Appendix 43

Whale Tail Open Pit 2019 Annual Inspection

December 16, 2019

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Dear Frederick,

RE: Amaruq Mine - Whale Tail Open Pit - 2019 Annual Inspection

1.0 INTRODUCTION

Agnico Eagle Mines Limited (AEM) operates the Amaruq Mine, in Nunavut, Canada. The mine is 150 km northwest of Baker Lake and 50 km northwest of AEM's Meadowbank Mine. The mine currently consists of the Whale Tail open pit, which entered commercial production in September 2019, and an exploration decline. Knight Piésold Ltd. (KP) has been providing geomechanical support for the mine since 2015, including providing recommendations on the open pit slope geometry.

Mr. Ben Peacock, P.Eng., of KP completed a site visit from September 6 to 9, 2019 in order to inspect the Whale Tail Open Pit, Quarry 1 and Attenuation Pond 5 (AP5). The latter two excavations are within the ultimate footprint of the Whale Tail Open Pit but are currently being used for water storage. The results of the inspection are summarized in this letter and detailed in Appendix A.

This letter supersedes a draft issued on November 22, 2019 (reference #NB19-00872).

2.0 OVERVIEW

The Whale Tail Open Pit is in the early stages of the planned mine life and currently consists of three excavations:

- **Whale Tail Open Pit -** Formerly referred to as Quarry 2, this is the largest of the three excavations and encompasses approximately the western half of the ultimate footprint of the open pit. At the time of the inspection it had a depth of approximately 21 m.
- **Quarry 1 -** An initial quarry along the eastern edge of the ultimate footprint of the open pit. Quarry 1 has a depth of approximately 21 m and is currently used to manage surface water.
- **AP5 -** A small excavation to the north of Quarry 1, currently used to manage surface water. AP5 is located along the eastern wall of the ultimate Whale Tail Open Pit.

3.0 INSPECTION RESULTS

3.1 GENERAL

The Whale Tail Open Pit was inspected on September 7 and 8 by Ben Peacock of KP and Jesse Clark (Geotechnical Engineer) of AEM. Observations made during the site visit were grouped according to four headings at AEM's request:

- **Priority 1 (P1) -** A high priority or structural safety issue considered immediately dangerous to life, health or the environment. Also includes issues with a significant risk of regulatory enforcement.

- **Priority 2 (P2) -** An issue that, if not corrected, could plausibly result in a structural safety issue leading to injury, environmental impact or significant regulatory enforcement. Also includes repeated deficiencies that demonstrate a systematic breakdown of procedures.
- **Priority 3 (P3) -** Single occurrences of deficiencies or non-conformances that in isolation are unlikely to result in structural safety issues. Also includes recommendations for pro-active measures important to the validation of the open pit slope design.
- **Priority 4 (P4) -** Opportunity for improvement, for example to meet industry best practices.

The observations and associated recommendations were reviewed with AEM during the site visit. Note that Quarry 1 and AP5 were not inspected in detail as they are currently being used for water storage and are flooded. These excavations should be inspected by the mine geotechnical team prior to the resumption of mining activities.

3.2 PRIORITY 1 OBSERVATIONS

No P1 observations were made during the inspection.

3.3 PRIORITY 2 OBSERVATIONS

The following P2 observations were made:

1. **Overburden -** Overburden was observed at the crest of the open pit slopes in numerous areas. The overburden represents a rockfall hazard, especially in the summer months when the active layer thaws. It is understood that AEM intends to construct a thermal cap for the overburden using waste rock in most cases. Two cap designs were discussed: one that covered only the overburden and one that covered the first 7 m high bench as well as the overburden. In either case, the Nunavut Mine Health and Safety Act (2011) requires a minimum offset of 2 m between the toe of the overburden or cap and the crest of the bench. KP recommends a minimum offset of 10 m in cases where a thermal cap will not be installed or where the installation of the cap will be delayed.

2. **Scaling -** In general, scaling of the bench faces appears to be well done and it is clear that AEM focusses on this aspect of slope management. However, two rockfall hazards were observed during the visit that require mitigation:
    a. Nose at the eastern end of the South Wall. The nose has ravelled and a number of loose blocks were observed on the crest of the benches in this area. AEM has identified the need for scaling and a berm in this area, but neither had been completed at time of visit. These measures should be implemented as a priority. It is recommended that AEM also avoid the creation of noses where possible, as they are prone to ravelling.
    b. South Wall block at west end by previous failure. Bermed off but should be knocked down.

