TECHNICAL MEMORANDUM

DATE 19 December 2016 **REFERENCE No.** 1410944-014-TM-Rev0-2016

TO Ms. Carrie Gillis
Faro Mine Remediation Project

FROM Malcolm Shang and Al Chance **EMAIL** Malcolm_Shang@golder.com; Al_Chance@golder.com

FARO – MINING SUPPORT SERVICES:
FARO CREEK DIVERSION OVERBURDEN REGRESSION CONCEPTUAL MITIGATION OPTIONS

1.0 INTRODUCTION

The Faro Mine Complex (FMC) is located approximately 350 kilometres northeast of Whitehorse, Yukon. Groundwater seepage that is occurring at the overburden/bedrock contact at the North Instability Zone of the Faro Pit east wall is contributing to the acceleration of overburden regression towards the access road and the Faro Creek Diversion (FCD) channel. In response to the overburden regression in this area, the Faro Mine Remediation Project (FMRP) requested Golder Associates Ltd. (Golder) to assess the overburden regression and to provide conceptual interim mitigation options until a permanent solution can be implemented. This work fulfills task number two of work plan # 001 of standing offer agreement AAM-13008-GOLD. This memorandum summarizes Golder's assessment of the overburden regression and conceptual mitigation options.

2.0 BACKGROUND

2.1 Crest Overburden Regression

Gradual regression of the overburden at the Faro Pit east wall crest is occurring at a localised area of the North Instability Zone (Figure 1). The most critical area, closest to the road, spans approximately 10 to 15 m parallel to the road and approximately 30 m perpendicular to the road; from the edge of the road to the overburden/bedrock contact below the pit crest. The distance from the edge of the road to the pit crest is approximately 15 m at this location. The North Instability Zone is an area on the Faro Pit east wall that has historically shown signs of bedrock and overburden instability. Based on historical information, the instability of the North Instability Zone is attributed to the exposure of the weak and intensely foliated phyllite unit and high pore pressure conditions (Golder 2002 and BGC 2016). A recent geotechnical investigation by BGC (2016) indicated that:

- Phyllite is no longer interpreted to occur behind the crest of the North instability.
- Further regression of the North Instability Zone will likely be limited by the presence of the relatively fresh and massive quartz monzonite unit encountered behind the crest.

The rate of regression of the overburden at the Faro Pit crest is estimated to be approximately 33 cm per year based on monitoring pin 15742 (Golder 2016a). The overburden regression is attributed to seepage that occurs at the base of the overburden where it is in contact with weathered and altered bedrock below. This seepage is eroding the weathered bedrock and undermining the overburden, causing local sloughing and raveling of the over-steepened overburden face. BGC (2016) indicated that if the seepage is left unmitigated, the crest of the slope will continue to regress and will eventually impact the access road and the FCD.

Based on a review of available data, a number of remedial measures have been attempted to reduce the seepage in the overburden during operations and post-closure. These remediation measures are summarized here:

- Attempts were made to intercept the seepage at or above the bedrock/overburden contact by the excavation of ditches with the occasional addition of a liner. The details of these efforts, including the locations, are unknown. Efforts were made futile where these ditches intercepted dykes and faults on the northeast wall and leakage continued through these structures (Piteau 1986).
- Half culvert flume sections and plastic tarpaulins were placed in the FCD to minimize seepage. These efforts proved ineffective (SRK 2003). Details of these remedial efforts, including the locations, are unknown.
- Based on recommendations from BGC (BGC 2002), remedial works were completed on the FCD in 2003. Remedial efforts consisted of lining approximately 2,300 m of the FCD channel with a combination of Bentomat® clay liner and 100 to 300 mm rip-rap applied on the channel surface. The channel geometry changed as a result of this remediation, the access road was realigned and a safety berm was constructed between the northern crest of the east wall and the road (Golder 2006). No formal construction record reports were produced or issued so the details of the construction, including the locations, are unknown.

Based on the continued seepage and overburden regression in this area, the previously attempted remediation measures to reduce seepage through the overburden were ineffective.

3.0 FARO PIT CREST REGRESSION ASSESSMENT

Golder completed a review of the available background information from 29 August to 6 September 2016 and conducted a site visit from 7 to 9 September 2016. The purpose of the site visit was to visually assess the overburden regression area. The area was inspected from the access road, and from the air using an unmanned aerial vehicle (UAV). The following findings were made from the background review and site visit:

- Aerial photographs from the Golder (2016b) site visit indicate that the seepage is localised, as it is not visible along the overburden face upstream or downstream of the overburden regression area. This suggests that the previous FCD channel remediation measures may have been effective in reducing seepage from the FCD channel into the overburden but ineffective in reducing seepage along the overburden/bedrock contact in the overburden regression area (refer to Section 2.1). If this is true, this would indicate that seepage from the FCD may not be the main source of seepage at the overburden regression area. Review of the information available also suggests that surface runoff originating from the hillside, northeast of the overburden regression area, may be contributing to the seepage by conveying surface runoff through the till and weathered bedrock into the overburden regression area.

- BGC (2016) geotechnical investigation (Drillhole Log #CH15-102-MW001) indicated that the overburden at the regression area extends approximately 12-16 m below ground surface, and that the groundwater level is approximately 3.5 m above bedrock (CH15-102-SI001, VW35063).
- Visual inspection of the area during the Golder 2016 site visit indicates that the overburden material may have a higher fines fraction than that which was reported by BGC (2016). BGC (2016) indicated that the overburden consists mainly of sand and gravel with some silt. The site visit photographs and the steep slope suggest a higher fines content. The aerial photographs also indicate the presence of cobbles and large boulders (approximately 2 m wide) which were not reported by BGC (2016).
- The regression mechanism seems to be erosive undercutting of the overburden material at the overburden/bedrock contact. The failure mechanism does not seem to be a circular slip type failure. This is supported by the presence of overhangs at the overburden regression area.
- Despite the local crest regression there is no visible evidence of tension cracking in the area. Tension cracks behind the crest would be indicative of a deeper-seated instability. This was previously reported in Golder (2014 and 2015) and confirmed by the Golder 2016 site visit.

Based on the available information, the regression is attributed to seepage that occurs at the overburden/bedrock contact. While some of the seepage flow may be due to losses from the diversion channel, surface water that infiltrates the exposed bedrock slopes above the channel and then flows downhill along the permeable weathered bedrock below the overburden is also a likely source for the groundwater seepage. Consequently, preventing seepage from the diversion channel will not likely eliminate the seepage on the pit wall.

This overburden/bedrock contact seepage, combined with seasonal freeze-thaw, is eroding and undermining the overburden on the slope face.

4.0 MITIGATION OPTIONS

Golder completed a screening level assessment of potential mitigation options. The mitigation options that were considered are summarized in Table 1. Each option was screened for feasibility based on the practicality of implementation, anticipated cost and the anticipated effectiveness of each option.

Table 1: Screening Level Assessment of Mitigation Options

Concept	Mitigation Option	Considerations	Feasibility
Do nothing	Do nothing	■ Rate of regression.	■ Possible
Minor re-sloping	Minor re-sloping to angle of repose	■ Rate of regression. ■ Re-sloping will reduce the likelihood of a sudden loss of overburden material.	■ Possible
Retain soil particles while allowing seepage to occur.	Inclined drain holes through bedrock into overburden	■ Previous experience indicates limited effectiveness. ■ Health and safety considerations with regards to drilling through bedrock below the overburden.	■ Possible but not recommended
	Shotcrete / mesh / drain system	■ Possible expansion-contraction cracking of shotcrete due to seasonal temperature changes. ■ Drain may freeze and block during winter, which may lead to a buildup of water behind the shotcrete during the colder seasons. ■ Soil nails may not extend past the active freeze-thaw layer in the seepage area.	■ Possible but not recommended
	Geofabric / geotextile / mesh system	■ Geofabric and geotextile durability considerations. ■ Soil nails may not extend past the active freeze-thaw layer in the seepage area.	■ Possible
Cut-off/divert seepage	FCD channel with an impermeable liner and tie the liner into bedrock	■ Insufficient space to excavate 12-16 m down to bedrock. ■ FCD channel flow will need to be diverted during construction.	■ Unlikely
	Grouting	■ Requires low percentage fines. ■ Visual assessment of overburden indicates possible low permeability. This is in contrast with BGC (2016) which indicates overburden consists mainly of sands and gravels with some fines. ■ Reduced seepage may be achieved but cut-off not guaranteed.	■ Possible if fines content is low. Further testing required. ■ Not recommended as cut-off not guaranteed.
	Jet-grouting	■ Not preferable due to presence of boulders.	■ Unlikely
	Cement-Soil-Mixer		
	Trench cutter cut-off wall	■ Expensive (estimated mobilization cost approximately $1-2 million). ■ Limited number of machines in North America. ■ Slope stability with additional machine load needs to be confirmed.	■ Possible but expensive and limited number of machines in North America.
	Secant pile wall	■ Expensive but cheaper than trench cutter and may be suitable as a more permanent solution. ■ Equipment more common than trench cutter. ■ Slope stability with additional machine load needs to be confirmed.	■ Possible but expensive, however, cheaper than trench cutter and equipment is more common.
	Realign FCD channel	■ Possible but not part of Golder's scope of work. ■ Not really a short-term option. We understand that this long-term option will be or has been assessed by others.	

Note: Feasibility considered the practicality of implementation, anticipated cost and the anticipated effectiveness of each option.

Based on the screening level assessment, it was agreed with FMRP to progress the following options to conceptual design level:

- Option 1: Do nothing
- Option 2: Minor re-sloping to angle of repose
- Option 3: Geofabric/geotextile/mesh system
- Option 4: Secant pile wall

These options are described and discussed in more detail in Sections 4.1 to 4.4, and compared in Section 4.5. While we have made our best attempts to provide costs for all options to American Association of Cost Engineering (AACE) Class 3 accuracy, Options 3 and 4 require further investigations and design to be considered within the AACE Class 3 accuracy range. The additional work required to improve the cost level accuracy of Options 3 and 4 to AACE Class 3 is beyond the scope of this study, as it was not possible at the proposal stage to anticipate the preferred options and the information that would be available or needed.

The cost estimate accuracy of Option 1 and 2 are considered AACE Class 3 accuracy, however, the cost estimate accuracy of Options 3 and 4 are closer to AACE Class 4 when the additional investigations and designs required are considered.

4.1 Option 1: Do Nothing

This option involves leaving the crest and slope as they are. The pro of this option is the zero cost. The con is the continued regression of the crest due to seepage and seasonal freeze-thaw at the overburden/bedrock contact. There is also risk of the crest regressing more than that which has occurred over the last 10 years due to a sudden failure of the overhangs and/or a wetter than normal year.

For this option, it is suggested that the vegetation is left in place, as their root systems most likely provide some tensile strength to the surficial soil and they also help remove water from the soil.

4.2 Option 2: Minor Re-Sloping

The minor re-sloping option, shown in Figure 2, consists of:

- Minor re-sloping of the overburden to its angle of repose using the crest-chaining method. The method involves draping heavy metals chains over the pit crest, and dragging them along the crest with a bulldozer. This technique is often used in open pit mines to remove loose material from pit bench faces.

The pro of this option is the relatively low cost, and the reduced likelihood of a sudden loss of overburden material. The cons are continued regression due to seepage and seasonal freeze-thaw at the overburden/bedrock contact. It is suggested that any large bushes that may prevent the chains from being dragged along the crest are trimmed. Trimming will reduce the likelihood of the bushes becoming entangled with the chains and uprooting the bushes and their root systems. Suitable health and safety mitigation measures are to be taken when trimming any bushes near the overburden crest.

4.2.1 Cost Estimate

The conceptual cost estimate for the chain scaling option is approximately CAD $45,000 and consists of approximately:

- CAD $5,000 for construction labour
- CAD $10,000 for construction equipment
- CAD $30,000 for construction materials

The majority of the cost is associated with the cost of supplying the large and heavy chains. Used mine shovel chain is often used for this task. It is possible that that there may be a potential cost saving if suitable chains are available on site or can be sourced locally.

The chain scaling cost estimate is based on the following assumptions:

- All work will be carried out in summer or autumn months. No allowance has been made for winter work, heating or hoarding.
- Heavy equipment mobilization out of Whitehorse.
- Labour is local to Whitehorse; four hours of travel has been included for crew mobilization and demobilization.
- Materials are sourced from Edmonton.
- Living out allowance is CAD $285 per day.
- It is assumed that three chains, 40 m long and 2” in diameter will be used.

The minor re-sloping cost estimate is considered an AACE Class 3 cost estimate.

4.3 Option 3: Geofabric/Geotextile/Mesh System

This option (Figure 3) consists of a layered system of non-woven geofabric, woven geotextile, high tensile strength wire mesh, and soil nails to hold the mesh and fabric in place. Prior to installation of the system, the overburden will be re-sloped to its angle of repose using the crest-chaining method, described in Section 4.1.

The purpose of the non-woven geofabric is to retain the soil particles while allowing seepage to pass through. The purpose of the woven geotextile is to shield the non-woven geofabric from UV radiation. These two layers will be held in place by a high tensile steel mesh with soil nails as anchors. The soil nails will be installed manually using hammer drills, and will be anchored to the soil with grout. The typical depth to which soil nails can be manually installed is 2-3 m. The soil nail depth and optimum spacing may also be limited by the presence of boulders in the overburden. It is important to note that this system is an erosion prevention system and not a slope stabilization/reinforcement system.

The pro of this option is the relatively lower cost when compared to the more permanent solution of realigning the FCD. The cons are that:

- Seepage will continue to erode the rocks below the overburden, albeit at a lower rate than the overburden is currently being eroded.
- Expansion-contraction of the non-woven geofabric and woven geotextile, due to seasonal change in temperatures (- 40 °C to 20 °C), may lead to the materials tearing at the soil nail anchors.
- The manually installed soil nails within the seepage zone (which may be approximately 3.5 m high and 8 m wide) may not extend past the active freeze-thaw zone (typically approximately 2 m). This poses a risk that the soil nails may pull out of the soil in this area.
- The woven geotextile will degrade over time due to UV radiation, however, the rate of degradation may be acceptable since some products can last greater than 50 years.

