Terrain Hazard Assessment and Construction Inspection Report

May and Jennie Project

Fortynine Creek

Prepared For:
802213 Alberta Ltd
301 Mount Royal Place
Nanaimo, BC
V9R 6A4

Prepared By:
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July 5, 2018

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802213 Alberta Ltd
301 Mount Royal Place
Nanaimo, BC, V9R 6A4

Attn: Mr. Kelly Funk

Re: Terrain Stability Assessment and Reconstruction Inspection –May and Jennie Project – Fortynine Creek – Nelson, BC

Dear Sir:

This letter presents the findings of a Terrain Stability Assessment (TSA) and reconstruction inspection completed along an existing trail proposed to access a mineral claim to conduct exploration drilling and hauling samples off site. The site assessment was completed on May 31, 2018 by Mr. Evan Kleindienst, P.Eng. / RPF of VAST Resource Solutions (VAST) in the company of Mr. Jeff Berdusco, RPF, of Moose Mountain Technical Services (MMTS) and Mr. Kelly Funk, Mineral Claim holder. The reconstruction inspection was completed on June 26, 2018 by Mr. Evan Kleindienst in the company of Mr. Kelly Funk.

The existing trail was previously constructed approximately 100 years ago (exact time is unknown) for the purpose of mining. Several abandoned adits, rail tracks, ore piles, and lumber exist along the existing access trail. The existing trail is approximately 4 metres (m) or more wide.

It is understood the access trail(s) will be upgraded/reconstructed to a standard conducive for Utility Task Vehicles (UTV) / Side-by-Side (SxS) only and drill pad sites will be approximately 5 m by 5 m in dimension.

The study area is located within a slope stability class 4 (Potentially Unstable) terrain hazard mapped polygon.

The objectives of this assessment are:

- To evaluate potential influences of trail reconstruction/new trail construction, and or construction of drill pad sites on terrain stability;
- To characterize the terrain and existing hazards in the areas within or connected to the proposed operations;
- To classify the likelihood of occurrences for terrain stability concern, the probability of that occurrence reaching or otherwise affecting the element at risk and a partial risk assessment of the identified elements at risk, including worker and public safety; and
- To provide site-specific recommendations and options to manage potential slope instability and/or risks either to the operations or resulting from the operations, including addressing worker safety.

1.0 STUDY AREA

The study area is situated in the Selkirk Mountains approximately 8 Kilometres (km) southwest of the community of Nelson, British Columbia. The study area is accessed via the Fortynine Creek Forest Service Road (FSR).

The study area is located within the Interior Cedar Hemlock moist warm 4 (ICHmw4) Biogeoclimatic zone, subzone, and variant. The climate is intermediate between ICHdw and ICHmw2, which is moist with hot summers and mild winters with light snowfall. Snowpack depths are less than moderate depth and duration.

Figure 1: Location Map

2.0 METHODOLOGY

2.1 References

In this report, reference is made to iMapBC, soils maps, and geological maps. The terrain hazard report previously completed at Terrain Survey Intensity Level (TSIL) "D" for this area was not available at the time of writing this report

Information provided to the undersigned, from Mr. Berdusco, that was reviewed during this assessment include:

- Images of the existing trail requiring reconstruct/upgrades;
- Google Earth kmz file of the study area showing the existing trail proposed for access to the site and proposed new trail locations for exploratory/drill rig access; and
- A map showing the proposed access route and potential drilling locations.

2.2 Partial Risk Analysis

A qualitative partial risk analysis for the proposed development used within this report is described below. A partial risk analysis is the product of the probability of occurrence of a specific hazardous landslide or other natural geohazard (ie. rockfall, hydrogeomorphic) and the probability of that hazard reaching or otherwise affecting the site occupied by a specific element at risk. To determine if a specific landslide or other geohazard is a hazard and could reach or affect the element at risk, spatial and temporal probabilities must be considered and are described below. Partial risk does not considered the vulnerability of the element at risk. Partial Risk is mathematically expressed as:

P(HA) = P(H) x P(S:H) x P(T:S)

2.2.1 Likelihood of Event Occurrence (P(H))

P(H) is the probability of occurrence of a specific hazardous event and that event being a hazard to the an element. P(H) is a measure of hazard, not risk, because it does not consider the effects, or potential effects, of the event on the element (LMH 56). Table 1 provides the assumed relationships between qualitative likelihood of occurrence ratings, quantitative annual probability of occurrence, probability of occurrence over a 20-year time period after harvesting or trail construction, and associated qualitative descriptions.