3. **East Wall Buttress -** A 3 m high rockfill buttress has been built along the east wall of the open pit. During the summer it is understood that the lake level was within 0.1 m of overtopping the crest of the open pit. The buttress was constructed in an effort to stabilize the saturated till at the crest of the wall. The water level in the lake has since subsided and the lake is planned to be dewatered by the end of 2019. Stability analyses have not been completed for the buttress and a Factor of Safety has not been calculated and compared to AEM's acceptance criteria. If there is a potential for the water level to rise again, this observation would escalate to Priority 1 and it is recommended that stability analyses be completed to confirm the buttress design.

3.4 PRIORITY 3 OBSERVATIONS

The following P3 observations were made:

1. **South Wall Till Slope -** The till at the crest of the south wall has slumped repeatedly. The till is offset from the crest of the rock slope by more than 10 m and does not pose a significant hazard to personnel within the open pit. However, the till has failed back to the berm of the road along the south wall of the open pit. The slope and road are inspected on a bi-weekly basis. If further slumps are observed the frequency of inspection should be increased and consideration given to closing the road.
2. **Barricade Procedure -** It is recommended that a procedure be developed that specifies the measures used to restrict access to areas with identified geotechnical hazards. If the mitigation measures recommended for an identified hazard won't be completed in the near term (e.g. if the area is not an active mining area) then access to that area should be prevented.
3. **Slope Instrumentation -** The open pit slopes are currently only monitored visually. Slope monitoring instrumentation is required and AEM is currently considering different options, many of which were discussed during the site visit. It is understood that the Slope Stability Radar (SSR) at the Meadowbank Mine will be brought to Amaruq later this year and that a second radar has been budgeted. The advantages and disadvantages of the instrumentation options discussed are presented in Appendix A.
4. **Documentation of Rock Mass Characteristics -** Mining activities provide a valuable opportunity to verify the rock mass characteristics on which the geotechnical design of the open pit slopes are based. It is recommended that the Maptek laser scanner owned by the mine be used in combination with spot and/or line mapping to document the orientation, persistence, spacing and large-scale roughness of the discontinuities, the position and characteristics of any faults, as well as the general rock mass quality. The collected data should be periodically compared to key design inputs (e.g. orientation of the foliation).
5. **Documentation of Bench Performance -** It is recommended that the performance of both the interim and final benches be documented as they are established. This allows the current open pit slope design to be validated and provides a basis for refining the design if required/desired. Information to be documented includes the wall orientation, planned bench geometry (bench height, bench face angle and bench width), actual bench geometry, foliation orientation and dominant lithology.

3.5 PRIORITY 4 OBSERVATIONS

The following P4 observations were made:

1. **Pre-Shear Blasting -** Pre-shear blasting is currently used for the final walls below the uppermost bench. It is recommended that the use of pre-shear blasting be extended to include the uppermost bench. A possible exception to this practice was discussed for benches where the bench face is expected to break back to shallow-dipping structure. In this circumstance, it may be more effective to use an alternate approach such as staggering the depth and spacing of the blastholes rather than attempting to drill the pre-shear holes at a shallow angle.
2. **Blasting Trials -** Significant blasting-induced damage was observed in some of the interim walls (e.g. the east wall), particularly within the weak komatiite. This has resulted in very poor bench performance and substantial back-break. It is understood that a higher powder factor was used in these areas. It is recommended that blasting trials be completed to refine the blasting practices used for different lithologies.

3. **Geotechnical Review and Approval -** Geotechnical staff currently only review the blast patterns and slope configuration for the final open pit walls. It is recommended that this be extended to all blast patterns, including interim walls, so that potential geotechnical hazards (e.g. interactions with faults, adverse slope geometry, talik, etc.) can be proactively identified and mitigated where practical. A formal sign-off procedure is recommended and it is understood that one is currently being developed.
4. **Geotechnical Inspection Frequency -** Formal visual geotechnical inspections of the open pit are completed twice a month. Additional inspections are completed on an ad hoc basis. It is recommended that a procedure be developed to adjust the frequency of the geotechnical inspections based on the observed slope performance (e.g. if a deformation rate is exceeded) and the risk associated with a particular slope.
5. **Geotechnical Inspection Photos -** Photos are taken as part of the inspections. It is recommended that a series of standard photos be incorporated into the formal inspections to facilitate the tracking of changes in the slope performance over longer time periods. This is most important for the slopes that will not be covered by the SSR.
6. **Geotechnical Hazard Maps -** Hazard maps for the open pit slopes are issued after each inspection. The observed hazards and recommended mitigation measures are also documented on the maps. During the visit, AEM staff indicated that there is inconsistency between staff as to how the hazard ratings are applied. It is recommended that a more systematic approach be implemented and that staff receive training on its application. Consider developing a Trigger Action Response Plan (TARP) as a reference.
7. **Fall of Ground Database -** Unusual occurrences and falls of ground are documented in a database, which is an important practice. It is recommended that the database be expanded to document the failure mode (e.g. planar failure) as well as the joint sets involved (in the case of a structural or complex failure mode).

