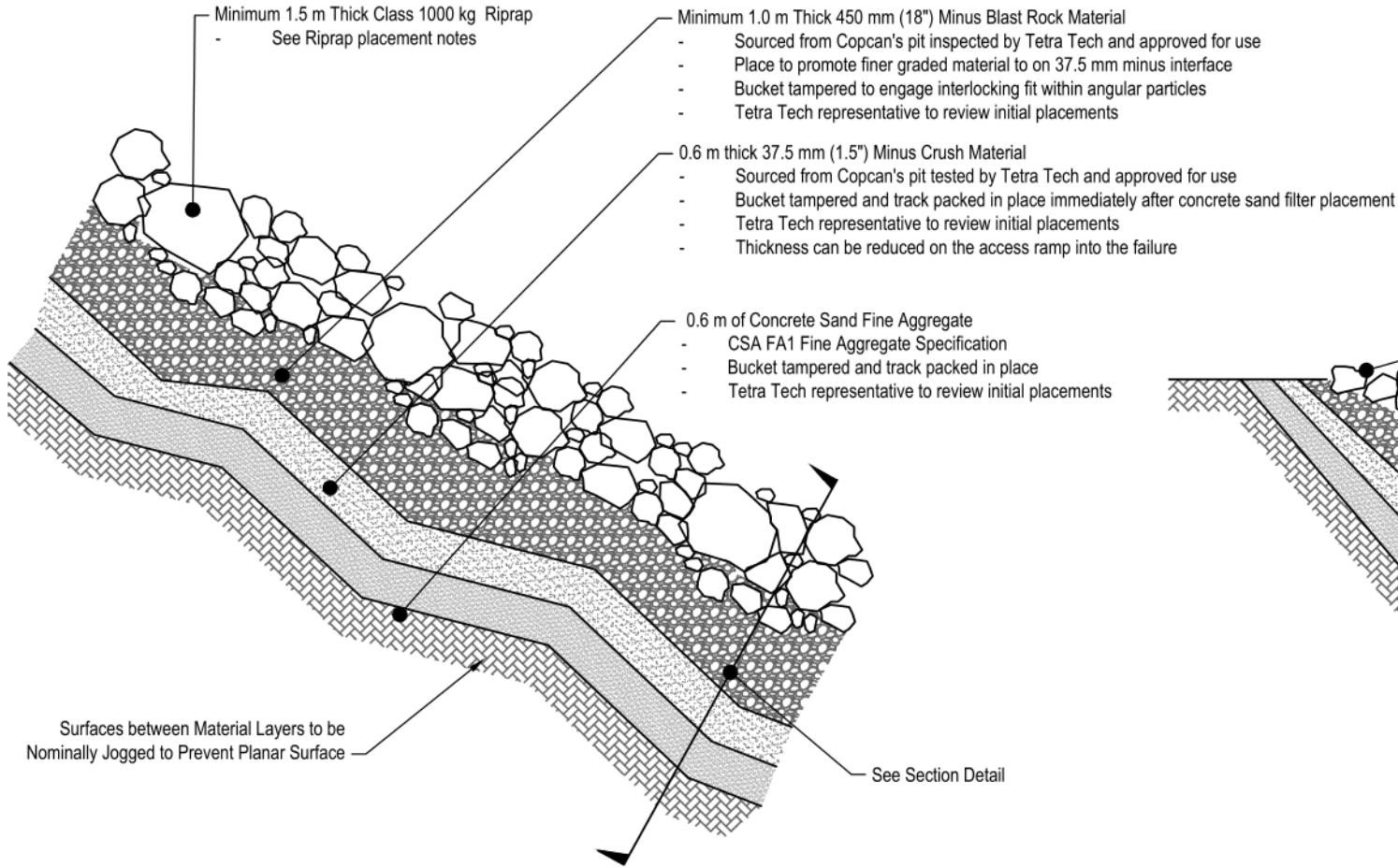
RUMMING ROAD FAILURE REMEDIATION
LANTZVILLE, BC

Slope Reconstruction Section
Through Upstream Culvert CL

PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0
OFFICE Nanaimo	DATE March 5, 2018		

Figure 6

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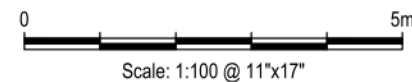


Section Detail

Riprap Notes:
All riprap including blast rock fill should be sourced and placed in accordance with BC MoTI Standard Specifications.
Voids should be kept to a minimum by particle orientation and use of smaller rocks in necessary.

ISSUED FOR USE

LEGEND	
	450 mm (18") Minus Blast Rock
	37.5 mm (1.5") Minus Crush
	Concrete Sand Fine Aggregate
	Undisturbed Native Quadra Sand



CLIENT

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RUMMING ROAD FAILURE REMEDIATION LANTZVILLE, BC				
Section Details				
PROJECT NO. VGEO03227-03	DWN IK	CKD AW	REV 0	Figure 7
OFFICE Nanaimo	DATE March 5, 2018			

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

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Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

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Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX B

FIELD REPORTS



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	001
Client:	Ministry of Transport and Infrastructure			Date:	February 5, 2018
Weather		Contractor: Onsite Rep:	Parksville Heavy Equipment John Christie	Tetra Tech Representative	Isaac Kitchingman (IK)
Light Rain	7 °C				

Site Activity and Observations:

0900 – IK onsite for review of progress.

- Contractor continuing to place filter sand and crush material for construction of the access down into the failure area;
- Excavator navigated to the western side of failure and began excavating a bench and sloping gravel fill above the native Quadra sand stratum creating a more stable sidewall;
- Loose sand material excavated from the base of the failure was being hauled out and stockpiled near the gully area between the highway and Rumming Road.
- Excavations within the failure were being advanced to expose the undisturbed Quadra sand.
- Filter sand was being placed to a thickness of ~2 m to 3 m with some bucket tampering and track packing taking place. Filter sand was placed part way up the side walls of failure as requested.
- 37.5 mm (1.5") minus crush was being placed up to 1 m thick as a travelling surface.
- 2 Lock blocks located on the east property had sloughed into the failure over the weekend. A tension crack was observed 1 m behind the last blocks left in place, some movement was evident and may slough further.
- Surveyors were visiting the site to complete daily checks on hydro pole.
- Sample of filter sand taken from site stockpile for sieve analysis.

0930 – IK left site

1200 – IK back to site as requested for discussions on trees

1230 – IK left site

Verbal discussions with site personnel:

- Discussions with John Christie regarding general progress. Also discussed the retaining wall lock blocks and for them to monitor with spotter and Tt will review if necessary to take down with excavator when work progress to a height that it can reach safely.
- Discussions with Jessica Learn regarding trees on eastern slope, most trees are greater than 3 m from edge of failure and could likely remain in place with the exception of some small arbutus which were planned for removal.
- General discussions with Ryan Gustafson regarding culvert and discharge options on the down slope outfall. Options to be considered by MOT and IK to discuss with Bob Patrick regarding possible effects to the remedial works currently ongoing. Not specifically in Tt's scope, however, some overlap with the remedial works will require drainage input from Tt.