Table 1: Qualitative description of the likelihood of occurrence

Likelihood of Occurrence (P(H))	Annual Probability of Occurrence (Pa) [5]	Probability of Occurrence over a 20-year period (Px)[6]	Qualitative Description [1]
Very High (VH)	>1/20 (>0.05)	> 65% chance that at least one event will occur within 20 years.	An event [2] is imminent or likely to occur frequently; well within the service lifetime [3] of a typical forest road (existing or soon after construction; or during or soon after harvesting [4].
High (H)	1/100 to 1/20 (0.01 – 0.05)	18-64% chance that at least one event will occur within 20 years.	An event [2] can happen or is probable within the lifetime [3] of a typical forest road; or during or soon after harvesting [4].
Moderate (M)	1/500 to 1/100 (0.002 – 0.01)	4-18% chance that at least one event will occur within 20 years.	An event [2] is not likely, but possible within the lifetime [3] of typical forest road; or during or soon after harvesting [4].
Low (L)	1/2500 to 1/500 (0.0004 – 0.002)	1-4% chance that at least one event will occur within 20 years.	An event [2] is unlikely to occur (remote possibility) with the lifetime [3] of a typical forest road; or during or soon after harvesting [4].
Very Low (VL)	<1/2500 (< 0.0004)	Less than 1% chance that at least one event will occur within 20 years.	The likelihood of an event [2] occurring is extremely remote to nil within the lifetime [3] of a typical forest road; or during or soon after harvesting [4].

1) Modified from Wise et al (2004), Table 2, pg 14; and BC Mof (2002, Appendix 10.2
2) An event can be a debris slide, opens slope failure, hydrogeomorphic (debris flow, debris flood, flood), or rockfall.
3) Assumes a 20 year + design life
4) Time period between logging and establishment of a new growth forest (generally on the order of 20 to 30 years).
5) Annual Probability (Pa) of 1/100, for example, means an event with an estimated return period of 100 years.
6) Px is the probability that at least one event will occur within the 20 period

2.2.2 Likelihood of an Effect (P(S:H) and P(T:S))

The likelihood of a specific event affecting a considered element depends on a combination of spatial probability and temporal probability.

Spatial Probability P(S:H)

Spatial probability (P(S:H)) relates to the potential of an event to reach or have a physical effect on the location of a considered element. If the element is of a fixed location and is always present (ie. permanent infrastructure or a creek), then the temporal probability is numerically equal to 1, and only the special probability, or likelihood of a special effect, needs consideration. Table 2 provides a quantitative expression of the likelihood of an event to affect the site occupied by an element.

Table 2: Likelihood of a Spatial Effect, Given that an Event Occurs

Relative Rating of Likelihood of an Event Affecting an Element	Description of Likelihood of Spatial Effect
High (H)	Event would most likely reach or significantly affect a considered element.
Moderate (M)	Event could possibly reach or significantly affect a considered element.
Low (L)	Event is unlikely to reach or significantly affect a considered element at the time of an event.

Temporal Probability, P(T:S)

Temporal probability (P(T:S)) relates to the potential for a mobile element to be at the affected location, if the considered event occurs.

For this assessment, the temporal variations are associated with human presence within the area at the time the event occurs. However, because the consequences of such an event are rated as High (or Very High), then the reduction of probability that follows (ie. temporal probability < 1) is not likely to be acceptable; therefore, the partial risk assessment within this report assumes that the temporal probability for all events is equal to 1 and the expression for partial risk used within this report reduces to $P(HA) = P(H) \times P(S:H)$.

2.2.3 Partial Risk Determination (P(HA))

Table 3 is the matrix used in this report for determining partial risk; that is, the product of the likelihood of occurrence of a specific event, and the likelihood of that event reaching or otherwise affecting the site occupied by a specific element.

Table 3: Matrix for Determining Partial Risk[1]

Likelihood of Occurrence of a Specific Hazardous Event, P(H)	Likelihood that the Event Will Reach or Otherwise Affect the Site Occupied by a Specific Element, Give that the Event Occurs P(S:H)		
	Low	Moderate	High
Very Low	*Very Low*	*Very Low*	*Low*
Low	*Very Low*	*Low*	*Moderate*
Moderate	*Low*	*Moderate*	*High*
High	*Moderate*	*High*	*Very High*
Very High	*High*	*Very High*	*Very High*

Modified from Wise et al (2004), Table 8, page 26.

3.0 PHYSIOGRAPHY

3.1 Topography

The study area is located from the lower to upper slope positions, at an elevation ranging between 1,220 m to 1,390 m above sea level, and is situated on a south west to west aspect. The ground slopes range from as little as 45-55% to as steep as 55-80%.

Several gullies containing ephemeral and/or permanent water exist throughout. Fortynine Creek is located more than 200 m downslope. The classification of Fortynine Creek (fishing bearing status) is unknown, but is within a Domestic Use Watershed.