4.0 ADDITIONAL CONSIDERATIONS

Several additional considerations were discussed during the site visit. These considerations are not associated with specific follow-up actions but are important to the successful operation of the mine.

- The current mine plan includes establishing the final extents of the northwest and north walls of the open pit in 2019. Establishing the final walls early in the mine life limits the opportunity to refine blasting practices and to consider adjustments to the slope design based on the performance of the interim slopes. This puts a premium on the proper implementation and validation of the bench and inter-ramp slope design.
- The three-month mine plan was reviewed from a geotechnical perspective. The review is summarized in Appendix A. The majority of the comments focus on opportunities to validate the current geotechnical design of the open pit. Other comments included emphasizing the importance of on-going planning to manage groundwater inflows from Whale Tail Lake and the associated talik, as well as the formation of ice walls in the winter.

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- The ultimate extents of the south wall of the open pit are in close proximity to the attenuation pond planned to the south of the open pit. This has been discussed in detail in previous studies by KP and is expected to increase both the likelihood and the magnitude of ice formation on the south wall. It is understood that AEM is reviewing options to locate the attenuation pond further away from the open pit and this is strongly encouraged.
- The importance of frequent communication between the geotechnical, planning and geology personnel at the mine was discussed.
- AEM is in the process of implementing a system to track areas requiring remediation and document when the remedial measures have been completed. This is a good practice and encouraged.

5.0 REFERENCES

Mine Health and Safety Act, 2011. *Consolidation of Mine Health and Safety Regulations.* Government of Northwest Territories and Nunavut. R-125-95, Section 1.137.

6.0 CLOSURE

We trust this letter meets your present needs. Please do not hesitate to contact us should you require anything further.

Yours truly,
Knight Piésold Ltd.

REGISTERED PROFESSIONAL ENGINEER
B.D. PEACOCK
LICENSEE
Dec 16, 2019
NT/NU

Prepared: Ben Peacock, P.Eng.
Senior Engineer

Reviewed: Robert A. Mercer, Ph.D., P.Eng.
Managing Principal

Approval that this document adheres to the Knight Piésold Quality System:

Attachments:

Appendix A Amaruq Project - Whale Tail Open Pit - 2019 Annual Inspection

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature
Date DEC 16/19.
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

/bp

APPENDIX A

Amaruq Project - Whale Tail Open Pit - 2019 Annual Inspection

(Pages A-1 to A-41)

Amaruq Project – Whale Tail Open Pit

2019 Annual Inspection

September 6 to 9, 2019

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Adding value. Delivering results.

Outline

- Introduction
- Observed Slope Performance
- Review of Three-Month Plan
- Monitoring and Inspections
- Design Verification
- Other Considerations