Action Items:

- Contractor to continue to take photos during progress
- Tetra Tech to review the site daily and keep in discussion with MOT (Jessica Learn)
- Tt to complete sieve analysis of the filter sand and check vs the concrete fine aggregate envelope.

PHOTOGRAPHS



Photo 1: Excavator benching the gravel overburden on the west side of failure.



Photo 2: Filter sand being placed up sides of sand sidewalls on southern sidewall of failure.

PHOTOGRAPHS



Photo 3: Crush travel surface being placed and tamped above sand filter.



Photo 4: Several lock blocks had dislodged over the weekend and fallen into the failure. Several blocks remain and have distorted from original place. Tension crack visible behind the blocks.



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	002
February 6, 2018	Ministry of Transport and Infrastructure			Date:	February 6, 2018
Weather		Contractor:	Parksville Heavy Equipment	Tetra Tech Representative	Isaac Kitchingman (IK)
Cloud / Light Rain	7 °C				Onsite Rep:

Site Activity and Observations:

0900 – IK onsite for review of progress.

- Contractor continuing to excavate loose material from base of failure, moving material downstream to the toe.
- Continuing to place filter sand and crush material for access down into the failure area;
- Excavations were being advanced to expose the undisturbed Quadra sand. IK observed undisturbed base at time of visit and Contractor continuing to take photos during progress.
- Progress had moved to over midway down the slope.
- Lock blocks from east hadn't shown indications of further movement. Spotters to continue to monitor diligently.

0930 – IK left site

1415 – IK back to site with BP as requested for general review and discussions.

1500 – IK and BP left site

Verbal discussions with site personnel:

- Discussions with John Christie regarding general progress and placement of filter/travel surface.
- Discussions on the requirement of slope review and Geotechnical inspection report for WorkSafe will be required when work progresses down the slope.
- Preliminary discussions with Ms. Jessica Learn and the Contractor on the spillway option for the storm water drainage.

Action Items:

- Contractor to continue to take photos during progress
- Tetra Tech to review the site daily and keep in discussion with MOT (Jessica Learn).
- Contractor and Tt to monitor how the flanks of the slope perform as the excavation moves down in the toe.

PHOTOGRAPHS



Photo 1: Progress of the ramp and access to the toe of the failure.



Photo 2: Excavator just over halfway down the slope, continuing to excavate loose material and asphalt debris.

PHOTOGRAPHS



Photo 4: Excavation of loose material and asphalt to expose undisturbed subgrade reviewed, covered with sand filter. Progressed to over midway down slope.



Photo 3: Lock blocks on east flank to be monitored and reviewed as part of the spotter's checks as the excavators work within the failure.



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	003
Client:	Ministry of Transport and Infrastructure			Date:	February 7, 2018
Weather		Contractor:	Parksville Heavy Equipment John Christie (JC) Jessica Learn (JL)	Tetra Tech Representatives	Isaac Kitchingman (IK) Bob Patrick, P.Eng. (BP)
Cloud / Light Rain	7 °C	Onsite Rep:			
		MOTI Rep:			

Site Activity and Observations:

0900 – IK onsite for review of progress.

- Contractor continuing to place filter sand and crush material for access road down into the failure area;
- Excavator removing loose material had progressed to the bottom of the failure near the railway tracks and was stockpiling material at the base for later removal;
- Lock blocks on the eastern property were still in place and had not appeared to have moved since yesterday. Tension crack had not obvious change in significance.
- Excavated sand material was being stockpiled near the existing culvert under Rumming Road and is likely going to be used as infill of the gulley area between the highway and Rumming Road.
- Filter sand was being placed to a thickness of ~2 m to 3 m with bucket tampering and track packing taking place. Filter sand was placed part way up the side walls of failure as requested.
- 37.5 mm minus crush was being placed up to 1 m thick as a travelling surface.
- IK walked around and down to the bottom area and reviewed the excavations near the toe. Width of failure had tapered to approximately 2 bucket widths (~3 m). Excavations to undisturbed ground were approximately 2 m deep compared to the original ground surface, sidewall height. Native ground appears to be compact to dense Quadra sands.

0945 – IK left site

1420 – IK and BP back to site as requested due to sloughing of western slope near the toe;

- Excavator at toe of failure was excavating loose material from the western side of slope. Tension cracked appeared ~3 m upslope from his excavation. As he was cleaning out the toe, the slope sloughed in and filled the cleaned out excavation.
- IK and BP reviewed slope for further signs of movement. No visible tension cracks were evident and slope appeared to be stable under the existing conditions.
- Contractor to continue preparing toe for sand filter and crush travel surface. Contractor to build ramp and being hauling stockpiled sand material from the toe of failure.

1600 – IK and BP left site

Verbal discussions with site personnel:

- Discussions with Mr. John Christie (JC) regarding general progress. Discussed the toe of failure and that the Tt will design the buttress and toe for field fit once the area has been cleared.
- Discussed with Ernie (excavator operator) regarding the cleanout of the toe area. No glacial till encountered.
- Discussions with Contractor regarding the sloughing on the western side of the toe excavations (western flank). Contractor indicated that there was an old log dump and buried wood waste was encountered which they began to remove. As it was removed, the slope lost support and began sloughing into the excavation. Discussed with the contractor that continued excavation of the toe may result in additional sloughing and failure of the slope above. Contractor to clean out and shore up face with sand and crush material as soon as possible so to stabilize the slope. Spotters to monitor any tree movement and or review slope for tension cracks as work progresses.
- Discussed with Ms. Jessica Learn (JL) regarding the sloughing that had occurred and general progress and updates from our observations. JL indicated the stormwater drainage from the south side of the highway is being diverted east on the south side of

the Highway and therefore will not enter the failure area. MOT will be coordinating that work and will be organizing grouting and decommissioning of the existing culverts.

Action Items:

- Sieve analysis from the sample of concrete fine aggregate taken met specifications
- MOT to provide LiDAR data to Tt for review and use for designing the slope remediation.
- BP to provide follow-up inspection report for the new slopes and working areas.
- Tt to review toe subgrade and develop plan for toe stability and buttress requirement.

PHOTOGRAPHS



Photo 1: Excavator at toe continuing to stockpile loose material and sort wood debris, asphalt and sand.



Photo 2: Looking west, mid-slope of the failure area.