There are health and safety risks associated with installing this system on a steep slope. However, the installation of similar systems for unstable rock and soil slopes are common practice in highway and road construction. Installation risks can therefore be managed with an experienced contractor.

4.3.1 Additional Work Required

Upon review of the information available, the following additional studies are required to confirm the feasibility of this option:

- Geotechnical investigation to determine the material properties of the overburden material; including shear strength properties for anchorage and material particle size distribution for soil retention fabric selection.
- Feasibility level design, work methodology and cost estimate.

4.3.2 Cost Estimate

The conceptual cost estimate for the geofabric soil retention option is approximately CAD $864,000 and consists of approximately:

- CAD $48,000 for a geotechnical investigation.
- CAD $16,000 for geotechnical laboratory testing.
- CAD $30,000 for a feasibility design.
- CAD $210,000 for construction labour.
- CAD $180,000 for construction equipment.
- CAD $380,000 for construction materials.

The cost estimate is based on the following assumptions:

- This cost estimate includes an estimated cost of a geotechnical field investigation, geotechnical laboratory testing, feasibility level design and direct implementation costs.
- Geotechnical field investigation estimate assumes:
  - Geotechnical drilling contractor is based in the lower mainland of British Columbia.
  - A combined mobilization and demobilization cost of CAD $30,000.
  - Mud-rotary drilling at a rate of CAD $300 per metre.
  - Two drill holes, each 20 m deep.
  - Completion of one drill hole per day.
- Geotechnical laboratory estimate consists of grain size analysis by sieve and hydrometer tests, Atterberg Limits tests, moisture content tests, and triaxial tests.
- The design cost estimate assumes 120 hours at CAD $208 for an intermediate engineer and 20 hours at CAD $265 for a senior engineer.
- The cost estimate for the geotechnical investigation is an indicative cost and may change due to contractor’s rates, material costs and scope.
- The laboratory and design costs are conceptual estimates and may change due to the findings of the field investigation.
- All construction work will be carried out in summer or fall months. No allowance has been made for winter work, heating or hoarding.
- Heavy equipment mobilization out of Whitehorse.
- Labour is local to Whitehorse; four hours of travel has been included for crew mobilization and demobilization.
- Materials are sourced from Edmonton.
- Living out allowance is CAD $285 per day.
- The area to be covered is estimated to be 1,500 m^2.
- The soil nails are 1" in diameter and will be installed manually to an average depth of 2.5 m.

AACE Class 3 cost estimation methods were used to estimate the cost of the Geofabric/Geotextile/Mesh System, however, the cost estimate is considered to be closer to an AACE Class 4 estimate when the additional studies (field investigation, laboratory testing and design) required are considered.

4.4 Option 4: Secant Pile Wall

A secant pile wall consists of a series of piles, constructed in such a way that the piles overlap to form a continuous wall. Secant piles have commonly been used to control of groundwater inflow, and can also act as a retaining wall to minimize movement in weak and wet soils. This option consists of a secant pile wall installed by a track mounted drill rig along the edge of the access road closest to the FCD channel. The proposed alignment is shown in Figure 4. The concept is to cut off the seepage and divert it downstream and back into the FCD channel which, based on the Golder (2016b) aerial photographs, does not seem to be seeping through the overburden downstream of the overburden regression area. No pumping will be required since the secant piles will divert the seepage flow, under gravity, back into the FCD channel.

The pros of this option are that:

- It is a known technology.
- It can be installed through boulders.
- It can act as a retaining wall if the overburden continues to erode, as long as the bedrock in which it is founded is stable. This seems possible since BGC (2016) indicated that further regression of the North Instability Zone is likely limited by the presence of the relatively fresh and massive quartz monzonite unit encountered behind the crest.

The cons to this option are that:

- It will require special equipment.
- It is expensive but may be suitable as a longer term solution.

4.4.1 Sufficient Working Space

During the screening assessment, a concern was raised as to whether there would be sufficient working space for a secant pile wall to be installed. Golder discussed this with a secant pile specialist, and the specialist indicated that there would be sufficient space as long as:

- The secant pile wall can be installed along the edge of the access road closest to the FCD channel.
- Two-way traffic is not required in the area during construction.

Sufficient space is defined here as a minimum of a 5 m wide, level working area from the centerline of the row of piling extending out into the road.

4.4.2 Effect of Additional Load on Slope Stability

Golder completed a high level slope stability assessment to determine the effect of the additional secant pile wall machine load on the stability of the overburden slope below the installation area. The following assumptions were used in the assessment:

- The stability analysis cross section was located along the critical regression portion of the crest, where the distance between the crest and the FCDC is at a minimum.
- The additional weight of the secant pile wall drill rig is assumed to be 100 tons.
- The additional load is applied to the centre of the access road as a point load.
- The unit weight of the overburden is assumed to be 20 kN/m^3.
- The overburden is assumed to have an effective friction angle of 35°. Cohesion was varied in the analysis to determine the cohesion that would be required to achieve an acceptable Factor of Safety.
- The phreatic surface is assumed to be 3.5 m above and parallel to the overburden/bedrock contact.
- The overburden/bedrock contact was inferred from BGC (2016).
- The bedrock is assumed to be impenetrable since the additional load is likely to be over the relatively fresh and massive quartz monzonite unit encountered behind the crest.
- For load induced excess pore pressures, two scenarios were completed. The first scenario assumed that excess pore pressures would be generated under the machine load, and the second scenario assumed that they would not. Both scenarios were completed because the undrained strength behaviour and liquefaction potential of the overburden is unknown. For the first scenario, the excess pore pressures were simulated by using the B-bar method, which accounts for changes in pore pressure due to rapidly applied loading conditions. A B-bar of 1 was used for this scenario i.e., it was assumed that the entire machine load was transferred to the pore water and not the soil structure. Fully drained conditions were assumed for the second scenario.

The results of the analysis are shown in Attachment A, and indicate that:

- The slope stability is sensitive to the machine load and the shear strength properties of the overburden.
- The slope stability is not sensitive to the liquefaction of an isolated saturated zone beneath the machine load.
- An acceptable FoS of 1.5 can be achieved if the overburden has an effective strength friction angle of 35° and a cohesion of at least 26 kPa. At present, there is insufficient geotechnical information available to confirm the strength properties of the overburden. To address this, a geotechnical investigation would have to be undertaken to determine the material properties of the overburden if this option was to be pursued further.

4.4.3 Additional Work Required

Additional studies required to confirm the feasibility of this option are:

- Geotechnical investigation to determine the material properties of the overburden material and the depth to bedrock along the secant pile wall alignment.
- Feasibility level design, work methodology and cost estimate.

4.4.4 Cost Estimate

The conceptual cost estimate for this option is approximately CAD $3,590,000 and consists of approximately:

- CAD $83,000 for a geotechnical investigation.
- CAD $47,000 for geotechnical laboratory testing.
- CAD $55,000 for a feasibility design.
- CAD $750,000 for construction labour.
- CAD $975,000 for construction equipment.
- CAD $1,680,000 for construction materials; of which approximately CAD $1,060,000 is for concrete and CAD $620,000 is for steel reinforcement. Material cost estimates include transport to site.

The majority of the cost is associated with the cost of the concrete and steel reinforcement. There may be a potential cost saving if these materials can be supplied or sourced locally.

The cost estimate is based on the following assumptions:

- This cost estimate only includes direct implementation costs and excludes the costs of any additional studies or design required.
- This cost estimate includes an estimated cost of a geotechnical field investigation, geotechnical laboratory testing, feasibility level design and direct implementation costs.
- Geotechnical field investigation estimate assumes:
  - Geotechnical drilling contractor is based in the lower mainland of British Columbia.
  - A combined mobilization and demobilization cost of CAD $30,000.
  - Mud-rotary drilling at a rate of CAD $300 per metre.
  - Six drill holes, each 20 m deep.
  - Completion of one drill hole per day.
- Geotechnical laboratory estimate consists of grain size analysis by sieve and hydrometer tests, Atterberg Limits tests, moisture content tests, and triaxial tests.

- The design cost estimate assumes 160 hours at CAD $208 for an intermediate engineer and 80 hours at CAD $265 for a senior engineer.
- The cost estimate for the geotechnical investigation is an indicative cost and may change due to contractor's rates, material costs and scope.
- The laboratory and design costs are conceptual estimates and may change due to the findings of the field investigation.
- All work will be carried out in summer or fall months. No allowance has been made for winter work, heating or hoarding.
- Drilling contractor is based in Vancouver or Edmonton.
- Labour is local to Whitehorse; four hours of travel has been included for crew mobilization and demobilization.
- Labour was assumed at 70 hours per week average based on seven days per week of 10-hour shifts. Crew turnarounds every 21 shifts.
- Living out allowance is CAD $285 per day.
- Heavy equipment mobilization out of Whitehorse.
- Materials are sourced from Edmonton.
- It is assumed that the length of the secant pile wall is 160 m and 21 m deep (5 m of pile will founded in bedrock), with each pile 1 m in diameter at 0.7 m centres.
- A concrete batch plant will be set up on site, and concrete can be batched at a cost of CAD $400 per m^3.
- Reinforcement is included in every second pile at 125 kg per meter of reinforced pile, in order to form a retaining wall that will support the FCDC in the event that the overburden down slope of the pile wall were to fail. The amount of reinforcement will need to be confirmed during feasibility and detailed level design.
- Sufficient lay down are is available for equipment and materials near the project location with a minimum width or four metres and length of 40 metres.
- No traffic control will be required during project construction.

AACE Class 3 cost estimation methods were used to estimate the cost of the Secant Pile Wall, however, the cost estimate is considered to be closer to an AACE Class 4 estimate when the additional studies (field investigation, laboratory testing and design) required are considered.

4.5 Comparison of Potential Mitigation Options

The four mitigation options that were progressed to the conceptual design level were compared using the following criteria: design life, cost, the need for additional work, and special requirements. The results of this comparison are summarized in Table 2.

Table 2: Comparison of Potential Mitigation Options

Mitigation Option	Design Life Estimate	Cost Estimate[a]	Additional Work Required	Special Requirements
Do nothing	Approximately 8-10 years	-	■ None	■ None
Minor re-sloping to angle of repose.	Approximately 10 years	Approximately CAD $45,000[b]	■ None	■ None
Geofabric/ geotextile/mesh system	Approximately 15 years[c]	Approximately CAD $864,000[d]	■ geotechnical investigation to determine overburden material properties ■ feasibility level design and cost estimate ■ detailed design	■ Experienced installation contractor
Secant pile wall	Approximately 30 years or longer	Approximately CAD $3,590,000[d]	■ geotechnical investigation to determine overburden material properties and depth to bedrock ■ feasibility level design and cost estimate ■ detailed design	■ Specialist designer and contractor

a) Cost estimate only includes cost of installation and does not include the cost of additional investigations, feasibility studies, design or project management.

b) This is considered an AACE Class 3 level estimate.

c) The approximately 15 year design life consists of an approximate 5 year design life of the geofabric/geotextile/mesh system and approximately 10 year design life of natural erosion.

d) This is considered closer to an AACE Class 4 level estimate.

At the request of FMRP, Golder completed a high level ranking of the options. Each of the options were assigned a ranking of between 1 and 4, relative to one another, for each criterion. The criteria were: design life, cost, the need for additional work, health and safety, and special requirements. All criteria were weighted equally. A ranking of 1 is the most preferred and 4 is the least preferred. The rankings may be subject to change depending on which criteria are most important to FMRP.

Table 3: Ranking of Potential Mitigation Options

Mitigation Option	Design Life Estimate	Cost Estimate	Health and Safety	Additional Investigations	Special Requirements	Cumulative Total[a]	Overall Rank
Do nothing	4	1	1	1	1	8	1
Minor re-sloping to angle of repose	3	2	2	2	2	11	2
Geofabric/ geotextile/ mesh system	2	3	3	3	3	14	3
Secant pile wall	1	4	4	4	4	17	4

a) This is the cumulative total of the rankings for each criterion.

5.0 CONCLUSIONS

The assessment indicates that:

- The do nothing option may be the most preferable interim mitigation measure if the existing rate of regression and risk of possible faster regression, due to a sudden failure of the overhangs and/or possible wetter year/s, is acceptable.
- The re-sloping option is preferable if the existing rate of regression is acceptable, and the reduced likelihood of a sudden loss of overburden material is desired. The majority of the cost for this option is associated with the cost of the chains. There may be a potential cost saving if suitable chains are available on site or can be sourced locally. It is suggested that any large bushes that may prevent the chains from being dragged along the crest are trimmed. Trimming will reduce the likelihood of the bushes becoming entangled with the chains and uprooting the bushes and their root systems. Suitable health and safety mitigation measures are to be taken when trimming any bushes near the overburden crest.
- The geofabric/geotextile/mesh system option may be a suitable interim mitigation measure if a design life of approximately 15 years is required. It is expected, however, that this mitigation measure will degrade over time due to seasonal changes in temperature (-40°C to 20°C), the active freeze-thaw zone (which may loosen soil nails) and UV radiation exposure. This option is, therefore, only suitable as an interim measure.
- The secant pile wall may be suitable as a longer term mitigation measure if the bedrock in which it is founded is stable. This seems possible since BGC (2016) indicated that further regression of the North Instability Zone is likely limited by the presence of the relatively fresh and massive quartz monzonite unit encountered behind the crest. The majority of the cost is associated with the cost of the concrete and steel reinforcement. There may be a potential cost saving if these materials can be supplied or sourced locally.

- Geotechnical investigations will be required for the geofabric/geotextile/mesh system and secant pile wall options to determine the material properties of the overburden. The secant pile wall option will also require the confirmation of bedrock depth along its alignment.
- The costs have been estimated using AACE Class 3 cost estimation methods, but Options 3 and 4 require further investigations and design to be considered within the AACE Class 3 accuracy range. The additional studies are beyond the scope of this current work. The cost estimate accuracy of Option 1 and 2 are considered AACE Class 3 accuracy, however, the cost estimate accuracy of Options 3 and 4 are closer to AACE Class 4 when the additional investigations and designs required are considered.