Introduction

Introduction

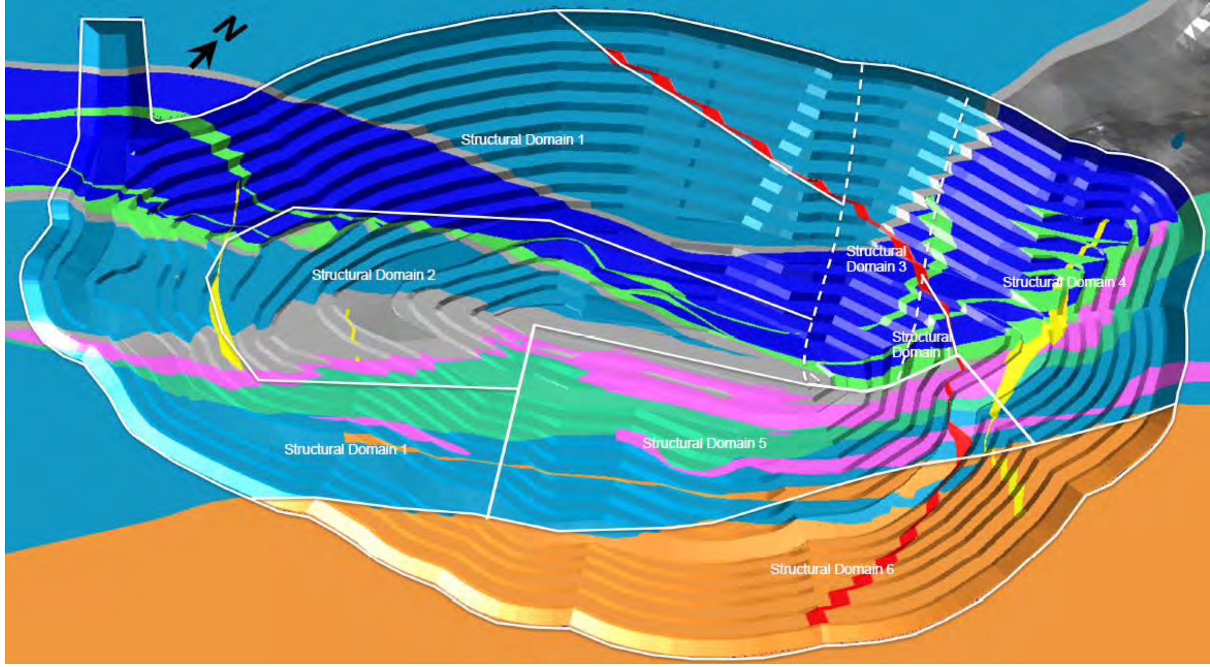
General

- Agnico Eagle Mines (AEM) is developing the Amaruq Project in Nunavut.
- The project consists of the Whale Tail and IVR deposits. The deposits are both planned to be mined using a combination of open pit and underground mining methods. Mining of the Whale Tail Open Pit is currently underway and recently entered commercial production.
- Knight Piésold (KP) has been providing geomechanical support for the project, including a 2016 pre-feasibility design study and 2018 feasibility design study for the Whale Tail Open Pit. A feasibility study for the IVR Open Pit and input to an updated PEA for the underground mine are currently in progress.
- AEM retained KP to complete the first annual inspection of the Whale Tail Open Pit. The inspection was completed during a site visit from September 6 to 9, 2019. The inspection is summarized in this presentation, along with other related discussion topics.