PHOTOGRAPHS



Photo 3: Excavations at the toe steepening due to depth of excavations to find undisturbed ground



Photo 4: Looking down at the toe cleanup after sloughing of the western flank had occurred

PHOTOGRAPHS



Photo 5: Sand being moved down the failure to cover the cleaned up toe excavations and help shore up the recent sloughing.



Photo 6: Cleaned up face of sloughed area.



PROJECT:	Rumming Road Slide Remediation	Tetra Tech Project.	VGE003227-03			
Location:	Rumming Road, Lantzville, BC	Report No.	004			
Client:	Ministry of Transport and Infrastructure	Date:	February 8, 2018			
Weather		Tetra Tech Representative	Isaac Kitchingman (IK) Bob Patrick, P.Eng. (BP)			
Cloud	8 °C					
Contractor:	Parksville Heavy Equipment					
Onsite Rep:	John Christie (JC)					
MOTI Rep:	Ms. Jessica Learn (JL)					
Site Activity and Observations: 0900 – IK onsite for review of progress. <ul style="list-style-type: none"> Contractor continuing to place filter sand and crush material for access road down into the failure area. Sand being placed up against western flank failure from yesterday; IK gave JC an updated slope inspection report issued by BP; Western slope appeared stable and no obvious signs of deformation observed; At the top of the eastern flank, near the hydro pole, small tension cracks have developed and slope may experience some sloughing in the near term. Spotter to monitor and keep away from edge when observing the work progress. Gully area on Rumming Road being infilled with waste sand material. 0945 – IK left site 1600 – IK called Jessica Learn as an update on work progress.						
Verbal discussions with site personnel: <ul style="list-style-type: none"> Discussions with Mr. John Christie (JC) regarding general progress. Work was progressing and filter placement and crush was being installed as discussed. Spotter to monitor the flanks for tension cracks and movement on an ongoing basis. Discussions with Ms. Jessica Learn, she had observed the tension cracks on the eastern flank, west of the hydro pole. Crews to monitor and check. Some sloughing may occur but unlikely to experience large failure. 						
Action Items and Future Work Plans: <ul style="list-style-type: none"> Tt to develop slope reconstruction and buttress plans. Once toe and western flank have had sand filter and crush cover placed, Contractor planning to develop access grade and haul sand material from toe of failure and place in the gully area over the next 7 to 10 days. 						

PHOTOGRAPHS



Photo 1: Excavator at toe continuing to stockpile loose material and clean out toe.



Photo 2: Tension crack behind lock block retaining wall on the east property.

PHOTOGRAPHS



Photo 3: Contractor continuing to build up sand filter and crush material to help support existing sidewalls.



Photo 4: Sand filter material placed against southern (upstream) face of the failure. Generally greater than 0.6 m thick under the excess crush.



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	005
Client:	Ministry of Transport and Infrastructure			Date:	February 9, 2018
Weather		Contractor: Onsite Rep: MOT Rep:	Parksville Heavy Equipment John Christie (JC) Jessica Learn (JL)	Tetra Tech Representatives:	Isaac Kitchingman (IK)
Cloudy Light Rain	6 °C				

Site Activity and Observations:

800 – IK onsite for review of sloughed slopes as requested by JL.

- Eastern slope had sloughed in, near the shoulder of the access ramp, west of the hydro pole. Estimated that 1 m of horizontal ground had been lost.
- Material had sloughed and come to rest at the base of slope shoulder, providing some support to the toe of the shoulder.
- Lock block retaining wall had not shown obvious sign of movement. Surveyors were coming to site to take readings of checkpoints, including checking the hydro pole for movement.
- Wooden section of eastern properties retaining wall appears to be close to failure. Bowing of timber whalers were bowing and wood appeared to be decaying. Small trees in front of wall likely providing some support. Photos taken.
- Excavator working at the base of failure was starting to stockpile the waste material and organizing the toe to accept the articulated truck for hauling. Anticipated for next week.
- Western flank still could have additional support placed at the toe of the recent sloughing that had occurred.

0945 – IK left site

Verbal discussions with site personnel:

- Discussions with Mr. John Christie (JC) and Ernie (Excavator Operator) regarding general progress and forecasted work plan.
- Discussed with JC and JL regarding the sloughing that occurred this morning. Sloughed material is not in the way of current workings, and it is providing some support of the above slope which could be left alone. Barricade should be set up to prevent workers or site visitors from getting too close to the edge and triggering further sloughing. Discussed that the side should be monitored for additional tension cracks as work progresses. Some further sloughing may occur from the eastern shoulder. The lock blocks are currently helping retain some of the soils that would likely slough in if blocks removed, and that area is to be closely monitored by spotters.

Action Items and Future Work Plans:

- Tt to develop slope reconstruction and buttress plans.
- Contractor planning to develop access road grade and haul sand material from toe of failure and place in gully over the next 7 to 10 days. Tetra Tech and MOT to review the toe area once sand pile removed and determining where the toe of slope should be developed from/possible key in details.

PHOTOGRAPHS



Photo 1: Sloughing on eastern shoulder of the failure sloughed into the work area. Approximately 1 m of horizontal ground was lost.



Photo 2: Tension crack behind lock block retaining wall on the east property.

PHOTOGRAPHS



Photo 3: Lock block retaining wall on eastern property.



Photo 4: Fill material behind retaining wall obvious in section. Sloughing that occurred shown in right of image.

PHOTOGRAPHS



Photo 5: Sloughing that occurred in the morning. ~ 1 m lost on the western side of the hydro pole.



Photo 6: Progress of the access road down to the toe of failure.



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	006
Client:	Ministry of Transport and Infrastructure			Date:	February 15, 2018
Weather		Contractor:	Parksville Heavy Equipment John Christie (JC) Jessica Learn (JL)	Tetra Tech Representatives:	Isaac Kitchingman (IK) Andrew Walker (AW)
Cloudy	9 °C	Onsite Rep:			
		MOT Rep:			

Site Activity and Observations:

IK briefly visited the site on February 13th and 14th to review progress. Contractor was continuing to haul sand material from the base of failure and place it in the gully area on Rumming Road. Discussions with JL indicated that MOTI and Lantzville had moved away from the plan of diverting the drainage on the south side (high side) of the highway further east, and has now changed to having it be diverted down the reconstructed slope.

1145 – IK and AW onsite to review progress and plan for the design of the drainage requirements to the slope rebuild.

- Contractor was still cleaning up the base of the failure. Wristed bucket excavator was at the base excavating the sand that had flowed into the ditching south of the railway tracks.
- Ditching had been excavated along the western side to approximately 3.5 m at its deepest point, reestablishing the original ground.
- Access ramp for the articulated rock truck had been constructed at approximately 20 degrees.