3.2 Bedrock Geology

Bedrock geology within the proposed study area is comprised of the Elise Formation within the Rossland Group, which consists of basaltic volcanic rock, mainly argillite. The rock types generally weather to medium grained soils.

3.3 Surficial Soils

Surficial soils in the project area consist of soils belonging to the Calamity Association (CL), which is comprised of steep mountainous colluvium deposits. The soil is comprised of a veneer to blanket matrix of Clayey SILT to Sandy SILT colluvium rubble over bedrock. The soil is classified as ML (inorganic silt and very fine sand with low plasticity) to SM (Silty Sand and Silt-Gravel-Sand mixtures with more than 15%

[1] Wise et al 2004. Landslide Risk Case Studies in Forest Development Planning and Operations. B.C. Min Forests Resources Branch, Victoria, B.C. Land Management Handbook. No. 56.

fines). The soil is generally considered well drained to rapidly drained, with minor deposits of moderately drained soil where higher percentages of clay and silt exist.

3.4 Existing Developments

Access is gained via the Fortynine Creek Forest Service Road (FSR), which is located 150 m or less downslope. Existing cutblocks and roads are located less than 200 m upslope. Domestic water intakes (DWI) are located on Fortynine Creek approximately 4 km downstream. These DWI are not anticipated to be adversely affected by the proposed development.

4.0 DISCUSSION

4.1 Existing Access Trail Reconstruction

It is our understanding that the existing trail will be reconstructed (ie. brush cleared, ditches re-established, cross ditches installed, surface repaired) to gain access to the drilling/sub-surface exploration locations (Figure 2). An excavator will be employed to open access to be utilized by UTV vehicles only to transport ore offsite for processing. Steep tight switchbacks exist and are conducive for UTV vehicles only.

The existing trail grade ranges from 10-17% favourable to as steep as 35-37% favourable for less than 100 m. Ditches and cross drain structures do not exist and are to be constructed.

Organics such as stumps and logs were used within the fill slope material during the original trail construction. These areas are showing signs of settlement and tension/settlement cracking and the trail surface is out-sloping and will required reworking.

Bedrock is scattered throughout the length of the assessed trail within the cutslope, which coincides with fill slopes containing a high percentage of broken rock. These fill slope areas are stable and do not require reworking.

4.2 Water Management

Significant water was observed to be flowing from an adit located on the cut slope side of the existing trail (Figure 2). It is our understanding that this this adit was constructed approximately 100 years ago. The water flowed out of the adit onto and over the trail surface. The majority of the water was contained to one location where it crossed the trail and dispersed to the slope below. This water was not contained within a defined channel. The water flowed overland on 65-70% slope, spreading wider with decreasing elevation, until it disappeared subsurface approximately 75 m below the trail. Slope instability is not expected to occur if this water is maintained in the historic path and additional inputs of water do not occur. If this water is to be moved to a new location, it is to be completed under the direction of a Qualified Professional (QP).

Approximately 10-15 m of the trail surface was saturated from this adit water. Reconstructing the trail through this saturated section is to be completed to minimize disturbance and alteration to the flow of water coming from the adit.

An old slag pile from the previous mining activities containing metal rail tracks and sawn lumber is located directly below the adit and saturated trail surface. The actual contents of this pile of material is unknown and could become unstable if water is dispersed towards the slag and historic mine waste material.

No additional water was observed to be running on the trail surface at the time of the assessment, but it is expected during the spring freshet or during periods of heavy rain events. Cross drain structures such as cross ditches will be required to maintain the natural drainage pattern.

Recommended cross ditch locations are provided based on the field assessment and illustrated in Figure 2.

4.3 Drilling/Exploration Program

It is our understanding that the drill is a small portable rig mounted on skids.

The proposed drilling and subsurface exploration program is located along the upper most existing trail. This existing trail has grades ranging from as little as 0-3% to as steep as 3-12%. The trail is approximately 5 m wide and will not require major reconstruction for drilling and exploration works. Some fill slope settlement has occurred where organics were used within the fill slope, which may require reworking.

Water used during diamond drilling operations will be dispersed to a sump/excavated hole and will not be dispersed to the surface.

4.4 Existing Fill Slope Failure

A recent (<5 years old) landslide exists within the fill slope of the trail (Figure 2). The estimated cause of this debris slide was up grade trail surface water directed to this location. This fill slope is unstable and will require some minor slope reworking.

The slide is approximately 5-8 m wide, 10-15 m long and 1 m plus deep. The failed soil material is comprised of a localized blanket deposit of Silty Clay to Clayey Silt colluvium, which deposited into the gully and creek below. Flowing water emerged from the failed material at the lower elevations of the deposition zone and continued to flow downstream carrying sediment rich water. Fine sediment has been deposited along the entire length of the creek and turbid water has reached Fortynine Creek, located more than 300 m downslope.