6.0 RECOMMENDATIONS

It is recommended that:

- The four conceptual mitigation options, described in this document, are compared to the proposed FCD channel realignment. If desired, Golder is available to provide a cost estimate for the FCD channel realignment, or assist with options comparison.
- Geotechnical investigations are carried out prior to the feasibility design of either the geofabric/geotextile/mesh system or secant pile wall option.
- Feasibility level and detailed designs are carried out prior to the implementation of either the geofabric/geotextile/mesh system or secant pile wall options.

7.0 CLOSURE

The reader is referred to the Study Limitations, which follows the text and forms an integral part of this memorandum.

We trust that the information provided in this technical memorandum meets your present needs. Should you have any questions or require additional information, please feel free to contact the undersigned.

GOLDER ASSOCIATES LTD.

PROFESSIONAL ENGINEER YUKON TERRITORY AL V. CHANCE Jan 3 2017

Malcolm Shang, BSc Eng, GDE
Geotechnical Specialist

Al Chance, PEng
Principal, Mining Geotechnical Engineer

MS/AVC/it/ah/ls

Attachments: Study Limitations
Figures 1 to 4
Attachment A: Option 4: Secant Pile Wall – Additional Load Slope Stability Analysis Figures

\\golder.gds\gal\burnaby\final\2014\dynamics numbers - mining division\1410944\1410944-014-tm-rev0-2016\1410944-014-tm-rev0-2016-overburden regression mitigation 19dec_16.docx

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STUDY LIMITATIONS

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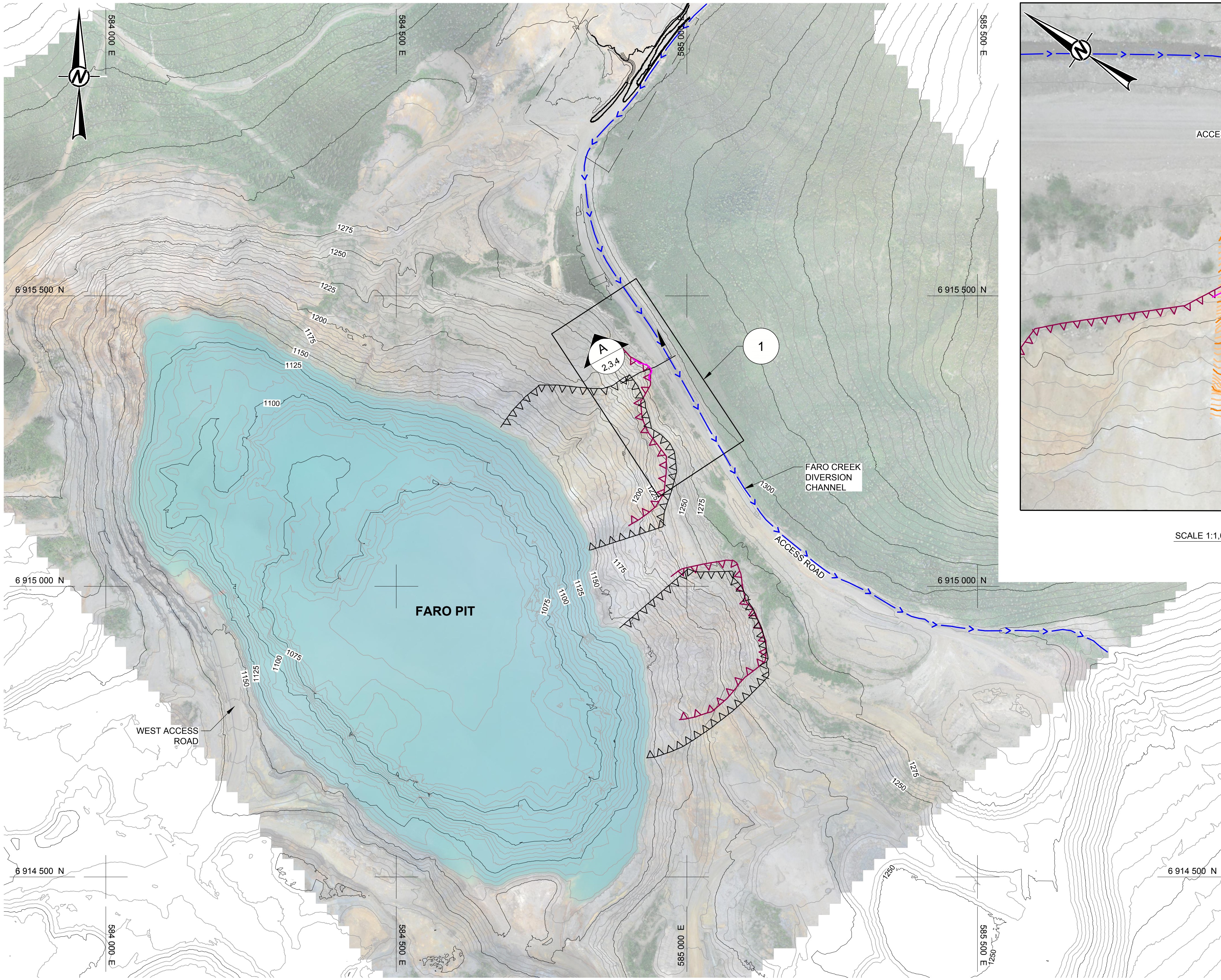
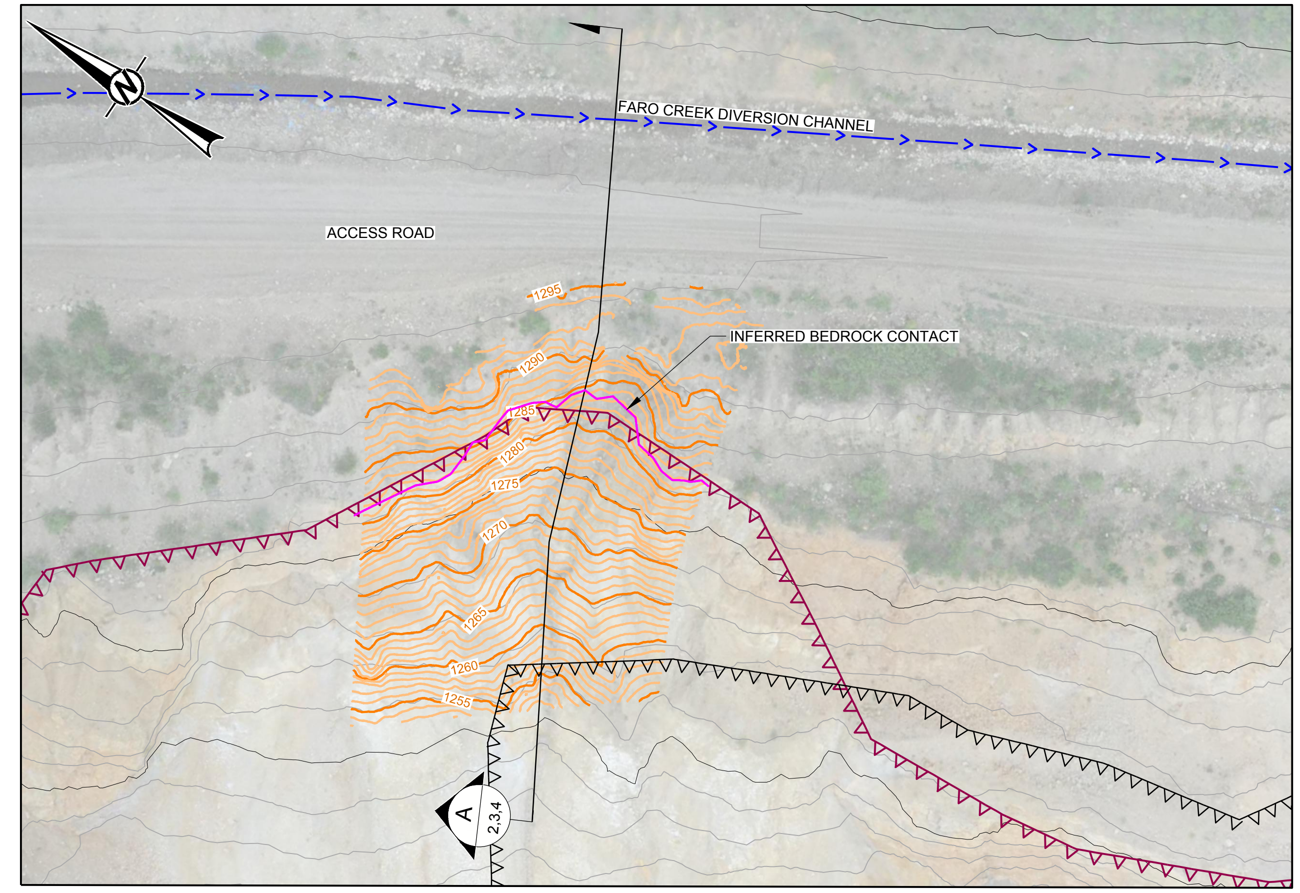




SCALE 1:1,000 m 1 OVERBURDEN CREST REGRESSION AREA

LEGEND

- INFERRED BEDROCK CONTACT
- EXTENT OF NORTH INSTABILITY ZONE (GOLDER 2016)
- EXTENT OF NORTH INSTABILITY ZONE (BCG 2016)

2003 LIDAR CONTOURS FROM CH2M HILL CANADA LTD.

- MAJOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

2016 UNMANNED AERIAL VEHICLE (UAV) SURVEY CONTOURS FROM GOLDER (2016)

- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

0 25 50
1:1,000 METRES

0 125 250
1:7,500 METRES

NOTES

1. ALL UNITS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM IS NAD 83, UTM.

REFERENCES

1. CONTOUR DATA PROVIDED BY GOVERNMENT OF YUKON, DATED: AUGUST 30, 2016, FILE: Faro_pit_50cm_contours.dwg.
2. OVERBURDEN CREST REGRESSION AREA CONTOUR DATA ACQUIRED VIA UNMANNED AERIAL VEHICLE (UAV) SURVEY (GOLDER 2016).
3. 2012 AIRPHOTO PROVIDED BY THE CLIENT.