Verbal discussions with site personnel:

- Discussions with Mr. John Christie (JC) and Ernie (Excavator Operator) regarding general progress and forecasted work plan. The excavation and clean-up of the ditch needs to be reviewed to make sure the low point is at the base of the slope. Discussions with wristed bucket excavator operator. Excavations from cleaning the ditch indicate that it was all waste sand with some organics near the base. Did not appear that over excavation had occurred
- Discussed with JC and Ernie that some stumps and possible tree removal on the east side will be required to develop the toe of the slope reconstruction on the east side.
- Discussed with JC and JL regarding possible personnel access down the ramp, AW will provide inspection report to allow workers to walk up and down centre line under certain conditions.
- Discussed the general drainage idea from the MOT and contractor. Property owner has signed easement with MOT to allow the culvert to discharge down the slope.
- MOTI and has elected to have a 900 mm culvert beneath Rumming Road, and a 900 mm culvert beneath the railway lines. MOTI has notified DFO of the outlet works to the ocean.

Action Items and Future Work Plans:

- Survey crew to pick up new extent of failure/excavated area, gravel ramp, and exposed ditching to date to assist in geometric modelling of slope reconstruction design. IK to discuss with surveys when onsite tomorrow.
- Tt to develop slope reconstruction incorporating the drainage requirements of the new culvert designs (by MOTI).
- Contractor planning to develop access road grade and haul sand material from toe of failure and place in gully over the next few days. Could be ready to start culvert construction from the ocean side, under railway next week.

PHOTOGRAPHS



Photo 1: Continued progress on the removal of the waste material from the bottom of the failure.



Photo 2: Cleaned out ditch towards the west from the bottom of the failure. Bottom of ditch appears ~3.5 m deep from top of railway.

PHOTOGRAPHS



Photo 3: View from inside the ditch. Looking west.



Photo 4: View looking up the failure. Some additional work to clean out the eastern toe will be required to help buttress the slope.

PHOTOGRAPHS



Photo 5: Slope inclinometer image indicating the access ramp is approximately 20 degrees.



Photo 6: View looking down the slope failure.



PROJECT:	Rumming Road Slide Remediation			Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC			Report No.	007
Client:	Ministry of Transport and Infrastructure			Date:	February 16, 2018
Weather		Contractor: Onsite Rep: MOT Rep:	Parksville Heavy Equipment John Christie (JC) Jessica Learn (JL), Ryan Gustafson (RG)	Tetra Tech Representatives:	Isaac Kitchingman (IK) Andrew Walker (AW)
Sunny	9 °C				

Site Activity and Observations:

0815– IK and AW onsite to discuss drainage with RG

- Ongoing hauling of sand material from the base of the excavation.
- Tree feller onsite to review additional trees in construction area.
- Slide alignment bias to the west side may require additional excavations on the east side to develop slope buttress.
- West shoulder of the slope may require some additional excavation to create better drainage pathway.

0920 – IK and AW left site

Verbal discussions with site personnel:

- General discussions with RG regarding his ideas on finished geometry requirements. Slope to tie into the top as close to the road as possible to keep a 1.5H:1V slope toe close to the existing toe. Eastern property with retaining wall will likely lose some ground due to the precarious detainment on the over steepened slope. Field fit work will be required to stabilize the area.
- Discussed with RG regarding the drainage elements outside of the slope reconstruction area. RG will provide guidance to the contractor on the Railway culvert, ocean outfall, upstream ditching and Rumming road culvert specs and, highway crossing. Tt to provide assistance and comments when requested and work plan budget allows.
- Discussed with surveyor regarding the pickup point of the new extent of failure/excavated area, gravel ramp, and exposed ditching to date.
- Discussions regarding the trees identified at the toe of slope, 1 stump and adjacent tree will likely be removed, and the maple tree on the west can be worked around at this point. Could be reviewed in geometry of slope requires its removal.
- Discussions with RG and JC regarding project timelines, majority of next week will involve hauling the sand material from the base of slope.

Action Items and Future Work Plans:

- Surveyors to provide updated surface from today's pick up points.
- Tt to have slope design IFR drawings early next week for review with MOTI and aim to have IFC drawings by end of next week.

PHOTOGRAPHS



Photo 1: Looking down slope of the area that will require additional excavation to shore up upper areas of the slope. Stump to be removed and tree shown on right will likely be removed.



Photo 2: Looking east at the same area to be developed for slope reconstruction stability.



PROJECT:	Rumming Road Slide Remediation	Tetra Tech Project.	VGEO03227-03			
Location:	Rumming Road, Lantzville, BC	Report No.	008			
Client:	Ministry of Transport and Infrastructure	Date:	February 27, 2018			
Weather		Tetra Tech Representatives:	Isaac Kitchingman (IK) Andrew Walker (AW)			
Cloudy	8 °C					
Contractor:	Parksville Heavy Equipment					
Onsite Rep:	John Christie (JC)					
MOT Rep:	Jessica Learn (JL)					
Site Activity and Observations: 1015– IK onsite to review progress and attend meeting with railway representatives <ul style="list-style-type: none"> ▪ Ongoing hauling of sand material from the base of the excavation. ▪ Crush material being backhauled to the base of excavation. ▪ The ditch lines to the east and west had been grubbed to ground levels pre failure 1045 – Testpit completed between the railway tracks and the toe of slope. <ul style="list-style-type: none"> ▪ Testpit exposed colluvial material had accumulated at the toe. Several layers of organic horizons were observed indicating previous ground surfaces. Native undisturbed material was not encountered to the end of testpit completed to approximately 3.5 m 1130 – IK left site 1430 – IK and AW onsite for meetings and discussions with contractor and site personnel						
Verbal discussions with site personnel: <ul style="list-style-type: none"> - General discussions with contractor regarding progress of the remediation. - Discussions with Jessica Learn and the Contractor regarding the drainage from the toe of slope to the seaward outfall. MoTI is going to oversee that area of the project, however Tetra Tech's input is that the toe needs to have positive drainage down to the inlet point and so the inlet elevation should be at such this can be maintained. - Discussions with the contractor in regards to working around the trees and identifying possible removals. - Discussed that the previously deposited sand at the base of slope does not need to be taken down to undisturbed native ground. 						
Action Items and Future Work Plans: <ul style="list-style-type: none"> - Tt to continue developing construction drawings to suit rebuild objectives. 						

PHOTOGRAPHS



Photo 1: Looking down slope of the area that will require additional excavation to shore up upper areas of the slope. Stump to be removed and tree shown on right may need to be removed, however reconstruction will try work around.



Photo 2: Testpit conducted at the toe of slope. Intermediate topsoil horizons indicating historic layering of colluvial deposits. Loose sand encountered through to end of testpit at a termination depth of 3.5 m.