Introduction

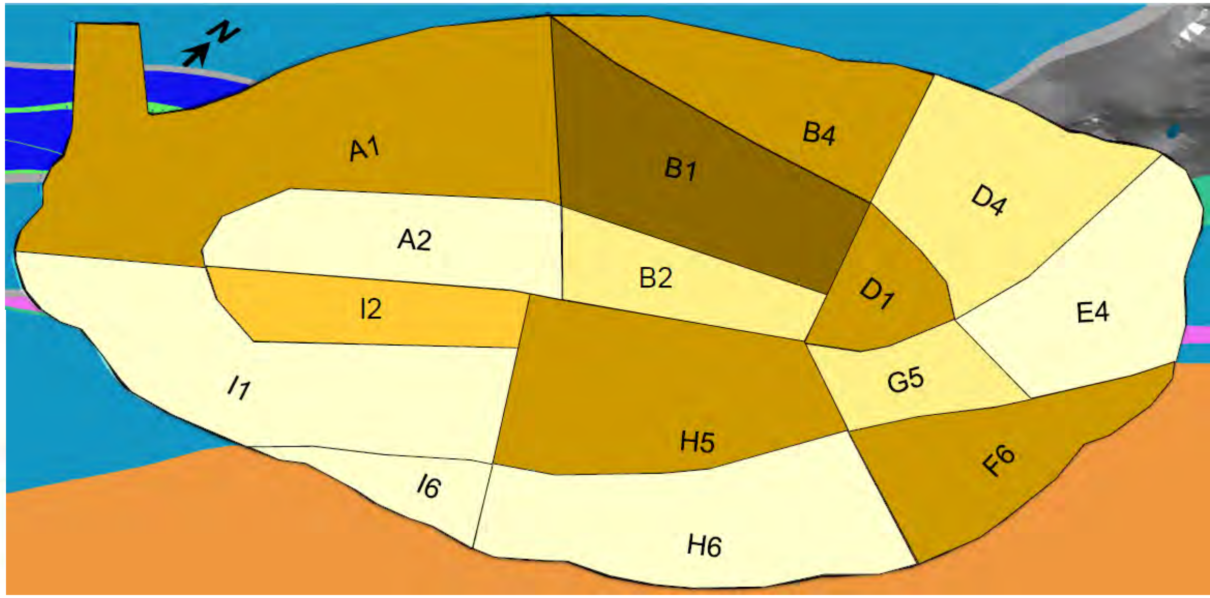
Overview

- The WHL-001-010F design is shown at right for reference. Note that this design is outdated, and the WHL-001-011C is the most recent design.
- The Structural Domains (which control the achievable slope geometry in many cases) are shown at upper right along with the lithologies expected in the final open pit walls.
- The design sectors and the Feasibility Study slope geometry recommendations are shown at lower right.



LITHOLOGY LEGEND:

GREYWACKE
CHERT
KOMATIITE - NORTH LIMB
KOMATIITE - SOUTH LIMB
IRON FORMATION
MAFIC VOLCANICS
DIORITE
RAMP FAULT



Base Bench Geometry

BASE CASE
BFA: 75°
Bench Width: 10 m
Bench Height: 21 m
IRA: 53°

KOMATIITE
BFA: 75°
Bench Width: 10.5 m
Bench Height: 21 m
IRA: 52°

Bench Geometry Controlled by Bench-Scale Failures

BFA: 65°
Bench Width: 10 m
Bench Height: 21 m
IRA: 47°

BFA: 65°
Bench Width: 10.5 m
Bench Height: 21 m
IRA: 46°

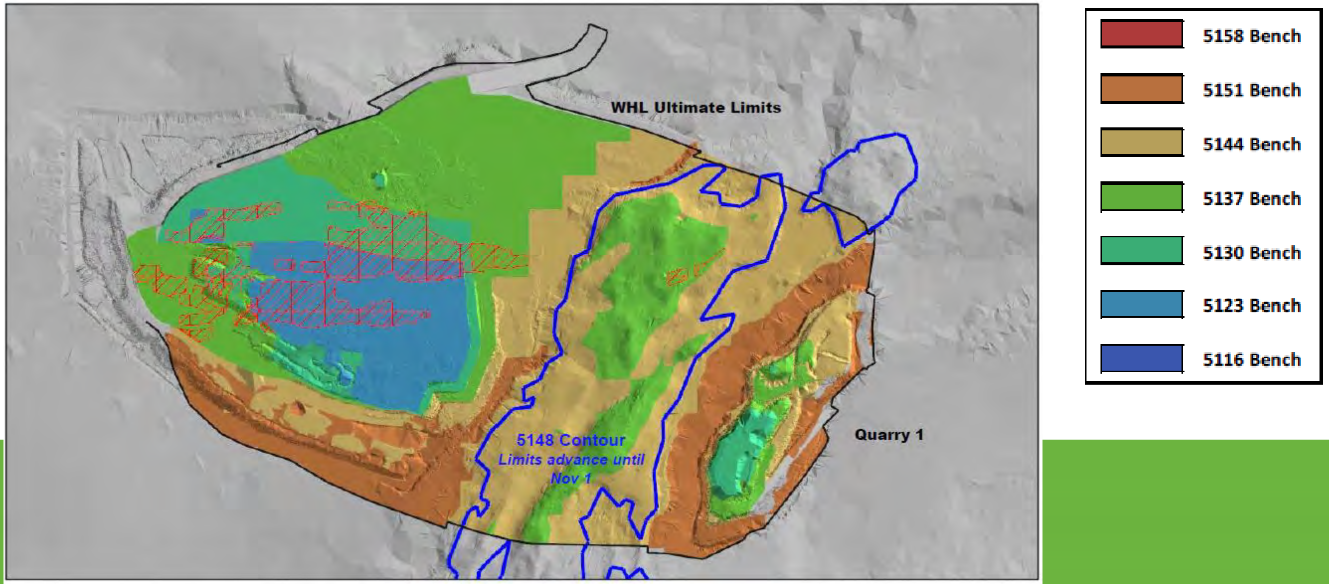
BFA: 65°
Bench Width: 13 m
Bench Height: 21 m
IRA: 43°