CLIENT

Yukon Government

YUKON GOVERNMENT
FARO MINE REMEDIATION PROJECT

CONSULTANT

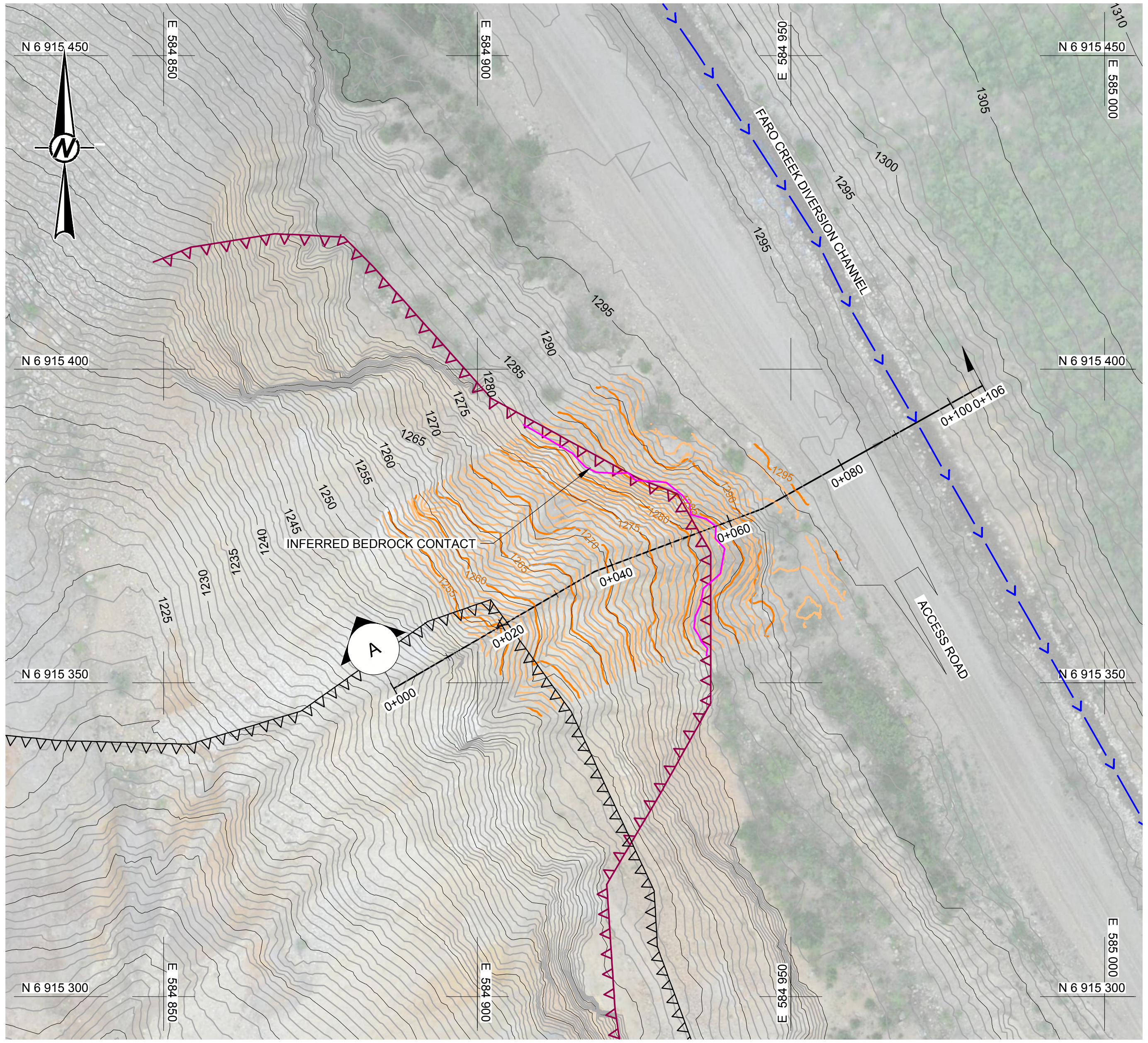
Golder Associates

YYYY-MM-DD	2016-12-06
PREPARED	JEF
DESIGN	MS
REVIEW	MS
APPROVED	AVC

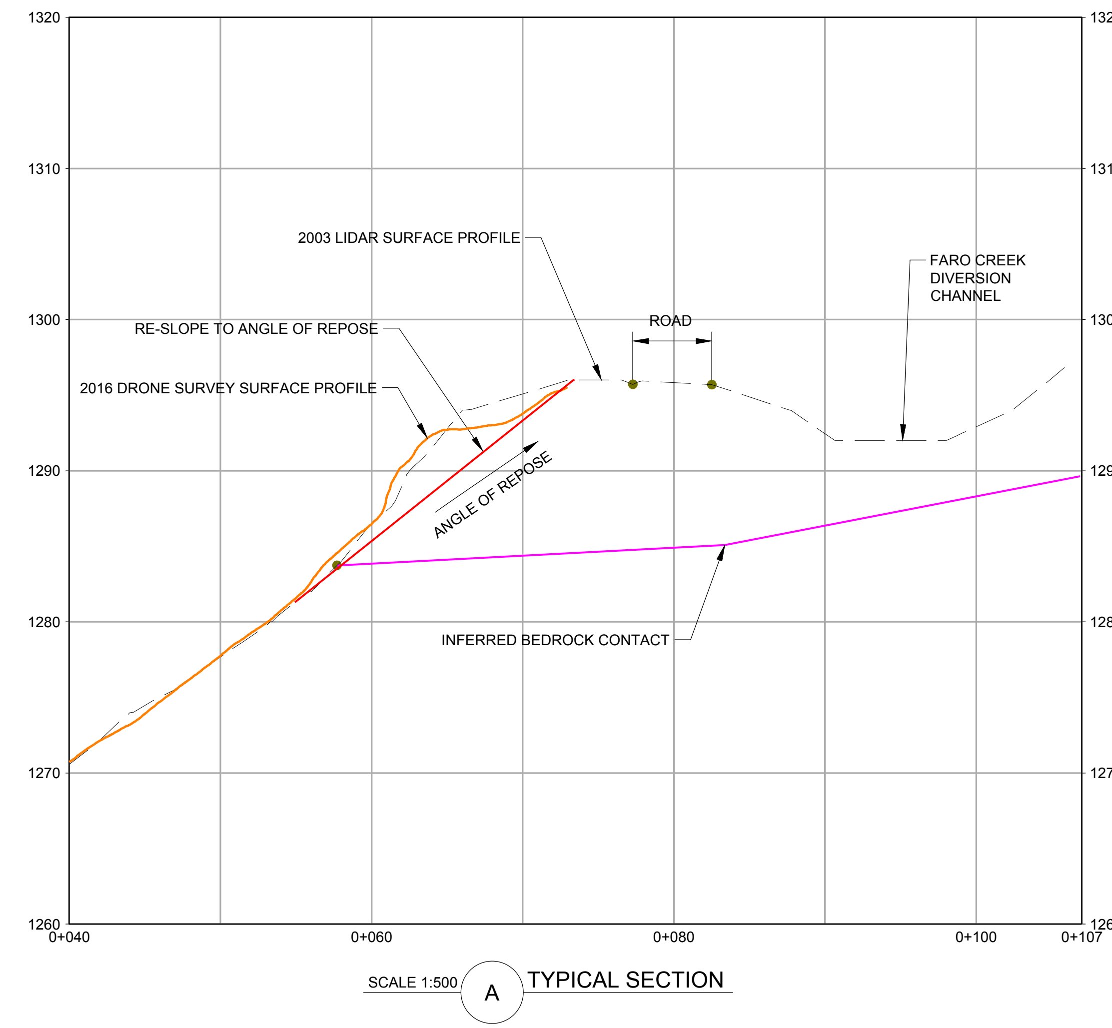
PROJECT
YG FARO MINE COMPLEX
FARO - MINING SUPPORT SERVICES

TITLE
LOCALITY PLAN

PROJECT No.	PHASE	Rev.	FIGURE
1410944	2016	0	1



PLAN VIEW
SCALE 1:1,000



SCALE 1:500 (A) TYPICAL SECTION

0 25 50
1:1,000 METRES

0 10 20
1:500 METRES

LEGEND

- INFERRED BEDROCK CONTACT
- EXTENT OF NORTH INSTABILITY ZONE (GOLDER 2016)
- EXTENT OF NORTH INSTABILITY ZONE (BCG 2016)

2003 LIDAR CONTOURS FROM CH2M HILL CANADA LTD.

- MAJOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

2016 UNMANNED AERIAL VEHICLE (UAV) SURVEY CONTOURS FROM GOLDER (2016)

- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

NOTES

1. ALL UNITS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM IS NAD 83, UTM.
3. CONTOUR INTERVAL SHOWN AT 1 m MINOR AND 5 m MAJOR.

REFERENCE

1. CONTOUR DATA PROVIDED BY GOVERNMENT OF YUKON, DATED: AUGUST 30, 2016, FILE: Faro_pit_50cm_contours.dwg.
2. OVERBURDEN CREST REGRESSION AREA CONTOUR DATA ACQUIRED VIA UNMANNED AERIAL VEHICLE (UAV) SURVEY (GOLDER 2016).
3. 2012 AIRPHOTO PROVIDED BY THE CLIENT.

CLIENT
YUKON GOVERNMENT
FARO MINE REMEDIATION PROJECT

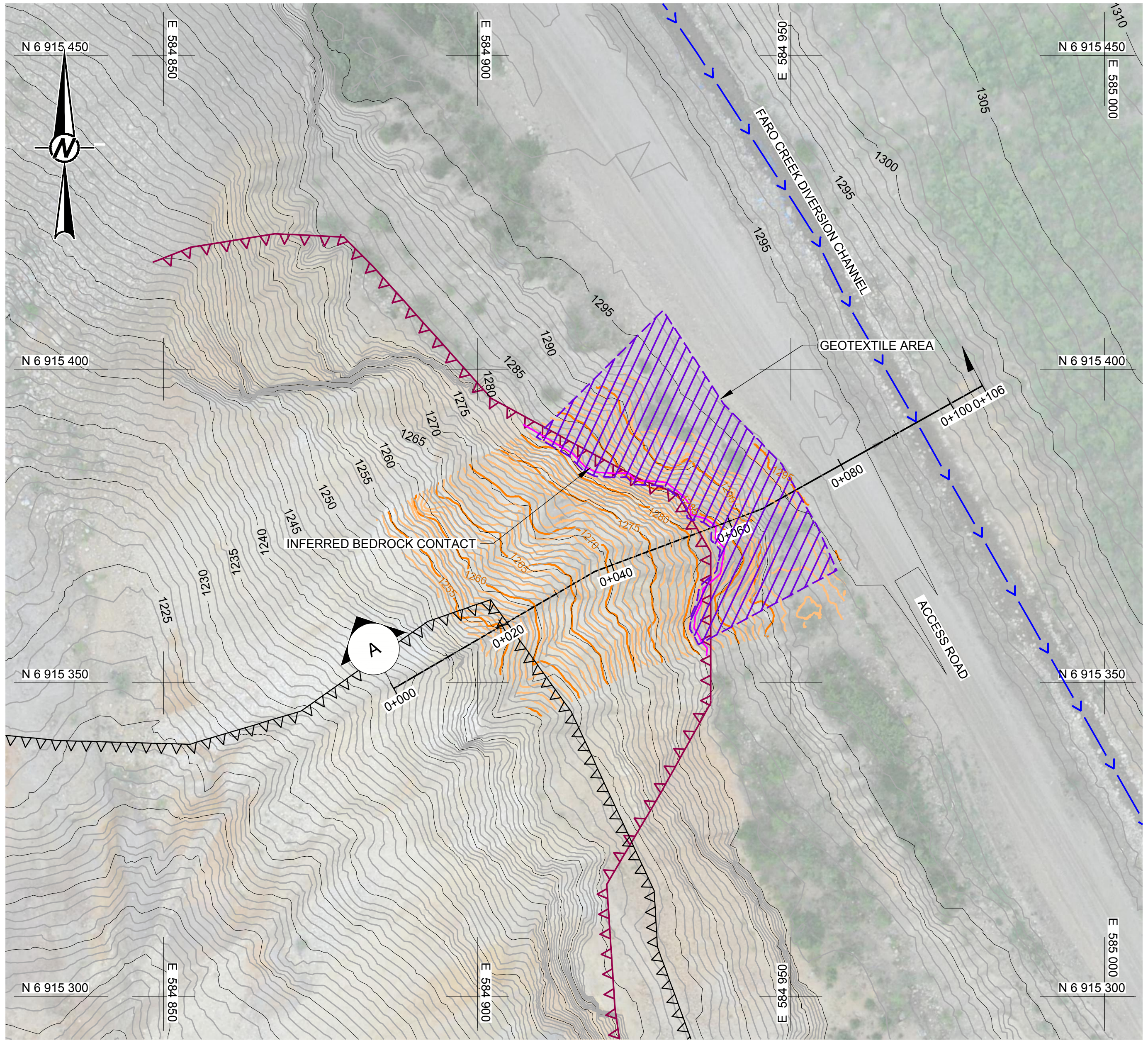
PROJECT
YG FARO MINE COMPLEX
FARO - MINING SUPPORT SERVICES

CONSULTANT

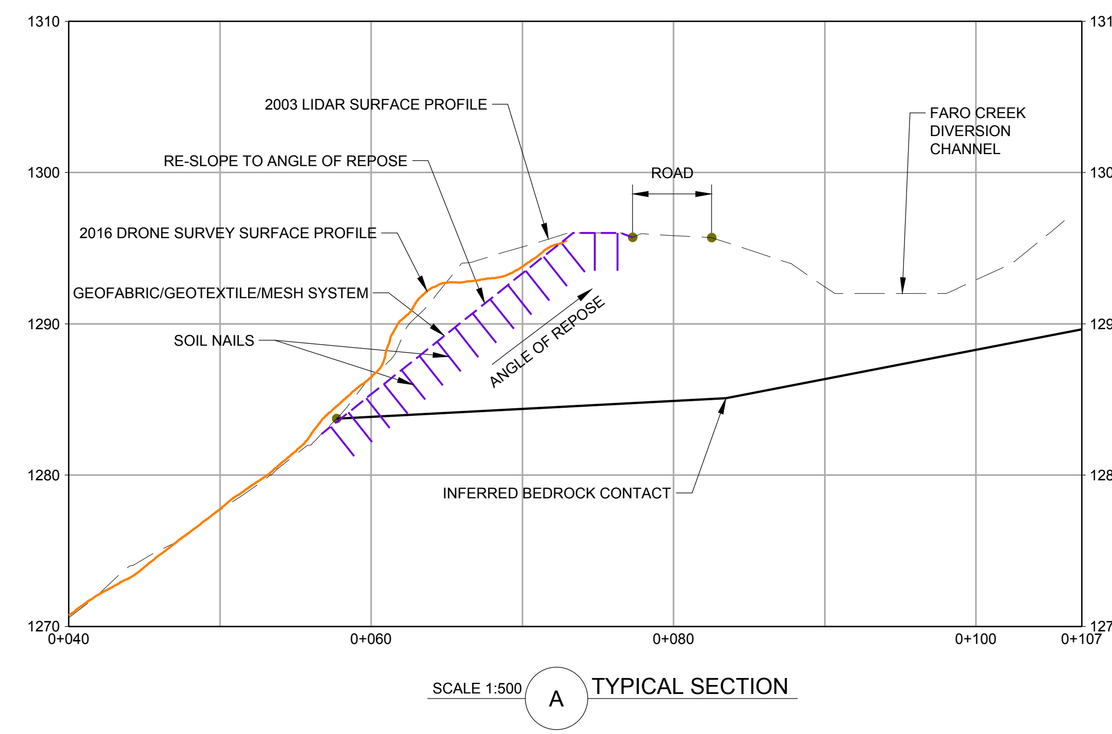
YYYY-MM-DD	2016-12-06
PREPARED	JEF
DESIGN	MS
REVIEW	MS
APPROVED	AVC

TITLE
FARO CREEK DIVERSION OVERBURDEN REGRESSION MITIGATION
OPTION 2: MINOR RE-SLOPING

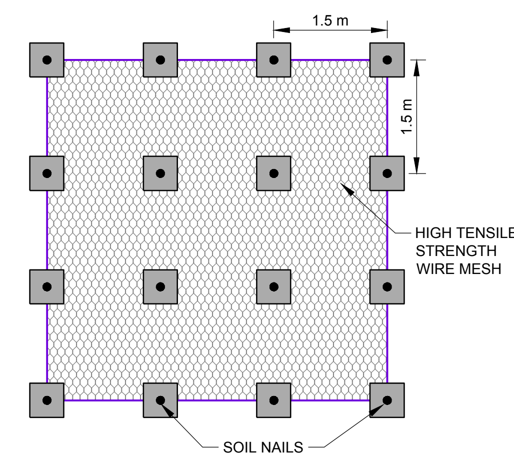
PROJECT No.	PHASE	Rev.	FIGURE
1410944	2016	0	2



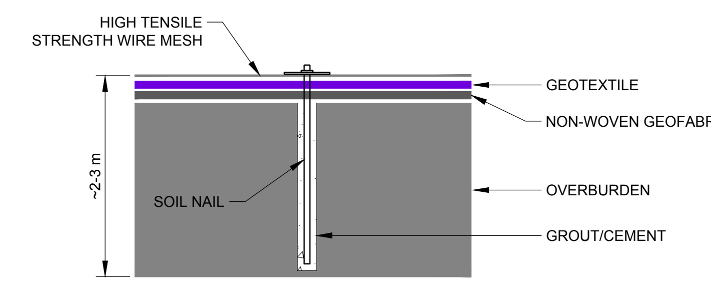
PLAN VIEW
SCALE 1:1,000



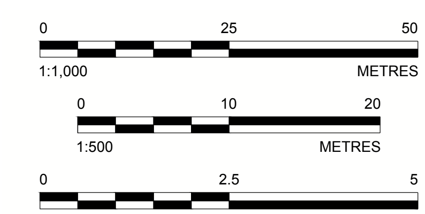
SCALE 1:500 A TYPICAL SECTION



GEOFABRIC/GEOTEXTILE/MESH SYSTEM
TYPICAL DETAIL - PLAN VIEW
SCALE 1:100



GEOFABRIC/GEOTEXTILE/MESH SYSTEM
TYPICAL DETAIL - SECTION VIEW
SCALE 1:100



LEGEND

- INFERRED BEDROCK CONTACT
- EXTENT OF NORTH INSTABILITY ZONE (GOLDER 2016)
- EXTENT OF NORTH INSTABILITY ZONE (BCG 2016)