PROJECT:	Rumming Road Slide Remediation		Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC		Report No.	009
Client:	Ministry of Transport and Infrastructure		Date:	March 20, 2018
Weather		Contractor:	Tetra Tech Representative:	Andrew Walker (AW)
Variable, raining to sunny	2°C to 15°C	Onsite Rep:		
		MOT Rep:		

Site Activity and Observations (March 1 and 2, 2018):

- Hauling and excavation of sand material from the base of the excavation completed.
- Crush material being backhauled and placed along the base of excavation.
- Crush material being compacted by a walk behind plate tamper.
- Rip rap boulders inspected and found to be suitable for use by Tetra Tech.
- Railway tracks removed, preparation for culvert crossing tracks.

Site Activity and Observations (March 12 to 16, 2018):

- Final construction drawings provided on March 12, 2018 to the Contractor and MoTI.
- 900 mm diameter culvert crossing railway tracks completed in previous week (March 5-9, 2018). Outfall and inlet constructed using rip rap and clean angular cobbles.
- Low point in base ditch constructed at inlet of culvert crossing tracks, a swale running parallel to the tracks was formed in the crush at the base so that all drainage is directed to the culvert inlet.
- Clean angular cobbles placed at west and east ends of base, overlying crush in areas where rip rap is not placed.
- Clean cobbles placed in water collection pool at culvert inlet, surrounded by riprap.
- Rip rap placed along base over angular swale. Completion of base on March 16, 2018, starting to place 18" minus (blast rock fill) material along to toe of the slope to transition up the slope.
- A swale parallel to the slope was formed out of the crush to encourage drainage towards the seaward outfall.

Verbal discussions with site personnel:

- General discussions with contractor regarding progress of the remediation.
- Discussions with Jessica Learn and the Contractor regarding the drainage from the toe of slope to the seaward outfall. From visual observations, the swale along the base would encourage positive drainage. Drainage along the slope is to be encouraged to the seaward outfall.
- Discussions with the contractor in regard to working around the trees and identifying possible removals. The 'eagle perch' tree was generally avoided as much as possible.
- Segregation of the 18" minus was discussed with the Contractor. The operators said that they would mix and avoid segregation as much as possible.

Action Items and Future Work Plans:

- Tetra Tech to continue monitoring and working with the Contractor and MoTI to reconstruct the slope in accordance with the design drawings. Field fits are being utilized and noted when necessary.

PHOTOGRAPHS



Photo 1: Looking east along the base of the slope at crush being placed and compacted.



Photo 2: Photo of angular riprap inspected and approved prior to use.



Photo 3: Inlet side of seaward outfall.



Photo 4: Outlet side of seaward outfall.



Photo 5: Complete collection pool at seaward outfall.



Photo 6: Completed riprap along base. Next step is importing and placing blast rock fill as the construction moves up the slope.



PROJECT:	Rumming Road Failure Remediation	Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC	Report No.	010
Client:	Ministry of Transport and Infrastructure	Date:	March 23, 2018
Contractor:	Parksville Heavy Equipment	Tetra Tech Representative:	Andrew Walker (AW) Isaac Kitchingman (IK)
Onsite Rep:	John Christie (JC)		
MOT Rep:	Jessica Learn (JL)		

Site Activity and Observations (March 19 to 23, 2018):

- Contractor grading 18" blast rock material and placing riprap particles on slope;
- Labourer working on slope, hand placing smaller rock particles on the riprap face;

March 21

- Western shoulder of the slope had not been cut as indicated on the drawings – discussed with Parksville Heavy equipment

March 22

- Observed the placement of the 18" blast rock. Contractor was mixing the material during placement to help mitigate segregation that may have occurred during hauling / dumping.
- Excavator operators were creating a swale surface prior to riprap placement as indicated on the drawings. Excavator would then track pack it as best as possible on the slope and regrade as necessary.

March 23

- Riprap was being placed and fitted into the slope. Some areas to the west looked slightly overbuilt from design drawings but geometry was field fit to transition into adjacent slope.
- Riprap has been placed around the large Fir trees on the eastern side near the toe.

Verbal discussions with site personnel:

- General discussions with contractor regarding progress of the remediation.
- Discussions with the contractor regards to trimming the western shoulder of the failure as indicated on the drawings. Contract indicated they will do this once the slope is rebuilt to that point.
- Discussed with the contractor the geometry of the slope. As the slope developed they need to keep control of the grades to check they are generally in line with the design and that the slope will conform to a 1.5H:1V with a swale. Riprap will need to start tightening up to promote water running on the surface rather than straight through as they work their way to the culvert outfall.

Action Items and Future Work Plans:

- Tetra Tech to continue monitoring and working with the Contractor and MoTI to reconstruct the slope in accordance with the design drawings. Field fits are being utilized and noted when necessary.

PHOTOGRAPHS



Photo 1: March 19, 2018. Looking down slope at the 18" blast rock placed



Photo 2: March 20, Excavator track packing the 18" blast rock material.



Photo 3: March 21, 2018. View looking upslope at the progress. Slope appears slightly overbuilt from designed slope. Field fit adjustments and ease of track packing contributing to overbuilt.



Photo 4: March 22, 2018. Looking upslope at riprap placement progress.



Photo 5: March 23, 2018. View looking at the west side.



Photo 6: March 23, 2018. View looking downslope of the failure reconstruction progress. 18" Blast rock being mixed and track packed before graded to have swale surface.



PROJECT:	Rumming Road Failure Remediation	Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC	Report No.	011
Client:	Ministry of Transport and Infrastructure	Date:	March 29, 2018
Contractor:	Parksville Heavy Equipment	Tetra Tech Representative:	Andrew Walker (AW)
Onsite Rep:	John Christie (JC)		Isaac Kitchingman (IK)
MOT Rep:	Jessica Learn (JL)		

Site Activity and Observations (March 26 to 29 2018):

March 26

- Contractor continuing to place 18" blast rock and riprap
- Discussions with RG, JL and JC regarding the eastern property retaining wall as to how it will be remediated.

March 27

- Contractor was working on the area immediately upslope of the two large firs on the eastern side of the failure. Large particles were placed to help support the existing slope and create stable area to place filter layers. IK and AW went through the anticipated work on the upper east area with the lock block retaining wall.

Verbal discussions with site personnel:

- General discussions with contractor regarding progress of the remediation.
- Discussions with the contractor regards to trimming the eastern shoulder of the failure. Failing lock block retaining wall will need to be removed and trimmed back where oversteepened fill exists. In addition, some trimming on the failure sidewalls should be completed to allow for better placement of the granular filter layers and more secure rock placement. JL was going to discuss with the land owner and Tetra Tech is to be onsite when the area is going to be addressed by the contractor.
- Discussed with the contractor the geometry of the slope. As the slope developed they need to keep control of the grades to check they are generally in line with the design and that the slope will conform to a 1.5H:1V with a swale. Riprap will need to start tightening up to promote water running on the surface rather than straight through as they work their way to the culvert outfall.
- Reinforced the importance of developing the swale with all granular layers and that they rise in grade as they transition into the adjacent native slopes thus promoting water to flow in the center of the reconstructed slope.