The slide is located directly below a switchback where significant material was removed from the cut slope and deposited to the lower fill slope side. Organics and old mining material (ie. metal rail tracks) exist within the failed material zone. The cutslope above the switch back is receding up the slope and must not be disturbed.

Overall, the existing fill slope failure headwall will continue to be active until trail surface water is redirected away from the headwall towards the gully located to the south and the oversteepened headwall within the fill slope is reworked to reduce the slope. It is expected that sediment rich water will continue to flow within the stream and be deposited downslope and into Fortynine Creek for an undetermined length of time into the future, or until the failed material becomes stable and significant vegetation is established.

4.5 New Trail Construction

It is our understanding new trail construction will be limited to extending the existing trail located just below the trail proposed for drilling exploration (Figure 2). This lower existing trail and potential new trail construction would only be utilized if subsurface drilling is required at lower elevations.

This existing trail consists of an outsloped trail surface due to failing fill slopes containing organics. Fill slope reworking will be required to gain access. If new trail construction is required beyond the end of this old trail is not expected to result in slope instability. The ground slopes range from 65-70%, are long and continuous. The soil consists of dry colluvium rubble deposits.

4.6 Safety

Steep trail grades (~35-37% favourable) exist along the access route proposed to access the drilling locations and haul the mined ore off site for processing. It is our understanding that ore will be hauled off site using a UTV vehicle. Safe work procedures must be developed for the use of UTV vehicles on the reconstructed trails, which are in accordance with Work Safe BC Occupational Health and Safety Regulations and the Health, Safety and Reclamation Code for Mines in British Columbia (June, 2017)..

4.7 Partial Risk Assessment

Likelihood of Occurrence, P(H)

Landslides

The likelihood of a landslide to occur given the current condition of the trail and water management is judged to be Moderate to High. The likelihood of a landslide to occur as a result of trail reconstruction and drilling/subsurface exploration works provided the recommendations contained at the end of this report are followed is judged to be Low.

The projected Event-of-Significance is a landslide caused by water transferred to a slope (fill slope or native slope below the trail) from the trail surface that does not naturally or historically receive this volume of water. The slide would be tens of cubic metres to several hundreds of cubic metres and would mobilize 20-30 m or more, potentially settling within a gully containing seasonal or permanent flowing water. Sediment rich water would mobilize downstream and would be delivered to Fortynine Creek. Efforts such as removing failed material from the stream and/or the construction of settlement ponds and silt fences could mitigate turbid water from reaching Fortynine Creek. Turbid water would enter Fortynine Creek for several days to weeks after and potentially for several years during high flow periods.

Spatial Effect, P(S:H)

Material from a landslide could reach a watercourse and transfer sediment rich water to Fortynine Creek; therefore, the likelihood of a landslide reaching or affecting the watercourse (Elements at Risk) is rated as Moderate to High.

Partial Risk Rating, P(H:A)

Based on the above ratings of P(H) and P(S:H), the partial risk rating per Table 3 for the likelihood of landslide occurring if no trail reconstruction is completed and it reaching a watercourse downslope over a 20-year period is rated as Moderate to Very High.

The likelihood of a landslide occurring if trail reconstruction is completed and the recommendations at the end of this report are followed and it reaching a watercourse downslope over a 20-year period after trail reconstruction is rated as Low to Moderate.

4.8 Construction Inspection

A construction inspection was completed on June 26, 2018 by the undersigned in the company of Mr. Kelly Funk. The purpose of the inspection was to assess the road reconstruction and if any adverse effects on slope stability have occurred, specifically two locations; where water flowed across the road from the historic adit and the previous fill slope failure.

During the assessment, the trail had been cleared of brush and trees, with organics removed from the road surface. The ditch line and cross ditches were not constructed at this time.

A cross ditch was constructed to convey water flowing from the adit across the road. This cross ditch is in the same location where water was flowing prior to the reconstruction. A ditch was constructed to collect additional seepage from directly in front of the adit and direct towards the cross ditch. No slope instability was observed downslope. Water was flowing along the same path and disappeared subsurface at the same location as it was prior to reconstruction. Slope instability was not observed.

A ditch was constructed along the back of the switchback to collect upslope drainage and direct away from the fill slope headwall area. Currently this ditch directs water towards fill material and is to be reconstructed to direct water to native soil within the gully to the south. The trail fill slope was reworked at the site of the previous fill slope failure (Section 4.4). The fill was pulled back and re-sloped to a stable angle. A berm was constructed so trail surface water cannot flow onto the headwall and to direct trail surface water towards the newly constructed ditch at the back of the switchback.

Overall, no slope stability was observed as a result of the road reconstruction.