2003 LIDAR CONTOURS FROM CH2M HILL CANADA LTD.

- MAJOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

2016 UNMANNED AERIAL VEHICLE (UAV) SURVEY CONTOURS FROM GOLDER (2016)

- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

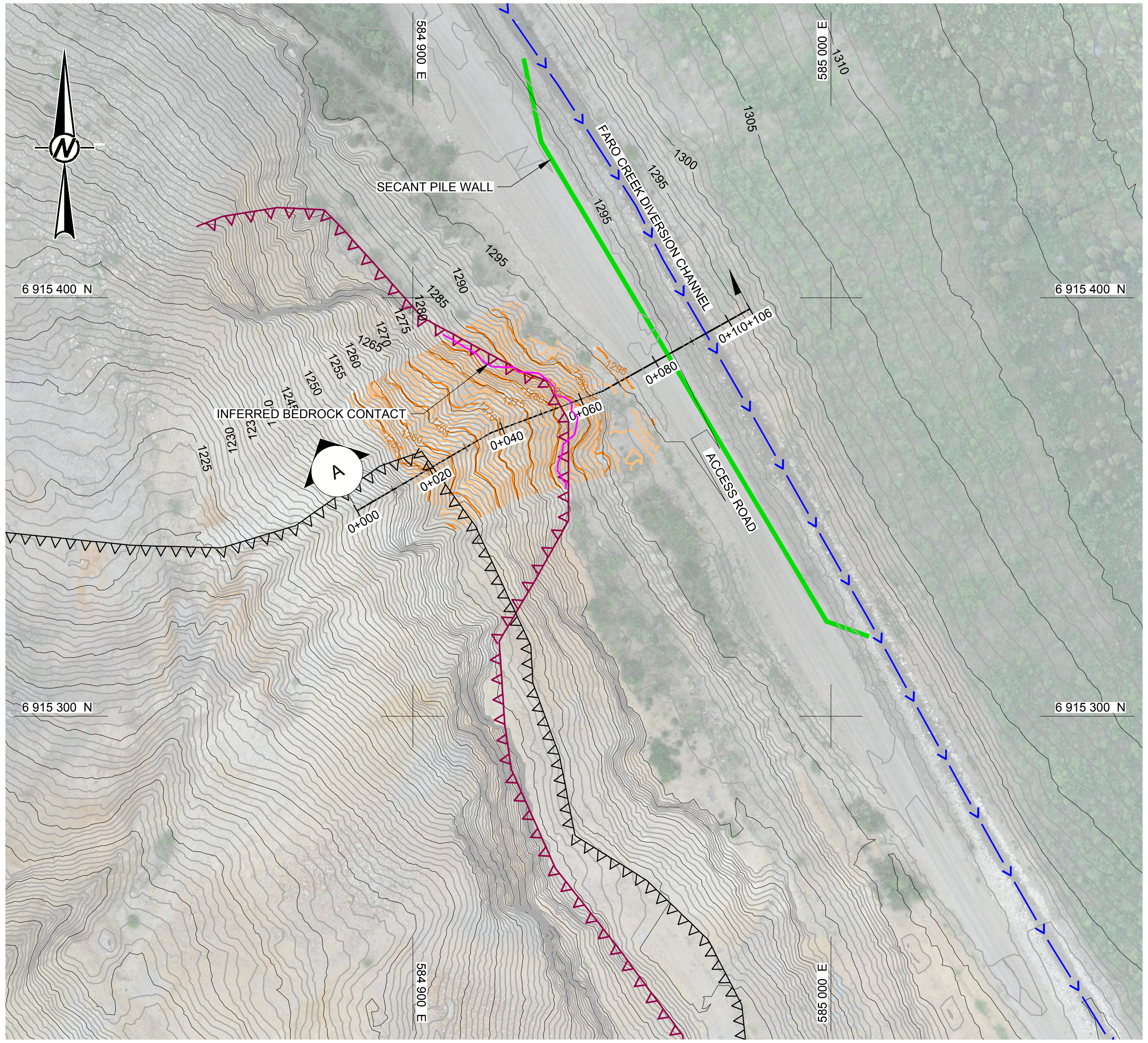
NOTES

1. ALL UNITS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM IS NAD 83, UTM.
3. CONTOUR INTERVAL SHOWN AT 1 m MINOR AND 5 m MAJOR.

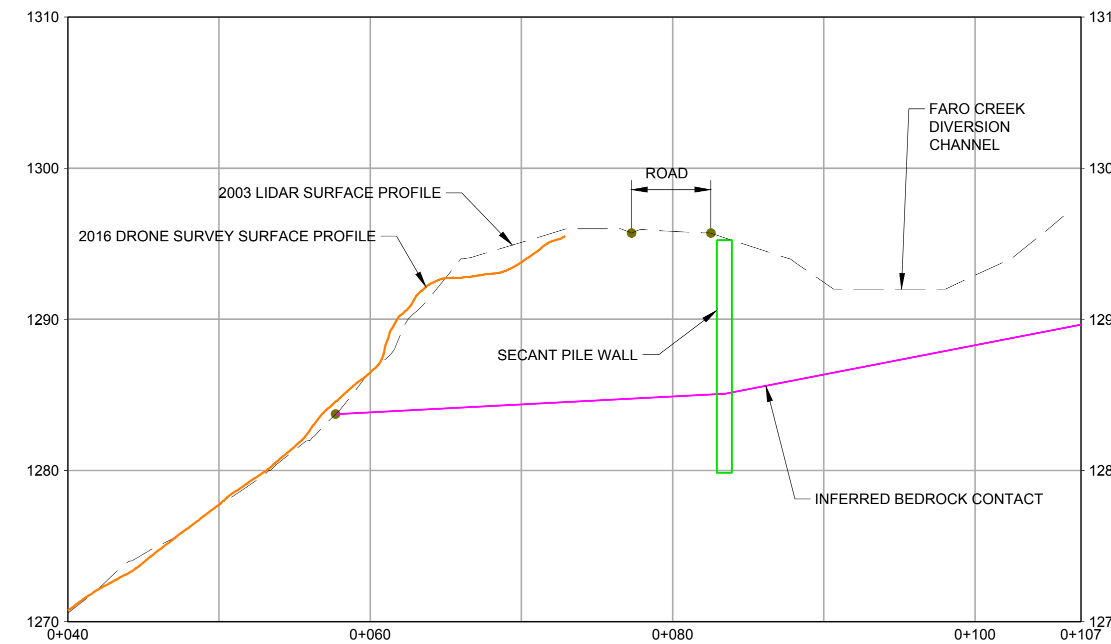
REFERENCE

1. CONTOUR DATA PROVIDED BY GOVERNMENT OF YUKON, DATED: AUGUST 30, 2016, FILE: Faro_pit_50cm_contours.dwg.
2. OVERBURDEN CREST REGRESSION AREA CONTOUR DATA ACQUIRED VIA UNMANNED AERIAL VEHICLE (UAV) SURVEY (GOLDER 2016).
3. 2012 AIRPHOTO PROVIDED BY THE CLIENT.

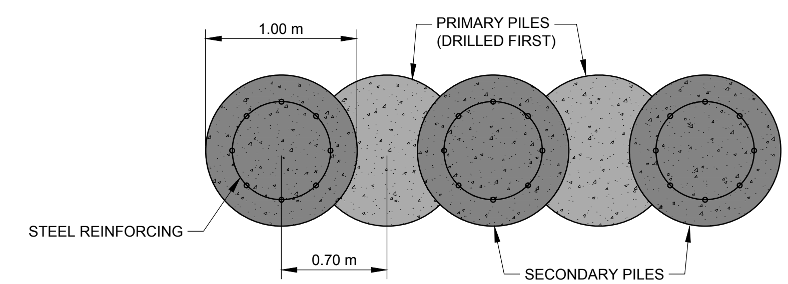
CLIENT	YUKON GOVERNMENT FARO MINE REMEDIATION PROJECT
PROJECT	YG FARO MINE COMPLEX FARO - MINING SUPPORT SERVICES
CONSULTANT	Golder Associates
YYYY-MM-DD	2016-12-06
PREPARED	JEF
DESIGN	MS
REVIEW	MS
APPROVED	AVC
TITLE	FARO CREEK DIVERSION OVERBURDEN REGRESSION MITIGATION OPTION 3: GEOFABRIC/GEOTEXTILE/MESH SYSTEM
PROJECT No.	1410944
PHASE	2016
Rev.	0
FIGURE	3



PLAN VIEW
SCALE 1:1,500



SCALE 1:500 (A) TYPICAL SECTION



SECANT PILE WALL TYPICAL DETAIL - PLAN VIEW
SCALE 1:50

0 25 50
1:1,500 METRES

0 10 20
1:500 METRES

0 1 2
1:50 METRES

LEGEND

- INFERRED BEDROCK CONTACT
- EXTENT OF NORTH INSTABILITY ZONE (GOLDER 2016)
- EXTENT OF NORTH INSTABILITY ZONE (BCG 2016)

2003 LIDAR CONTOURS FROM CH2M HILL CANADA LTD.

- MAJOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

2016 UNMANNED AERIAL VEHICLE (UAV) SURVEY CONTOURS FROM GOLDER (2016)

- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 5 m)
- MINOR TOPOGRAPHIC CONTOUR (INTERVAL = 1 m)

NOTES

1. ALL UNITS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM IS NAD 83, UTM.
3. CONTOUR INTERVAL SHOWN AT 1 m MINOR AND 5 m MAJOR.

REFERENCE

1. CONTOUR DATA PROVIDED BY GOVERNMENT OF YUKON, DATED: AUGUST 30, 2016, FILE: Faro_pit_50cm_contours.dwg.
2. OVERBURDEN CREST REGRESSION AREA CONTOUR DATA ACQUIRED VIA UNMANNED AERIAL VEHICLE (UAV) SURVEY (GOLDER 2016).
3. 2012 AIRPHOTO PROVIDED BY THE CLIENT.

CLIENT	YUKON GOVERNMENT FARO MINE REMEDIATION PROJECT	PROJECT	YG FARO MINE COMPLEX FARO - MINING SUPPORT SERVICES
CONSULTANT	YYYY-MM-DD: 2016-12-06 PREPARED: JEF DESIGN: MS REVIEW: MS APPROVED: AVC	TITLE	FARO CREEK DIVERSION OVERBURDEN REGRESSION MITIGATION OPTION 4: SECANT PILE WALL
		PROJECT No. 1410944	PHASE 2016 · Rev. 0 · FIGURE 4

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25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

ATTACHMENT A
Secant Pile Wall – Additional Load Slope Stability Analysis Figures

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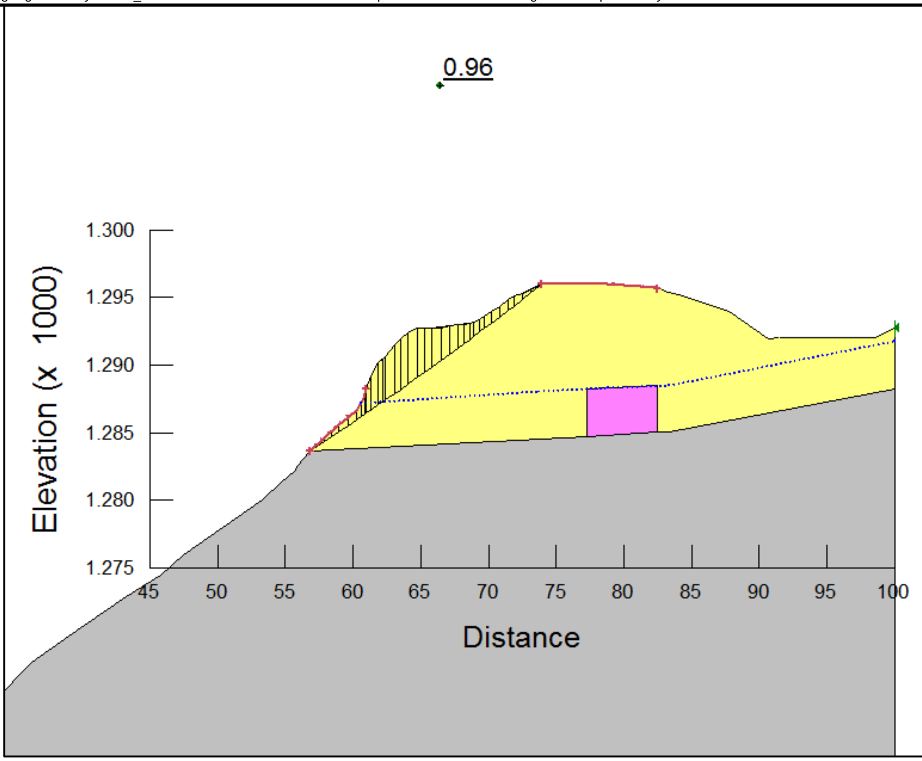