Action Items and Future Work Plans:

PHOTOGRAPHS



Photo 1: March 19, 2018. Looking down slope at the 18" blast rock placed



Photo 2: March 20, Excavator track packing the 18" blast rock material.



Photo 3: March 21, 2018. View looking upslope at the progress. Slope appears slightly overbuilt from designed slope. Field fit adjustments and ease of track packing contributing to overbuilt.



Photo 4: March 22, 2018. Looking upslope at riprap placement progress.



Photo 5: March 23, 2018. View looking at the west side.



Photo 6: March 23, 2018. View looking downslope of the failure reconstruction progress. 18" Blast rock being mixed and track packed before graded to have swale surface.



PROJECT:	Rumming Road Failure Remediation	Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC	Report No.	012
Client:	Ministry of Transport and Infrastructure	Date:	April 6, 2018
Contractor:	Parksville Heavy Equipment	Tetra Tech Representative:	Andrew Walker (AW) Isaac Kitchingman (IK)
Onsite Rep:	John Christie (JC)		
MOT Rep:	Jessica Learn (JL) - away		

Site Activity and Observations (April 3 to April 6, 2018):**April 3**

- Contractor continuing to place 18" blast rock and riprap slope reconstruction in general accordance with the design.
- Granular filter layers were being placed up the sides of the newly shaped shoulders.
- Discussions with JC to maintain and promote swale like shape in the rebuild, swale to match alignment of proposed culvert. Culvert alignment was roughly marked out and some survey elevations to establish preliminary invert levels were also marked.

April 4

- Contractor continuing to place 18" blast rock and riprap and rebuild the slope in general accordance with design

April 5

- Contractor continuing to place 18" blast rock and riprap to form the swale slope. 3" clear blast rock and 18" blast rock were being scattered within the swale for hand placement and filling of voids.
- 1.5" crush was being hauled and placed to bring up grades to the culvert invert level.
- Geotextile was placed around the corner of the wooden retaining wall to help support the fill area of the eastern property.

April 6

- 1.5" crush was being hauled and placed to bring up road grade to the culvert level.
- Material was being track packed in the lower lifts – rolling packer delivered to site to complete compaction under the road prism.
- Contractor continued to haul crush material and compact in ~0.3 m lifts

Verbal discussions with site personnel:

- General discussions with contractor regarding progress of the remediation.
- Discussions with the contractor regards to placing smaller blast rock and drain rock to help fill voids within the riprap slope, especially in the swale area downstream of the culvert outlet. Contractor to hand place particles to help promote water to travel along the surface as far down the slope as reasonably possible.
- Discussed with the contractor that when constructing the eastern property corner, the base area should be graded to provide a back sloped subgrade to place riprap particles up to the wooden retaining wall. Large tabular particles should be set aside for use in constructing this area. Tetra Tech to be onsite when this construction is occurring.

Action Items and Future Work Plans:

- Contractor to continue placing crush material beneath the road prism and bring up grades to the culvert invert. Culvert is planned to be installed next week as well as the last several meters of the riprap slope.
- Tetra Tech to be onsite to review the construction of the area of the eastern property and wooden retaining wall.

PHOTOGRAPHS



Photo 1: April 3, 2018. Looking down slope riprap construction and the recently removed lock block wall area.



Photo 2: April 4, 2018, Swale being developed in the riprap subsequent granular layers.



Photo 3: April 5, 2018. 1.5" crush hauled in to build up grades within the road prism.



Photo 4: April 5, 2018. Geotextile place along eastern property cut and retaining wall area.



Photo 5: April 6, 2018. Area near the wooden retaining wall that requires some back sloping to provide base for tabular rocks to build up area.



Photo 6: April 6, 2018. Packer at site to complete compaction of the road rebuild area. Lifts being placed at approximately 0.3 m.



PROJECT:	Rumming Road Failure Remediation	Tetra Tech Project.	VGEO03227-03
Location:	Rumming Road, Lantzville, BC	Report No.	013
Client:	Ministry of Transport and Infrastructure	Date:	April 13, 2018
Contractor:	Parksville Heavy Equipment	Tetra Tech Representative:	Andrew Walker (AW) Isaac Kitchingman (IK)
Onsite Rep:	John Christie (JC)		
MOT Rep:	Jessica Learn (JL) – Bryce Pirozzini		

Site Activity and Observations (April 9 to April 13 2018):**April 9**

- Contractor continuing to place 1.5" crush under road prism and building up grades to crown of culvert level. Compaction being completed using a 13-ton packer. Contractor indicated they would spend about 1.5 hrs packing each lift going over areas a minimum of 6-8 passes.

April 10

- Rocks placed at culvert outfall. Large flat tabular particles placed in a step formation below culvert outfall. Smaller drain rock also stockpiled within spillway area to help fill voids between riprap particles – yet to be infilled.
- Culvert trench excavated and placement of the sections was being completed at a grade of approximately 1.5%. Haunches of the pipe were compacted using bar and jumping jack. Diesel plate packer (1000 lb) was also being used once backfilled above pipe springline.

April 11

- Culvert placement completed across to the south side of Rumming Road. Contractor continuing to raise grade with 1.5" crush and finishing the slope reconstruction. Contractor planning to change material to 19 mm (3/4") minus crush to bring road grade up to pavement level.
- Elongated tabular riprap particles were onsite for use in rebuilding the eastern property corner/retaining wall area.

April 13

- Road structure was in final stages of reconstruction to finished pavement level using 19 mm crush.
- Riprap slope was completed to finished geometry, including the eastern property corner. Riprap was placed snug to the existing timber retaining structure and area was capped with existing granular fill and 19 mm crush.

Verbal discussions with site personnel:

- General discussions with contractor regarding progress of the remediation.
- Discussions with the contractor in regards to the ditch lining design requirement along the south side of Rumming Road. Clay material proving difficult to source for the contractor and they suggested using a geotextile (Armtek 250) lined with drain rock. Specifications were reviewed and permeability is too high for what is desired by this design element. Discussions with RG regarding ditch lining and that it may be delayed until an adequate source of material is available. Synthetic liner option was also discussed however, maintenance procedures would likely damage any membrane.
- Smaller rock particles and stockpiled within spillway still require proper hand placement and leveling out to leave channel like swale.
- Discussed the sump area that is currently rising with rainfall. Contractor to monitor and work with MoTI to have contingency to pump and remove the water – especially with forecasted rainfall over the weekend.