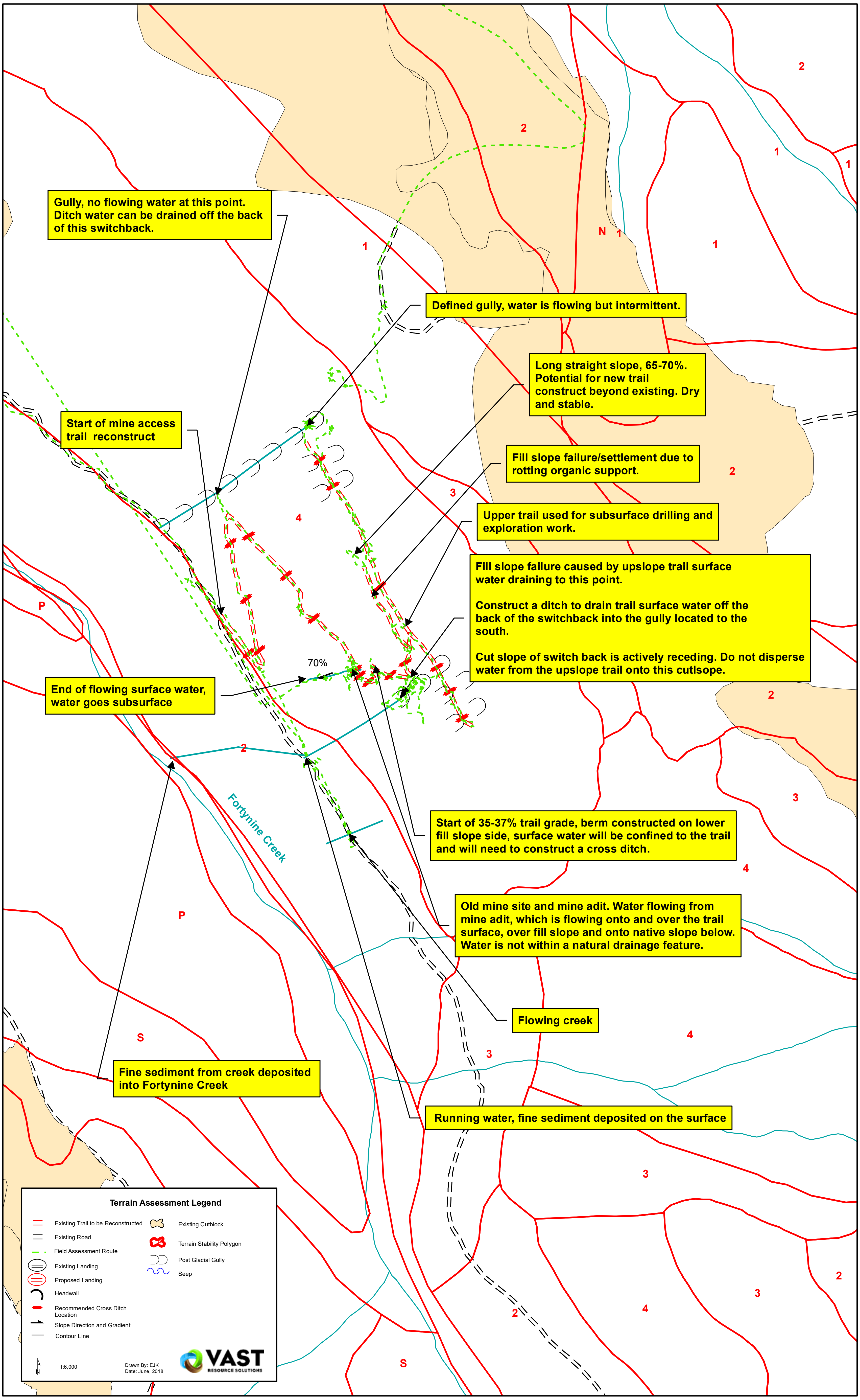


Figure 2: Site Assessment Map

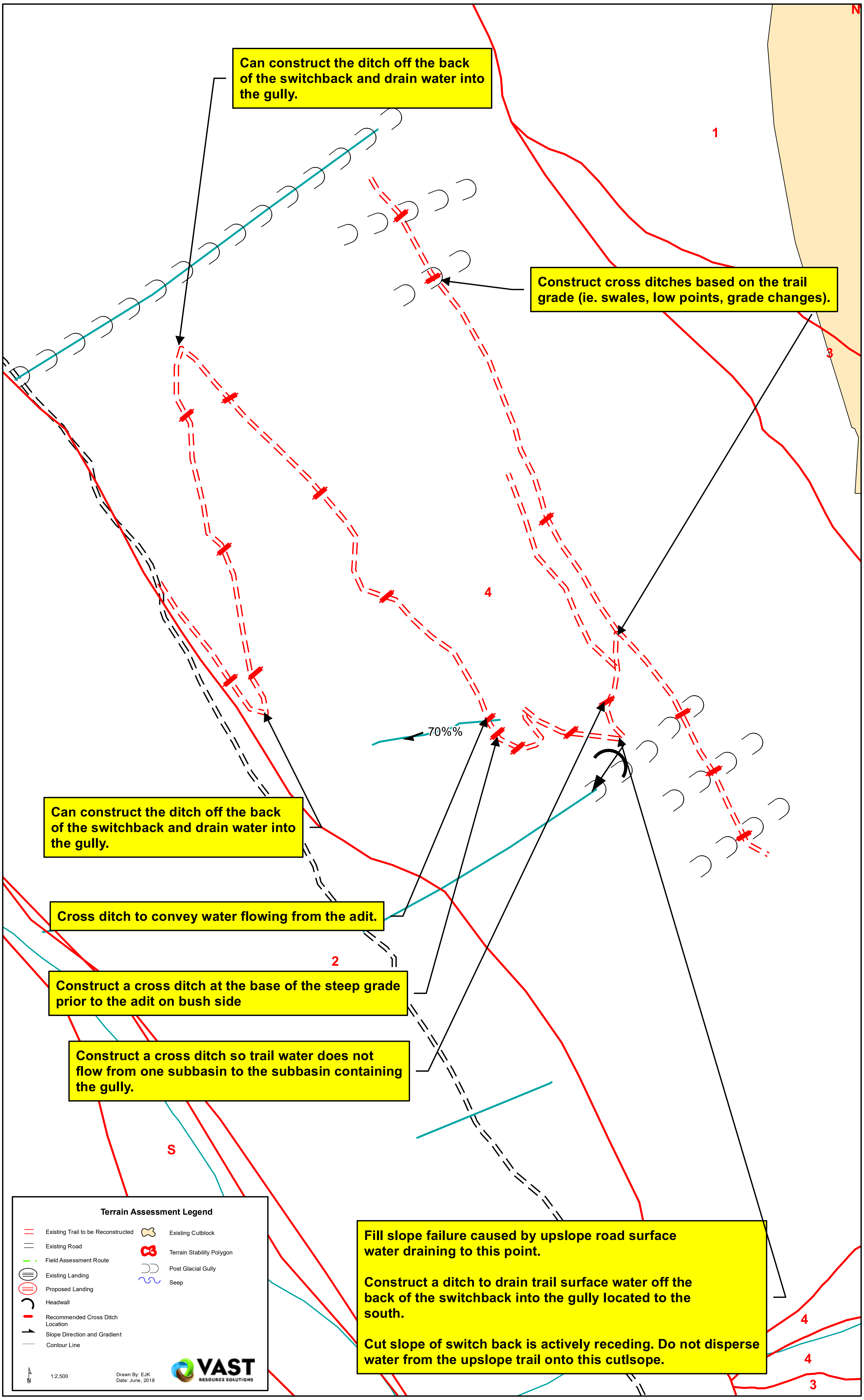


Figure 3: Recommended Cross Ditch Locations Map

5.0 RECOMMENDATIONS

The following recommendations are provided. See Figure 2 and Figure 3 for site specific details and recommendations.

5.1 Recommendations for Safety

- Due to the steep grades that exist along the proposed access trails that will be used to haul ore off site using a UTV, safe work procedures must be development in accordance with Work Safe BC Occupational Health and Safety Regulations and the Health, Safety and Reclamation Code for Mines in British Columbia (June, 2017), which are to include but not limited to:
    - All personnel must be properly trained by an accredited training body (ie. Canada Safety Council);
    - Site orientation (s) must be completed and documented for all existing and new workers prior to entering the site;
    - Development of safe work procedures for hauling ore off site (ie. using low gear, slow speeds, maximum load weight, loads must be secured and tied down, what to do in the event of a runaway) must be developed and communicated to all workers;
    - Workers operating UTV's must wear protective headgear that meets the requirement of WCB Occupational Health and Safety Regulation 8.12;
    - Choose the proper speed and take into consideration the capability of the vehicle, the terrain, visibility and other operating conditions, plus operator skills and experience;
    - Anything carried on the UTV must be secured firmly to the carrier;
    - When carrying chainsaw a chain guard must be securely fastened to the saw;
    - Ensure the UTV is maintained in sound operating condition;
    - Check daily to ensure good condition of the brakes, steering, fuel, oil, coolant, tires and lights as applicable;
    - The UTV must be parked in a safe position at all times; and
    - Read and understand the owner's manual and the UTV's limitations.
- Proper Personal Protective Equipment must be warn at all times coinciding with the hazard (ie. work around an excavator includes hard hat, high visual clothing, steel toed boots, etc); and
- Install a gate to control public access.