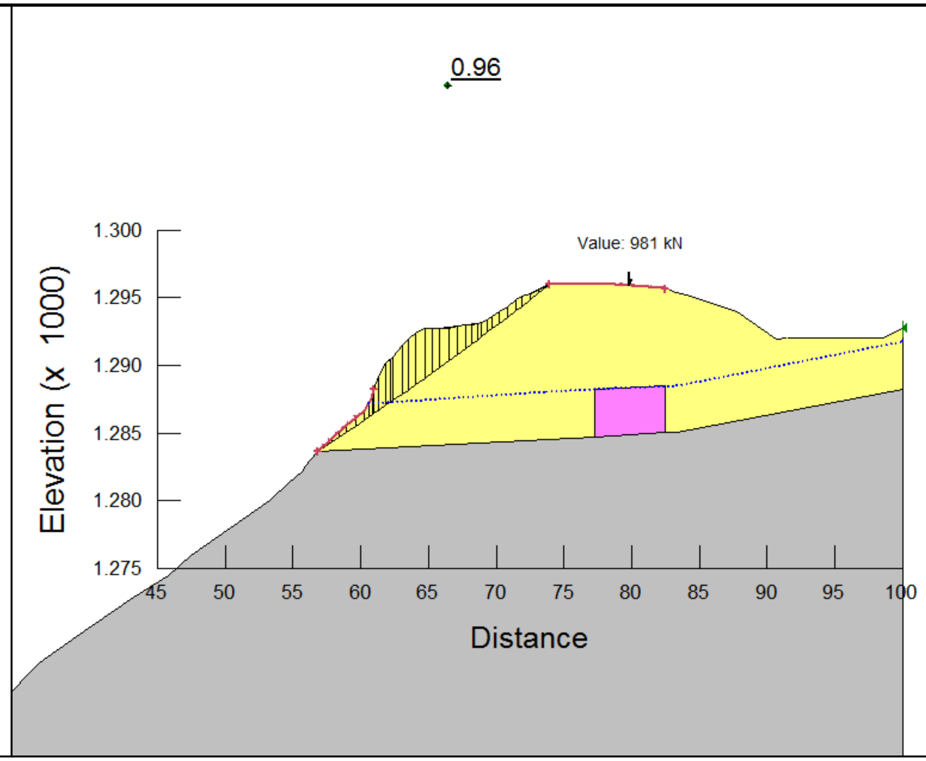

Material Properties				
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)	(yellow)	20	φ' = 35°, Cohesion = 0 kPa	0
Overburden (Till)	(magenta)	20	φ' = 35°, Cohesion = 0 kPa	1.0
Bedrock	(grey)	Impenetrable		

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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FARO, YUKON TERRITORY

PROJECT
FARO – MINING SUPPORT SERVICES

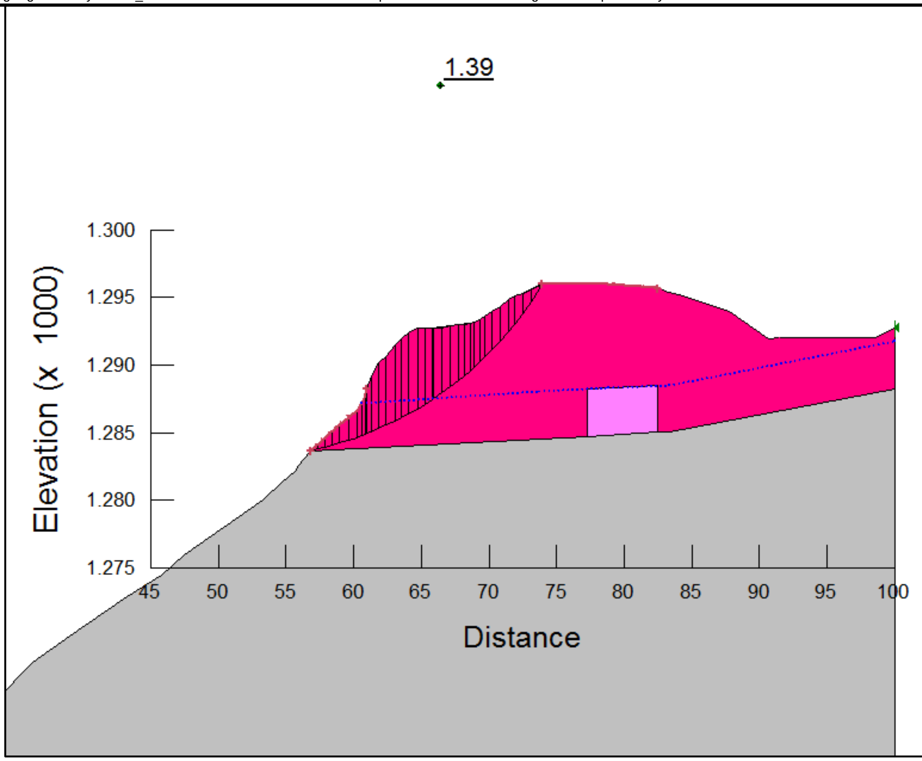
CONSULTANT

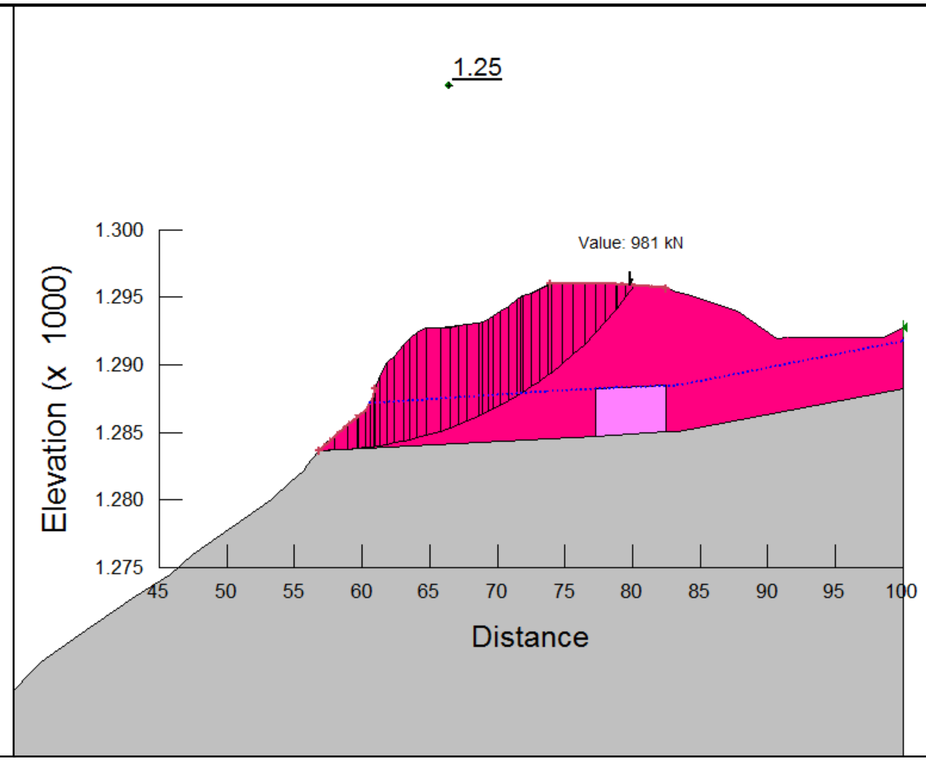
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL ADDITIONAL LOAD SLOPE STABILITY ANALYSIS UNDRAINED LOADING ; COHESION = 0

PROJECT No.	Phase/Task	Rev.	Figure
1410944	**2016 / 21203**	**0**	**A-1**

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Material Properties					
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)	(red)	20	φ' = 35°, Cohesion = 10 kPa	0
Overburden (Till)	(pink)	20	φ' = 35°, Cohesion = 0 kPa	1.0
Bedrock	(grey)	Impenetrable		

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

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CONSULTANT

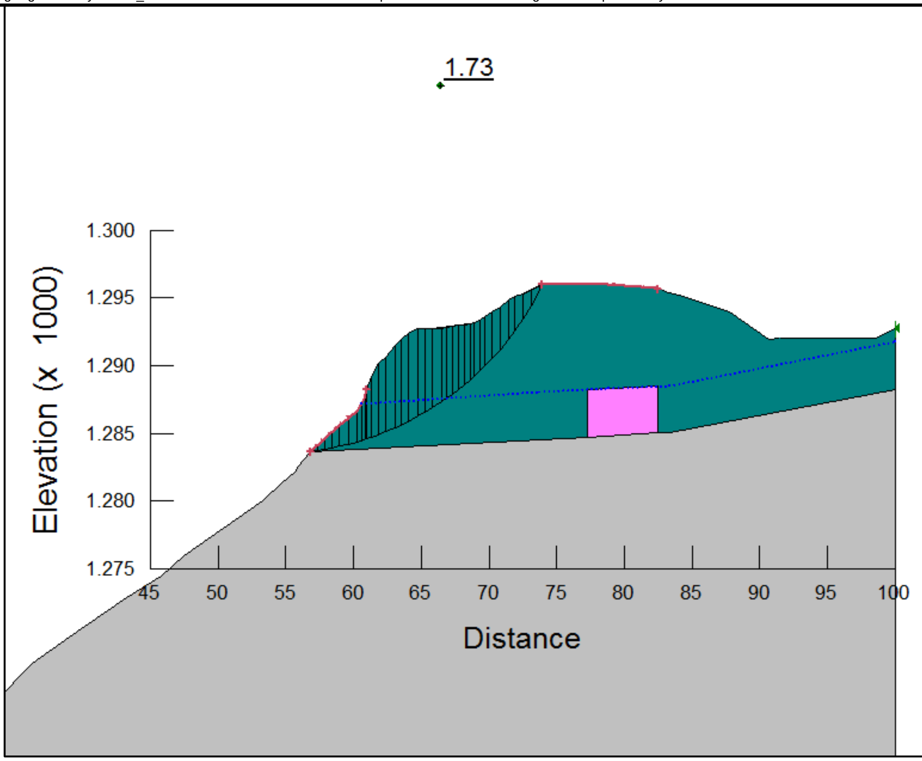
Golder Associates

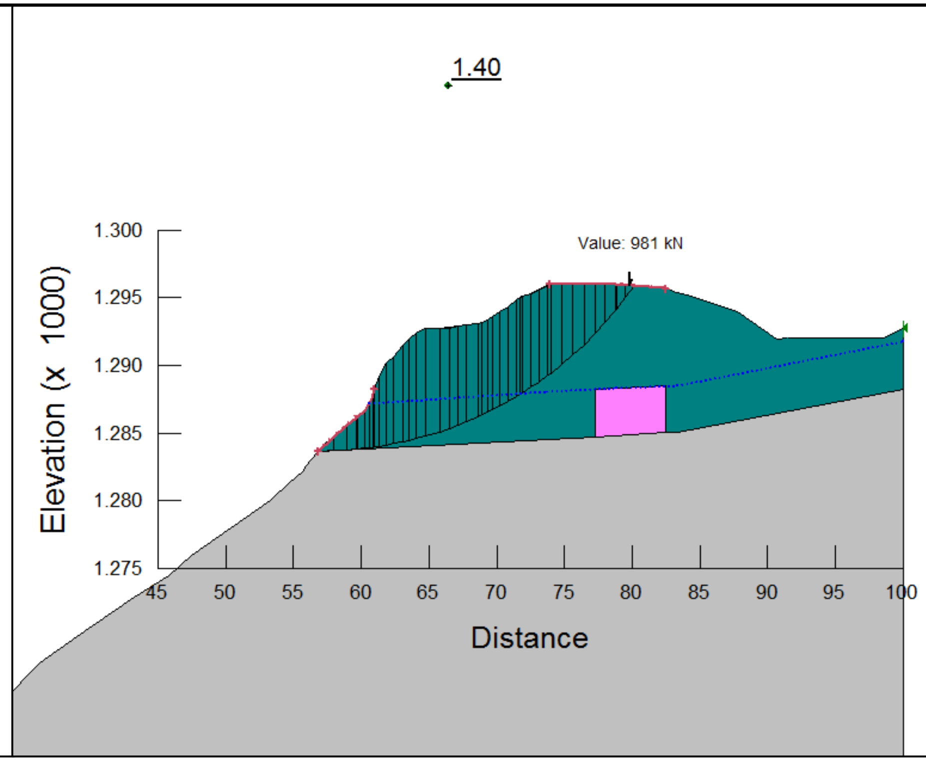
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
UNDRAINED LOADING ; COHESION = 10

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-2

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Material Properties				
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)		20	φ' = 35°, Cohesion = 20 kPa	0
Overburden (Till)		20	φ' = 35°, Cohesion = 0 kPa	1.0
Bedrock		Impenetrable		

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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FARO, YUKON TERRITORY