Action Items and Future Work Plans:

- Contractor planning to place culvert through Highway 19 on Sunday and Monday night shifts.
- Asphalt paving of Rumming Road likely delayed until later until summer – will allow for the new construction to settle.
- Tetra Tech to complete a final observation of work scoped area and provide final construction summary report, which will include monitoring recommendations.

PHOTOGRAPHS



Photo 1: April 9, 2018. East at the slope reconstruction progress.



Photo 2: April 10, 2018. Culvert being placed in the Rumming Road reconstruction.



Photo 3: April 9, 2018. Culvert outfall area. Flat tabular particles placed to receive initial water discharge and dissipate water energy.



Photo 4: April 10, 2018. Sump area collecting stormwater from catchment areas. Contractor to monitor and reduce level as appropriate.



Photo 5: April 11, 2018. Placement and compaction of the pavement structure – Rumming Road.



Photo 6: April 13, 2018. View looking west at the final slope reconstruction grade. Existing granular fill being spread out to level out area and transition the new construction with existing grades.

APPENDIX C

SCHEDULE A – SUMMARY OF DESIGN AND FIELD REVIEW ASSIGNMENTS AND ASSURANCE OF FIELD REVIEWS AND COMPLIANCE



Note: This document is an attachment to the *Assurance of Professional Design & Commitment for Field Reviews* and *Assurance of Field Reviews and Compliance* forms.

Check the Yes or No boxes for each discipline to indicate responsibility for Field Reviews. If Yes, indicate which of the items apply by checking the box adjacent to the item, or provide an alternate means acceptable to the Ministry to clearly define the scope of the assignment and responsibilities.

Please note: To revise the descriptions or to add additional fields to accommodate specific responsibilities, the 'protection' of this form may be removed ("Review", "Protect Document", and click "Stop Protection" button). Then add more rows below and copy/paste with fields; then 'protect' the document again to recommence fill in.

1) CIVIL

Geographic Limits:

I am responsible for Field Reviews ☐ Yes ☐ No

<input type="checkbox"/> a) Highway and side road horizontal and vertical alignment geometry	<input type="checkbox"/> t) Geometric definition of structures and retaining wall primary alignments
<input type="checkbox"/> b) Road cross section templates	<input type="checkbox"/> u) Structural capacity of civil components
<input type="checkbox"/> c) Interchanges	<input type="checkbox"/> v) Site utilities including water mains, sanitary sewer, gas, electrical, ITS and telecommunications routing
<input type="checkbox"/> d) Intersections	<input type="checkbox"/> w) Site electrical and lighting systems
<input type="checkbox"/> e) Roadside design and clear zone	<input type="checkbox"/> x) Property acquisition concept
<input type="checkbox"/> f) Bicycle and pedestrian accommodation	<input type="checkbox"/> y) Traffic engineering
<input type="checkbox"/> g) Clearing and grubbing	<input type="checkbox"/> z) Detour geometrics
<input type="checkbox"/> h) Roadway and drainage excavation	<input type="checkbox"/> aa) Traffic management plan
<input type="checkbox"/> i) Earth excavation and embankments geometry	<input type="checkbox"/> bb) Guide signs
<input type="checkbox"/> j) Rock excavation and embankments geometry	<input type="checkbox"/> cc) Guide sign structures geometry
<input type="checkbox"/> k) Special slope treatment locations	<input type="checkbox"/> dd) Signing and pavement marking
<input type="checkbox"/> l) Earthworks quantities balance and mass haul	<input type="checkbox"/> ee) Noise wall structure
<input type="checkbox"/> m) Paving, granular surfacing, base and sub-bases geometry	<input type="checkbox"/> ff) Review of applicable shop drawings
<input type="checkbox"/> n) Quantity estimating	<input type="checkbox"/> gg)
<input type="checkbox"/> o) Construction staging concept	<input type="checkbox"/> hh)
<input type="checkbox"/> p) Storm drainage	<input type="checkbox"/> ii)
<input type="checkbox"/> q) River Engineering	<input type="checkbox"/> jj)
<input type="checkbox"/> r) Hydraulic Design of Major Crossings	<input type="checkbox"/> kk)
<input type="checkbox"/> s) Bridge Foundation Scour Design	<input type="checkbox"/> ll)

**SCHEDULE A – SUMMARY OF DESIGN
AND FIELD REVIEW ASSIGNMENTS**

2) STRUCTURAL

Geographic Limits or Components: _____

I am responsible for Field Reviews ☐ Yes ☐ No

<input type="checkbox"/> a) Structural design of bridges	<input type="checkbox"/> h) Verification of the satisfactory completion of an in-house check of the structural design
<input type="checkbox"/> b) Structural design of retaining walls	<input type="checkbox"/> j)
<input type="checkbox"/> c) Bridge seismic design	<input type="checkbox"/> k)
<input type="checkbox"/> d) Structural aspects of deep foundations	<input type="checkbox"/> j)
<input type="checkbox"/> e) Guide sign foundations	<input type="checkbox"/> k)
<input type="checkbox"/> f) Review of applicable shop drawings	<input type="checkbox"/> l)
<input type="checkbox"/> g) Structural aspects of unbonded post-tensioned concrete design and construction	<input type="checkbox"/> m)

3) ELECTRICAL

Geographic Limits: _____

I am responsible for Field Reviews ☐ Yes ☐ No

<input type="checkbox"/> a) Electrical systems and devices	<input type="checkbox"/> f)
<input type="checkbox"/> b) Electrical systems and devices maintenance manuals	<input type="checkbox"/> g)
<input type="checkbox"/> c) Structural capacity of electrical components, including anchorage and seismic restraint	<input type="checkbox"/> h)
<input type="checkbox"/> d) Clearances of all electrical utility equipment	<input type="checkbox"/> i)
<input type="checkbox"/> e) Review of applicable shop drawings	<input type="checkbox"/> j)

**SCHEDULE A – SUMMARY OF DESIGN
AND FIELD REVIEW ASSIGNMENTS**

4) ENVIRONMENTAL

Geographic Limits: _____

I am responsible for Field Reviews ☐ Yes ☐ No

<input type="checkbox"/> a) Environmental impact assessment	<input type="checkbox"/> h) Environmental regulatory process management
<input type="checkbox"/> b) Public Information process and management	<input type="checkbox"/> i) Environmental audits and site remediation
<input type="checkbox"/> c) Monitoring, assessment and abatement of environmental noise	<input type="checkbox"/> j)
<input type="checkbox"/> d) Monitoring, assessment and abatement of air quality	<input type="checkbox"/> k)
<input type="checkbox"/> e) Monitoring, assessment and abatement of water quality	<input type="checkbox"/> l)
<input type="checkbox"/> f) Monitoring, assessment and abatement of storm water management	<input type="checkbox"/> m)
<input type="checkbox"/> g) Environmental impact mitigation planning and implementation	<input type="checkbox"/> n)