5.2 Recommendations for Trail Reconstruction and New Construction

- Monitor all areas post trail reconstruction or new construction for signs of slope instability (ie. Cut slumps, erosion, fill slope failures, downslope landslides, significant blowdown) and immediately notify the QP;
- If significant water/seeps are encountered during the trail reconstruction or new trail construction that results in soil erosion downslope, contact the QP;
- Install cross ditches at the recommended locations shown on Figure 3. Cross ditches must be constructed prior to the end of the 2018 field season (i.e. October). If significant water is collected within a cross ditch, additional cross ditches are to be constructed. Refer to Appendix II for recommended additional culvert/cross ditch spacing for all newly constructed and reconstructed

trails. Contact a QP if significant soil erosion or slope instability is observed (i.e fill slope tension cracks);

- Re-establish the ditchline along the entire section of the trail. In-slope the road at 1-2% if a ditch cannot be constructed due to bedrock. The ditch must be constructed prior to the end of the 2018 field season (ie. October);
- If water is encountered along a trail, maintain the natural drainage pattern (ie. cross ditch or culvert(s);
- Sediment catch basins must be installed prior to all ditch water entering a creek;
- Based on the slopes (50-70%) and dry colluvium rubble soil, balance cut and fill construction can be employed for new trails constructed within the assessed area. Minimize disturbance to existing cutslopes and fill slopes if the trail is already constructed to a standard conducive for UTV/SxS and no instability exists (ie. fill slope settlement, cut slope slumping);
- Surfacing with coarse grained material (gravel) may be required in localized sections of the trail where moist to wet soils and or soft soils exist;
- Trail construction beyond the assessed area or switchback widening must be reviewed by a Qualified Professional prior to construction;
- The following recommendations are to be included, but not limited to, in the deactivation/decommissioning plan prepared by a Qualified Professional.
  - New trails and drill pad sites are to be pulled back (ripped, decompacted, and recontoured) with organics placed on the surface and the natural drainage pattern maintained (i.e. swales constructed at gullies);
  - Existing trails reconstructed for this project must have all drainage infrastructure (ie. ditches and cross ditches) constructed. The Qualified Professional is to establish the location and layout all cross ditches;
  - Areas where there is a potential for erosion to occur post deactivation should be seeded with a suitable seed mix.
- If trails are planned for permanent access, organics (stumps and logs) must not be utilized within the fill;
- If the trails are planned for temporary access, organics (stumps and logs) can be used to laterally support the fill slope. Fill must be kept within reach of an excavator. Trail sections supported by organics must be removed within 3 years or sooner of construction;
- Recommended cut slope and fill slope angles for newly constructed trails are:
  - 80% for permanent fill slopes;
  - 100% for temporary trails supported by organics;
  - 100% for cut slope if soil material (133% if the cut is required to be oversteepened for operational purposes); and
  - 200% for cut slope if bedrock;

5.3 Recommendations for Fill Slope Failure Area

- Pull back the oversteepened headwall located within the fill slope to minimize addition material from failing;

- Construct a ditch to collect trail surface water from upgrade and direct away from the failed fill slope towards native soil within the gully located off the back of the switchback to the south. Water must not be directed to fill slope material. Construct a sediment catch basin prior to the gully. A ribbon is hung in the approximate location to disperse the ditch water into the gully;
- Monitor for additional signs of slope instability at this location and contact a QP if instability is observed;
- A site visit is to be completed by a QP within two weeks after reconstruction to assess the slope stability hazard; and
- Do not disperse water from the upper existing trail towards the receding switchback cutslope located directly above the fill slope failure (Figure 2).

5.4 Recommendations for Water Flowing from the Adit

- Minimize the disturbance of the saturated road surface material by placing wood planks (ie. rig mat) or other suitable material on the road surface. This material is to be removed at the end of each season and prior to freshet;
- Maintain the existing drainage pattern with respect to the water flowing from the adit. Construct a drainage cross ditch on the town side of the saturated road where the water was currently flowing during the field assessment. Monitor downslope for signs of instability;
- Do not concentrate the adit water towards the slag and wood debris pile located downslope of the adit;
- Contact a QP immediately if slope instability is observed within the road surface or downslope of the road;
- Do not transfer this water to another location without the approval of a QP; and
- A site visit is to be completed by a QP within two weeks of reconstruction to assess the slope stability hazard.

5.5 Recommendations during Drilling Operations

- Water used during diamond drilling operations must be directed towards an excavated sump and must not be allowed to drain on the surface. Monitor downslope of the sump for signs of slope instability (ie. slumping, tension cracks, seeps).