PROJECT
FARO – MINING SUPPORT SERVICES

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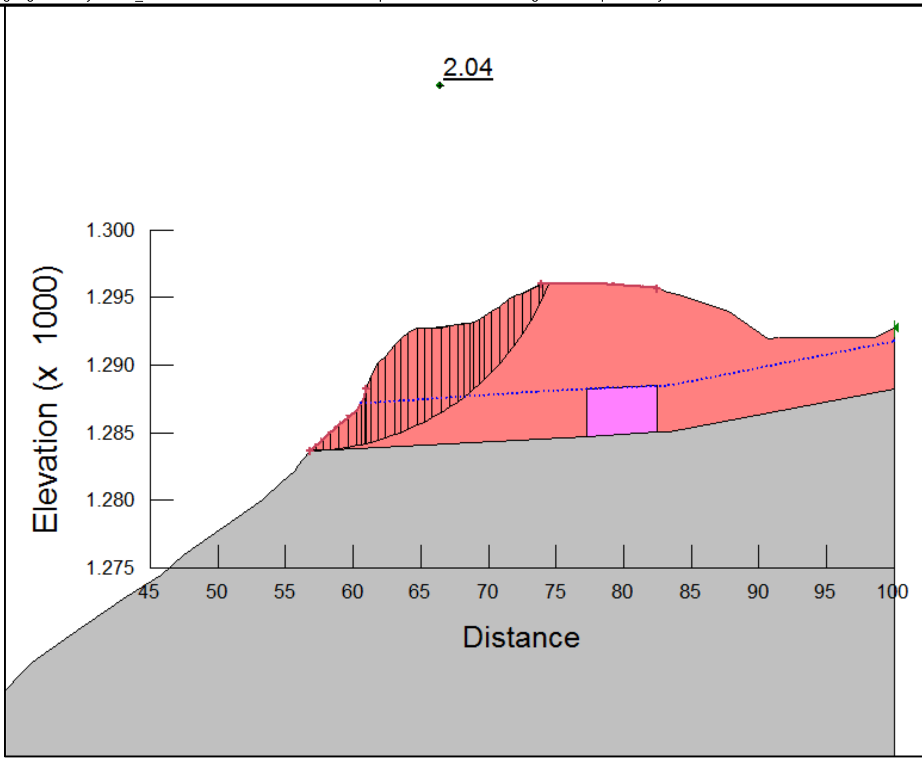
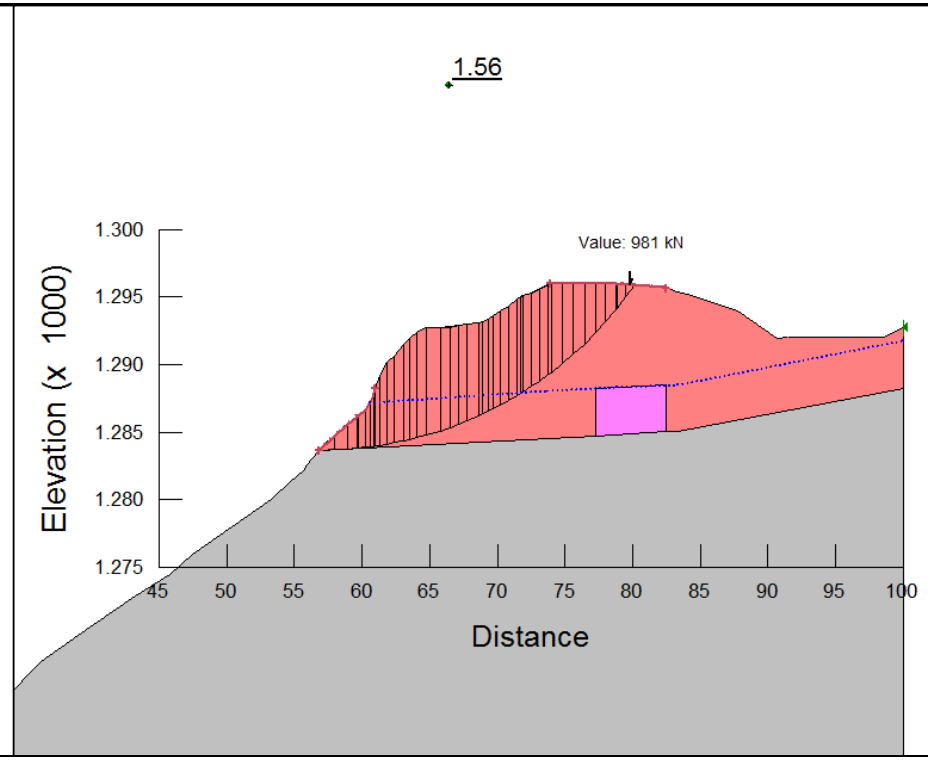
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
UNDRAINED LOADING ; COHESION = 20

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-3

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Material Properties				
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)		20	φ' = 35°, Cohesion = 30 kPa	0
Overburden (Till)		20	φ' = 35°, Cohesion = 0 kPa	1.0
Bedrock		Impenetrable		

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

CLIENT
GOVERNMENT OF YUKON
FARO, YUKON TERRITORY

CONSULTANT

Golder Associates

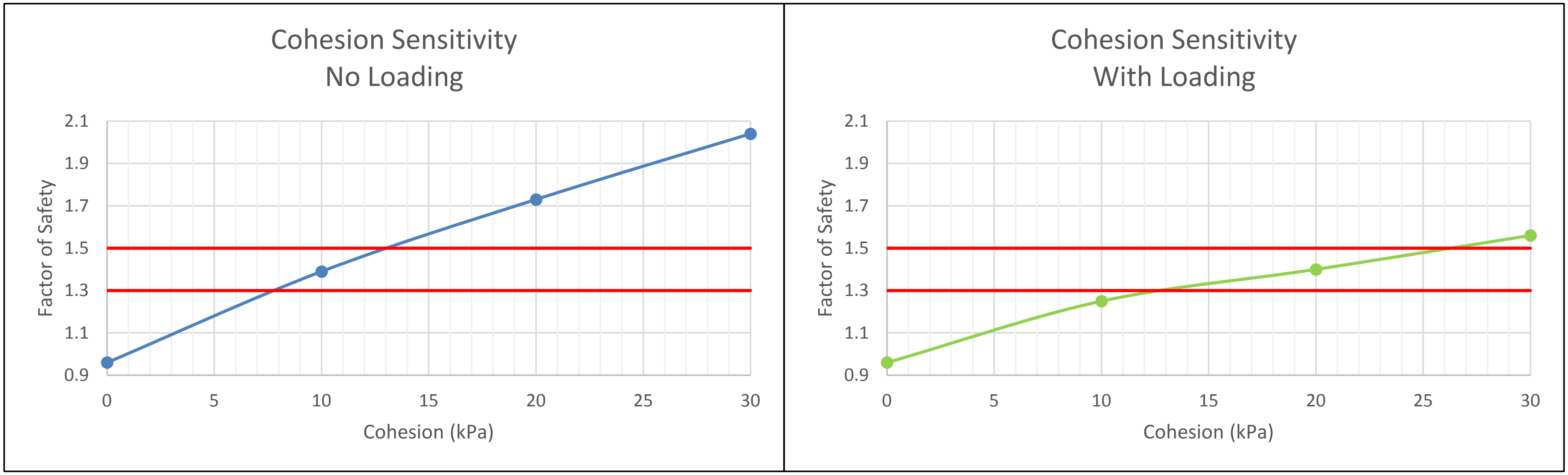
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

PROJECT
FARO – MINING SUPPORT SERVICES

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
UNDRAINED LOADING ; COHESION = 30

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-4

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability



Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

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GOVERNMENT OF YUKON
FARO, YUKON TERRITORY

PROJECT
FARO – MINING SUPPORT SERVICES

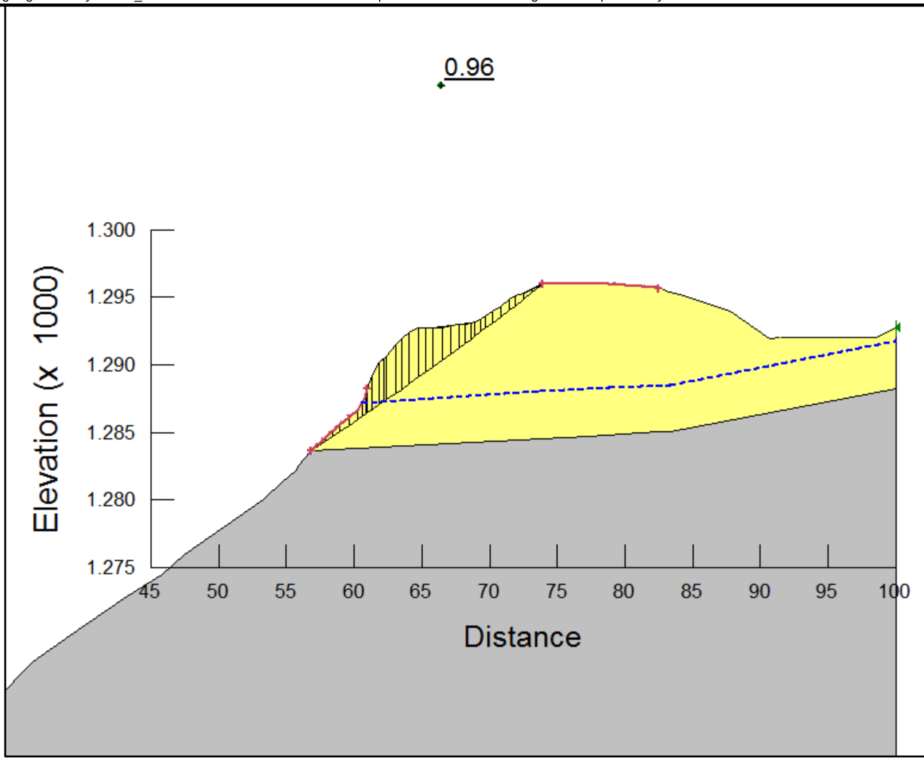
CONSULTANT

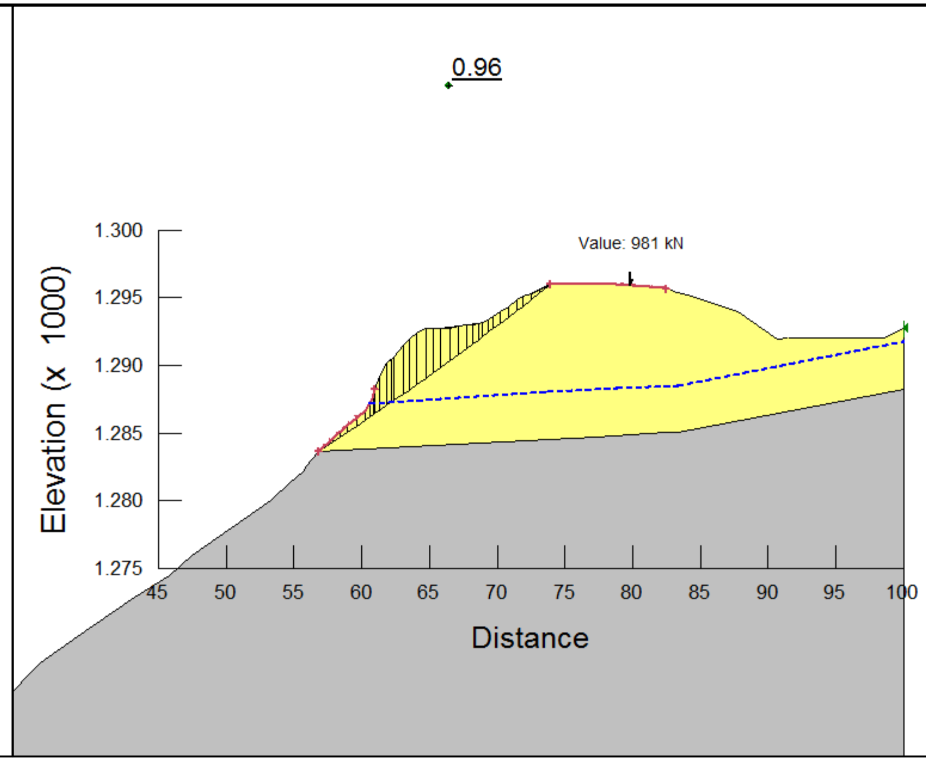
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
NO LOADING VS LOADING ASSUMING UNDRAINED LOADING

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-5

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Material Properties				
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)	(yellow)	20	φ' = 35°, Cohesion = 0 kPa	0
Bedrock	(grey)	Impenetrable		

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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PROJECT
FARO – MINING SUPPORT SERVICES

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YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
DRAINED LOADING ; COHESION = 0

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-6

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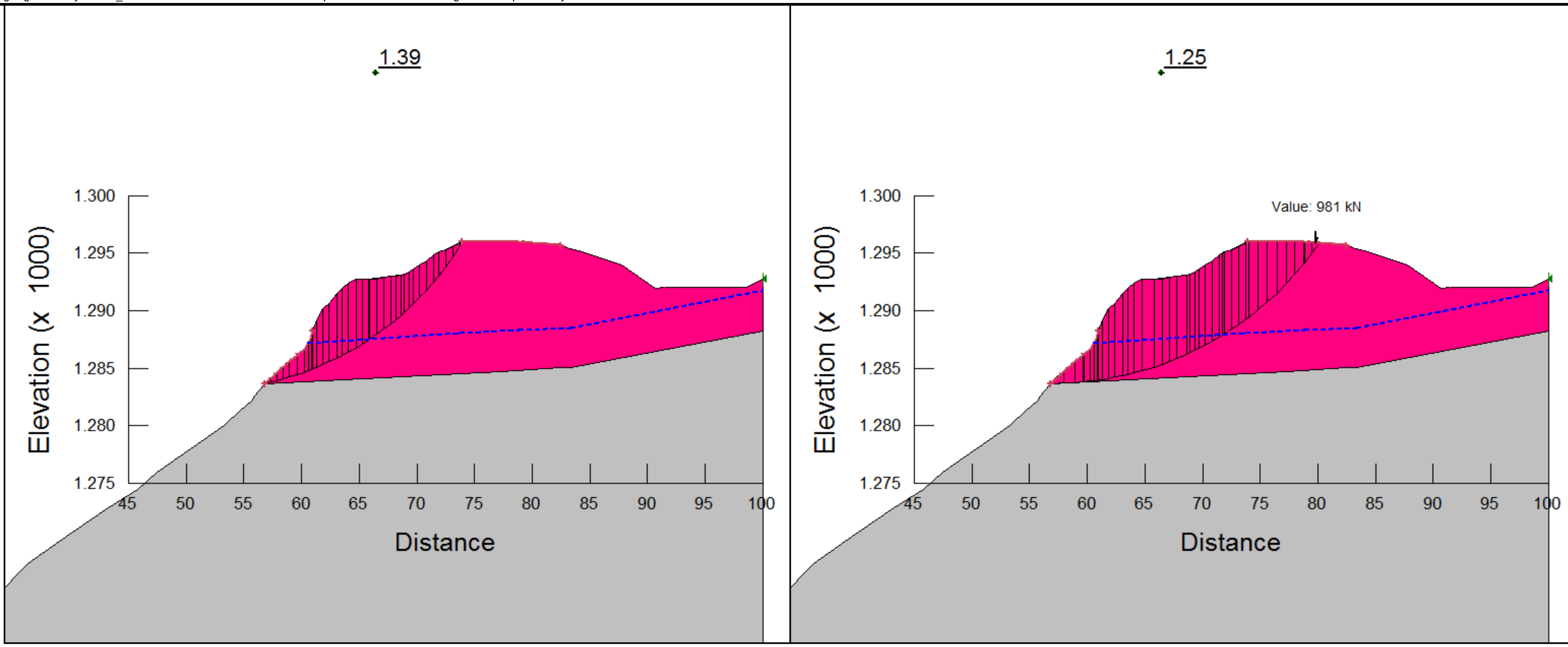