5) GEOTECHNICAL — Temporary

Geographic Limits: Road Failure along Rumming Road, Lantzville, BC

I am responsible for Field Reviews ☒ Yes ☐ No

<input checked="" type="checkbox"/> a) Excavation	<input type="checkbox"/> e)
<input type="checkbox"/> b) Shoring	<input type="checkbox"/> f)
<input type="checkbox"/> c) Underpinning	<input type="checkbox"/> g)
<input type="checkbox"/> d) Temporary construction dewatering	<input type="checkbox"/> h)

GEOTECHNICAL — Permanent

Geographic Limits: Road Failure along Rumming Road, Lantzville, BC

I am responsible for Field Reviews ☒ Yes ☐ No

<input type="checkbox"/> i) Gravel and paving structure strength and lifecycle	<input type="checkbox"/> v) Rock excavation and embankments
<input type="checkbox"/> j) Pavement mix design	<input checked="" type="checkbox"/> w) Special slope treatment
<input type="checkbox"/> k) Borrow and aggregate materials sourcing	<input type="checkbox"/> x) Foundations
<input type="checkbox"/> l) Bearing capacity of the soil	<input checked="" type="checkbox"/> y) Soil earth structures
<input type="checkbox"/> m) anchorage and seismic restraint	<input type="checkbox"/> z) Retaining wall global stability

**SCHEDULE A – SUMMARY OF DESIGN
AND FIELD REVIEW ASSIGNMENTS**

<input type="checkbox"/> n) Geotechnical aspects of deep foundations	<input type="checkbox"/> aa) Seismic design of retaining walls
<input type="checkbox"/> o) Compaction of engineered fill	<input checked="" type="checkbox"/> bb) Placement of rock armouring and inspection of granular filter along remediated road failure zone
<input type="checkbox"/> p) Structural considerations of soil, including slope stability and seismic loading	<input type="checkbox"/> cc)
<input checked="" type="checkbox"/> q) Backfill	<input type="checkbox"/> dd)
<input type="checkbox"/> r) Permanent dewatering	<input type="checkbox"/> ee)
<input type="checkbox"/> s) Permanent underpinning	<input type="checkbox"/> ff)
<input type="checkbox"/> t) Granular surfacing, base and sub-bases	<input type="checkbox"/> gg)
<input type="checkbox"/> u) Earth excavation and embankments	<input type="checkbox"/> hh)

6) SAFETY AUDITOR: _____

I am responsible for Field Reviews ☐ Yes ☐ No

☐ a)

☐ c)

☐ b)

☐ d)

7) OTHER ENGINEERING SPECIALIZATION: _____

I am responsible for Field Reviews ☐ Yes ☐ No

☐ a)

☐ c)

☐ b)

☐ d)

8) OTHER ENGINEERING SPECIALIZATION: _____

I am responsible for Field Reviews ☐ Yes ☐ No

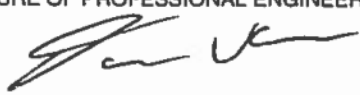

☐ a)

☐ c)

☐ b)

☐ d)

**SCHEDULE A – SUMMARY OF DESIGN
AND FIELD REVIEW ASSIGNMENTS**

SIGNATURE OF PROFESSIONAL ENGINEER 			
NAME OF PROFESSIONAL ENGINEER <i>(please print)</i> Andrew Walker		DATE SIGNED Y M D 2018 06 22	
ADDRESS <i>(please print)</i> 1 - 4376 Boban Drive, Nanaimo, BC V9T 6A7			
PHONE NO. 250-756-2256	FAX NO. 250-756-2686		

(If the Professional Engineer is a member of a firm, also complete the following sentence.)

I am a member of the firm of *(legal name)* Tetra Tech Canada Inc.
and I sign this document on behalf of the firm.

The Ministry concurs with this assignment of responsibilities and will ensure that the Field Reviews indicated above as not being the responsibility of the Registered Professional are performed.		
MINISTRY SIGNATURE	<u>Ryan Gustafson, P.Eng.</u> MINISTRY NAME <i>(please print)</i>	DATE
(Note: The Ministry's signatory will normally be the "Ministry Contact" assigned to oversee the EOR's contract.)		



PROJECT NO.	STRUCTURE NO.	DISTRICT	REGION
PROJECT/STRUCTURE NAME Rumming Road Erosion Event - Remediation			
LOCATION / DESCRIPTION Road Failure along Rumming Road, Lantzville, BC			

To: Ministry of Transportation and Infrastructure

Date: June 22, 2018

3rd Floor 2100 Labieux Road

Nanaimo, BC V9T 6E9

Attention: Ryan Gustafson, P.Eng.

I hereby give assurance that:

1. I am a Professional Engineer⁽¹⁾, registered or licensed to practice in British Columbia;
2. I have fulfilled my obligation for field reviews⁽²⁾ for this Project/Structure;
3. I have utilized the care, skill and diligence that, in accordance with the standards of my profession, are required of Professional Engineers performing field reviews in the Province of British Columbia; and
4. I hereby provide the assurance that those parts of the work for which I have the field review responsibility substantially comply with:
 - a. The design⁽³⁾, and
 - b. The applicable construction codes, standards, guidelines, and the Project/Structure specifications.

SIGNATURE OF PROFESSIONAL ENGINEER 		
NAME OF PROFESSIONAL ENGINEER (please print) Andrew Walker	DATE SIGNED Y M D 2018 06 22	
ADDRESS (please print) 1-4376 Boban Drive, Nanaimo, BC V9T 6A7		
PHONE NO. 250-756-2256	FAX NO. 250-756-2686	

(If the Professional Engineer is a member of a firm, also complete the following sentence.)

I am a member of the firm of (legal name) Tetra Tech Canada Inc.

and I sign this document on behalf of the firm.

⁽¹⁾ "Professional Engineer" means a person who is registered or licensed as a Professional Engineer under the *Engineers and Geoscientists Act*, and includes a limited licensee.

⁽²⁾ "field reviews" means such reviews of the construction at the project site (and/or the fabrication locations, where applicable) considered necessary by and at the discretion of the applicable Professional Engineer, and agreed to in writing by the Ministry.

⁽³⁾ the "design" means the compendium of drawings, plans, specifications and other like material produced by the designers to calculate, determine and define the items of work to be constructed.

NOTE: This form must be submitted to the Ministry of Transportation and Infrastructure in a timely manner after completion of the Project but before final acceptance by the Ministry of Transportation and Infrastructure is made. A separate signed copy of this form must be submitted by each Professional Engineer who has undertaken field reviews for this Project/Structure.