5.6 Post Construction Inspection Recommendations

- Move the ditch that was constructed at the back of the switchback above the fill slope failure so water is deposited onto native soil within the gully to the south, not onto fill slope material. An orange ribbon with “culvert” writing was hung where the ditch is to be constructed to and disperse water; and
- Continue to monitor downslope of the cross ditch that conveys the water flowing out of the adit for signs of slope instability (ie. tension cracks, soil movement, changes in the fill slope) and immediately call the QP if instability occurs.

6.0 CLOSURE

This report has been prepared in accordance with generally accepted engineering practices in British Columbia. No other warranty, express or implied is made.

Services provided by VAST Resource Solutions Inc. (VAST) for this report have been conducted in a manner consistent with the level of skill, care and competence ordinarily exercised by members of the profession currently practicing under similar conditions and like circumstances in the same jurisdiction in which the services were provided. Professional judgment has been applied in developing the recommendations in this report.

The conclusions and/or recommendations provided in this report do not relieve the client or their agents or representatives of the responsibility to comply with applicable Acts, regulations, bylaws and/or decisions of any authorities that have jurisdiction under an enactment.

Assessments of soils and rock characteristics are based on interpretation of shallow sub-surface hand dug test pits. Sub-surface and bedrock conditions have been inferred from hand test pits, trail cut slopes, root wads of fallen trees and exposed bedrock. Variability (even over short distances) is inherent in geological features, and actual ground conditions encountered may vary from those identified.

In order to properly understand the suggestions, recommendations and opinions expressed within this report, reference must be made to the whole report. We cannot be responsible for the use of portions of the report by any party without reference to the whole report.

This report is prepared for the specific site assessed, whether it is a forestry development, a building, or a design objective that was described to us by the client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed within the report 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 have been specifically requested by the client to review and revise the report in light of such alteration or variation.

The information and opinions expressed in the report, or any document forming part of the report, are for the sole benefit of the client. No other party may use or rely upon the report or any portion thereof without 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 authorize 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 use which a third party makes of the report, or any portion thereof, is the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting for the unauthorized use of the report.

In the event that conditions vary from those interpreted for this assessment, we reserve the right to re-assess the proposed development and amend our recommendations accordingly. The author reserves the right to amend this report if additional information becomes available.

The report is based on, and limited by, circumstances, conditions and information available at the time the work was completed. The recommendations of this report are based in part on information provided by others. VAST Resource Solutions believes this information is accurate but cannot guarantee or warrant its accuracy or completeness.

The information presented in this report was acquired, compiled and interpreted exclusively for 802213 Alberta Ltd and Moose Mountain Technical Services for the purposes described in this report. VAST

Resource Solutions Inc. does not accept any responsibility for the use of this report, in whole or in part, for any purpose other than intended or to any third party for use whatsoever.

This document has been digitally signed and sealed and certified by the author. Hard copies of the report can be produced upon request.

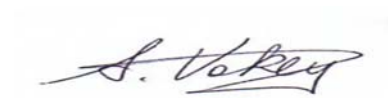
Yours truly,

Prepared By:

I am the author
05 July 2018

Evan Kleindienst, P.Eng. / R.P.F.

Reviewed By:



Shawn Vokey, P.Eng.

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APPENDIX I: CULVERT/CROSS DITCH SPACING GUIDLINES

EROSION HAZARD	SLIGHT	MODERATE	HIGH
MORE THAN 50% BY SOIL TYPE	HARDPAN, SOLID ROCK	GRAVEL COBBLES	SANDS, SILTS, CLAYS
Road Gradient			
0-3%	350 m	300 m	250 m
3-8%	250 m	200 m	150 m
8-15%	200 m	150 m	100 m
15%+	150 m	100 m	Less than 100 m

Table 4: Guidelines for Maximum Culvert Spacing for Forest Roads

Reduce the spacing between culverts as required to prevent excessive accumulation of water in the ditches, particularly at road junctions, along road segments with steep uphill side slopes, and along areas of seepage or piping in cuts. Examine the downslope on which the culvert will discharge. If extensive erosion or mass-wasting may occur, change the location to suit the situation.

Skew cross drainage culverts to the road centreline by 3 degrees for each 1 percent road gradient that the road exceeds 3 percent (to a maximum of 45 degrees). Use a maximum slope of 2 percent to divert ditch line water into the culvert.

Ditches

Use a minimum roadside ditch depth equal to 1.5 times the culvert diameter, but not less than 700 mm.

Ditch roads properly and provide culverts of the right size and alignment to handle peak runoffs, to minimize water movement along ditches and the road surface.

Output

1. Once the volumes (see Table 5) have been minimized, determine the optimum balance line for waste, borrow and overhaul.
2. Produce overburden, primary (within each soil classification) and secondary volume summaries.
3. Plot right-of-way boundaries and calculate right-lf-way areas in hectares (to 3 decimal places).