Material Properties					
Material		Unit Weight (kN/m³)	Shear Strength	B-Bar
Overburden (Till)		20	φ' = 35°, Cohesion = 10 kPa	0
Bedrock		Impenetrable		

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

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GOVERNMENT OF YUKON
FARO, YUKON TERRITORY

CONSULTANT

Golder Associates

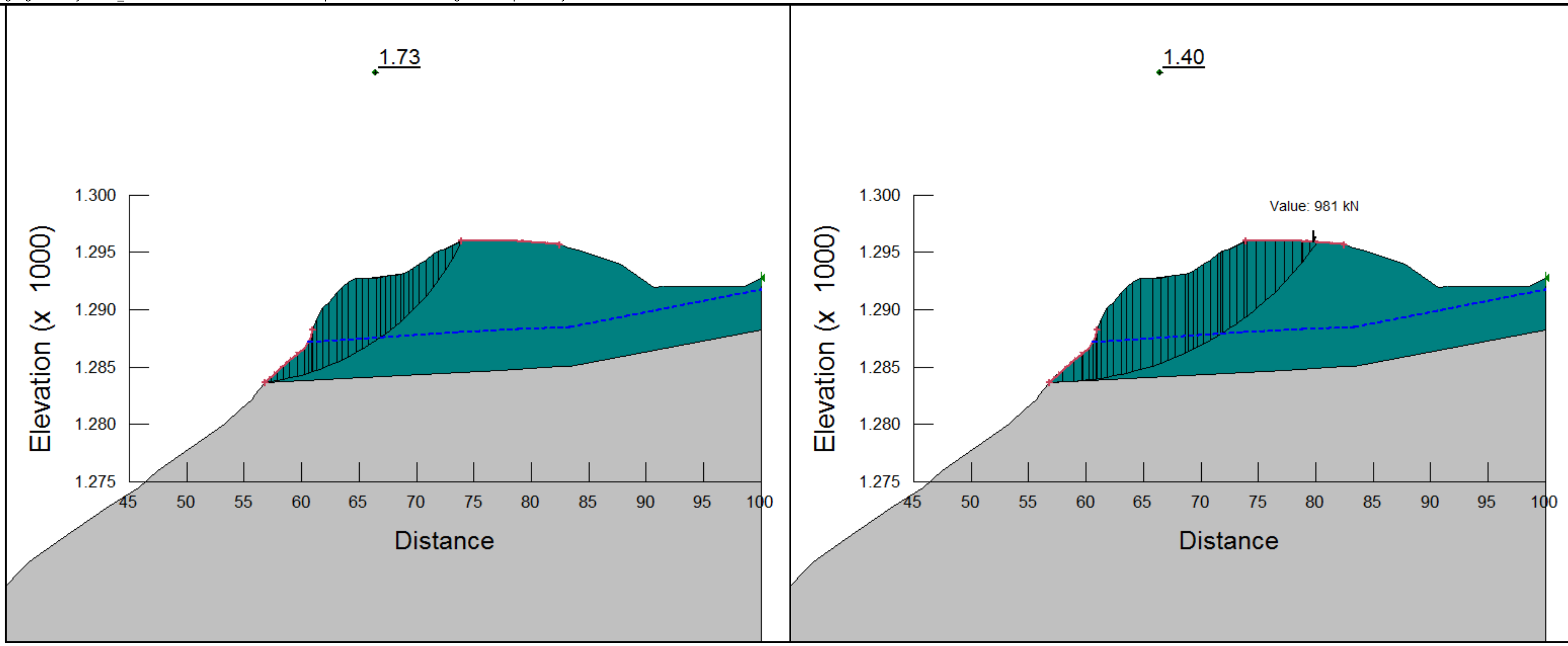
YYYY-MM-DD	2016-12-16
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

PROJECT
FARO – MINING SUPPORT SERVICES

TITLE
OPTION 4: SECANT PILE WALL ADDITIONAL LOAD SLOPE STABILITY ANALYSIS DRAINED LOADING ; COHESION = 10

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-7

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability



Material Properties				
Material		Unit Weight (kN/m³)	Shear Strength	B-Bar
Overburden (Till)		20	φ' = 35°, Cohesion = 20 kPa	0
Bedrock		Impenetrable		

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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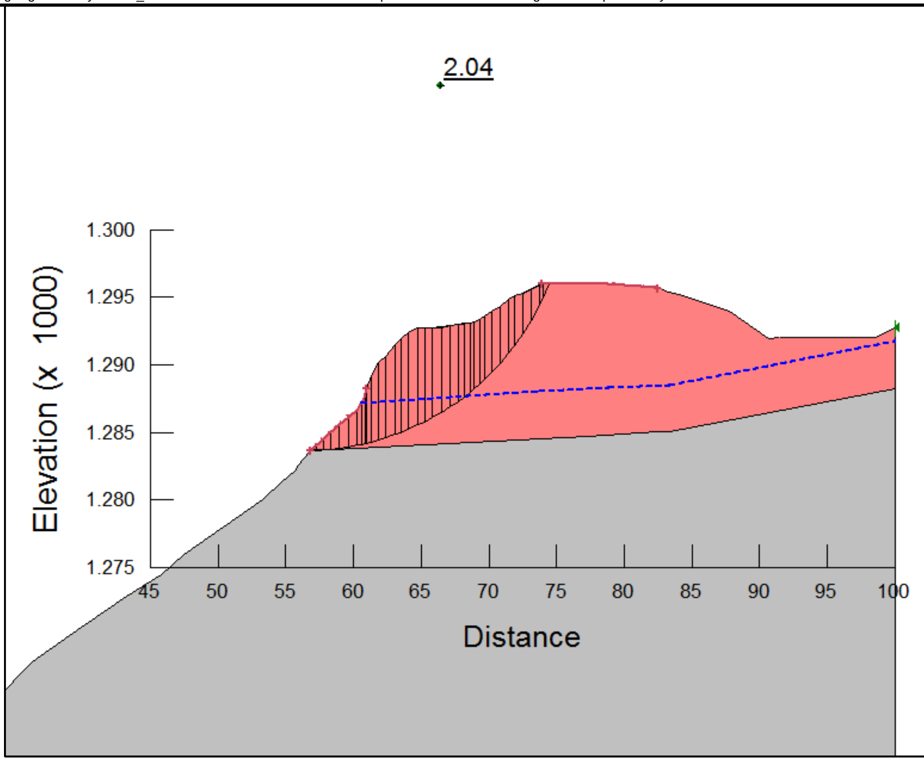
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

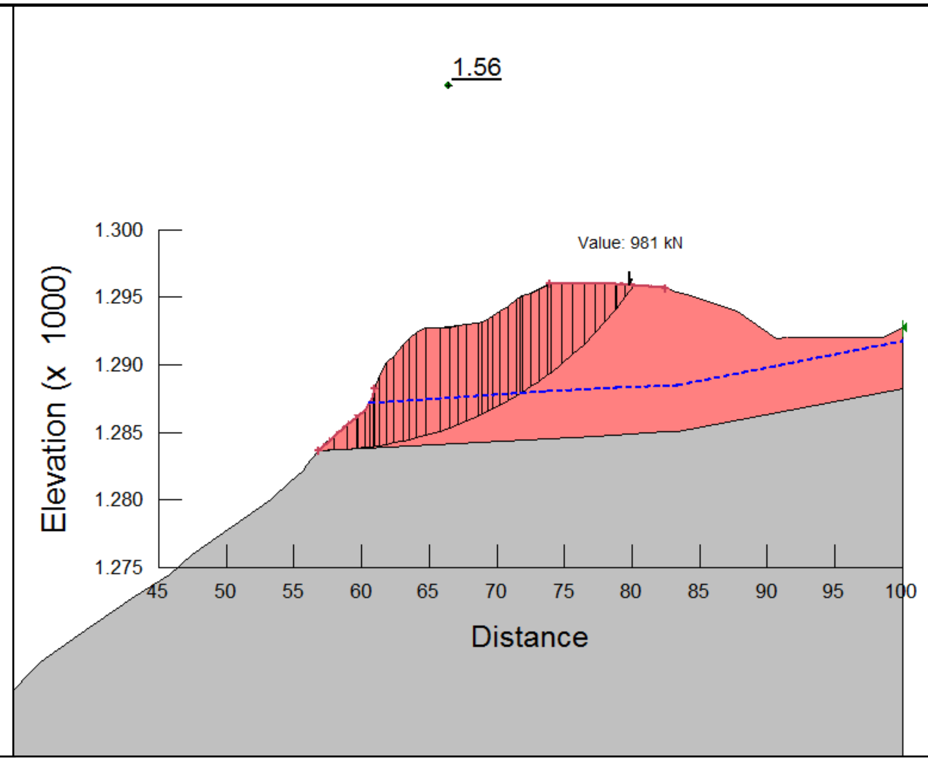
PROJECT
FARO – MINING SUPPORT SERVICES

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
DRAINED LOADING ; COHESION = 20

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-8

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Material Properties				
Material		**Unit Weight (kN/m³)**	**Shear Strength**	**B-Bar**
Overburden (Till)		20	φ' = 35°, Cohesion = 30 kPa	0
Bedrock		Impenetrable		

Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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YYYY-MM-DD	2016-12-16
PREPARED	CTM
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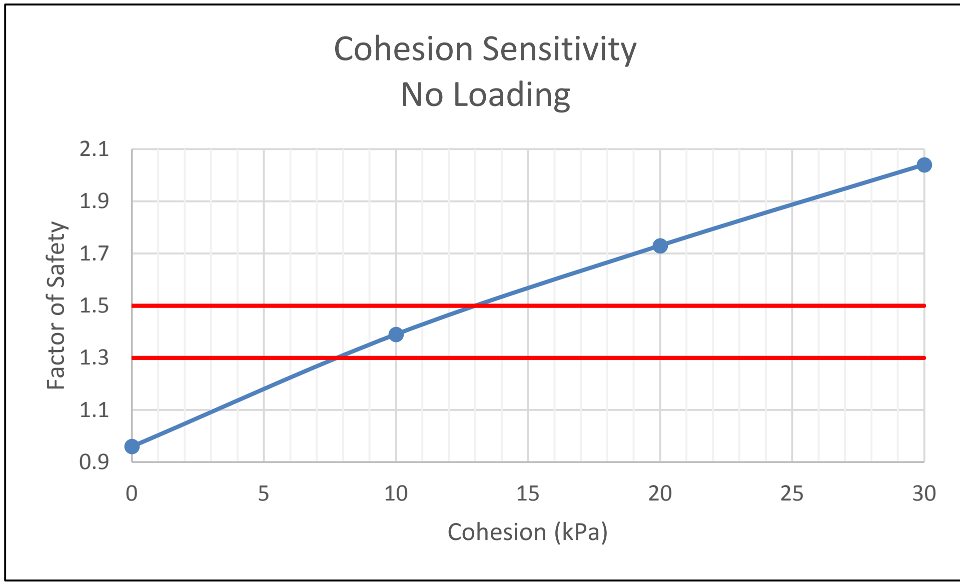
APPROVED	AVC

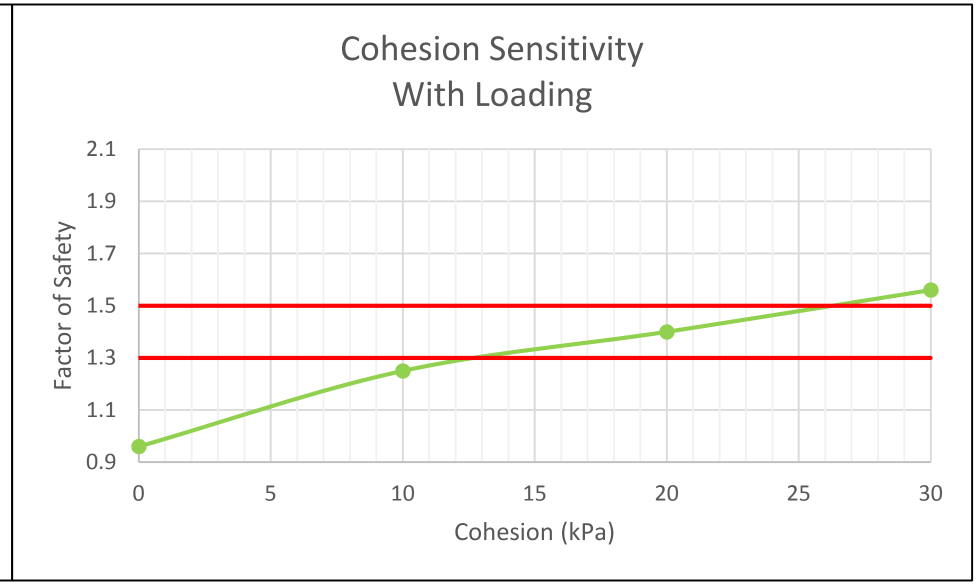
PROJECT
FARO – MINING SUPPORT SERVICES

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
DRAINED LOADING ; COHESION = 30

PROJECT No.	Phase./Task	Rev.	Figure
1410944	**2016 / 21203**	**0**	**A-9**

Path: \\golder.gds\gal\burnaby\Active_2014\1426\1410944 YG 2014 Faro Pit Slopes\2016\21200 - Crest Regression\Slope Stability





Slope/W File: SecantWallStabilityAssessment_3OCT16_ctm_ms

Notes:

1. Phreatic elevation assumed to be 3.5 m above bedrock contact.
2. Bedrock contact inferred from BGC (2016)
3. Point load assumed to be ~100 tons; based on Bauer BG 28 H specification.
4. B-bar = 1 assumes 100% of additional load is transferred to excess pore pressure.

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PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AVC

TITLE
OPTION 4: SECANT PILE WALL
ADDITIONAL LOAD SLOPE STABILITY ANALYSIS
NO LOADING VS LOADING ASSUMING DRAINED LOADING

PROJECT No.	Phase./Task	Rev.	Figure
1410944	2016 / 21203	0	A-10