Observed Slope Performance

Observed Slope Performance

General

- The Whale Tail open pit (Quarry 2) was inspected on September 7. Observations made during the inspection are summarized on the following slides.
- The approximate current pit geometry is shown below. It is very early in the mine life and only a few benches have been developed. The deepest portion of the open pit is approximately 21 m below surface. Most of the final pit walls, which were a focus of the inspection, are within 14 m of the surface and impacted by the overburden contact. As such, they are not necessarily representative of the future performance of the lower benches.
- Note that numerous areas were observed with loose material or overburden at the crest of the bench. The bi-weekly inspection reports also frequently note the need for scaling or the presence of loose. It is important that the benches are scaled as they are developed, particularly for the final walls. Do scaling practices need to be reviewed with the crews?
- Attenuation Pond 5 (AP5) and Quarry 1, on the east side of Whale Tail Lake, will form part of the Whale Tail Open Pit once the lake is drained and stripping continues. These areas were visited on September 9. Both AP5 and Quarry 1 are currently being used for water storage and are flooded. As a result, access is restricted and a detailed inspection was not completed.
- Note that the interim benches are excavated as single 7 m high benches.



Observed Slope Performance

Northwest Wall

- First bench of the final wall in the Komatiite. Design Sector A1.
- Wall did not perform well and had to be scaled several times.
- Komatiite is of surprisingly good quality, and is not strongly foliated. This is at the upper end of the expected rock mass quality distribution for this unit.
- Western end of wall (at left in image below) is primarily in till. Next bench in that area predicted to be in Komatiite and intersect Brittle Structures. It is likely to perform poorly.

Observed Slope Performance

North Wall (5151 Bench)

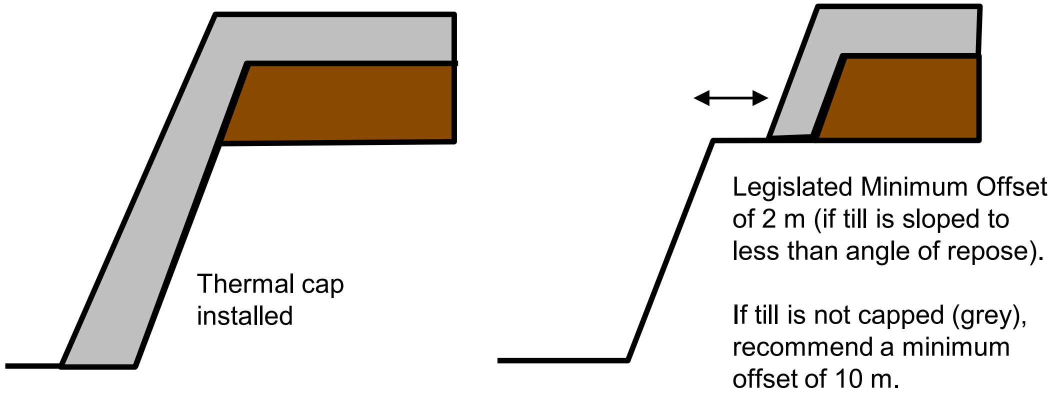
- First bench of the final pit wall in the Greywacke. Design Sector A1.
- There is unconsolidated till at the crest of the bench, and the rock forming the bench itself is broken up. Pre-shear was not used.
- The management of the overburden is discussed on the following slide.
- It is recommended that pre-shear holes be completed for all final walls.

Observed Slope Performance

North Wall – Overburden Management

The management of overburden at the crest of the slope was discussed. This applies to all of the walls; not just the North Wall.

- In most cases, the mine intends to cap the till with NAG, including buttressing the bench face.
- The alternative is to strip the overburden back from the crest of the slope.
  - An offset of 10 m was recommended in the FS.
  - The NU mine act requires a minimum 2 m offset, and that the till be graded at an angle less than the angle of repose.



Observed Slope Performance

North Wall (5144 Bench)

- Interim wall in the Greywacke.
- Performance is similar to 5151 bench, with bench geometry controlled by dip of the foliation (55°).
- At the western end of the bench, the slope approaches what was the northern shore of the western lobe of Whale Tail Lake. In the active face, the rock mass becomes progressively lower in quality with much tighter foliation spacing as it approaches the former shoreline. Plan is to mine out this material, which is the preferred approach.

Observed Slope Performance

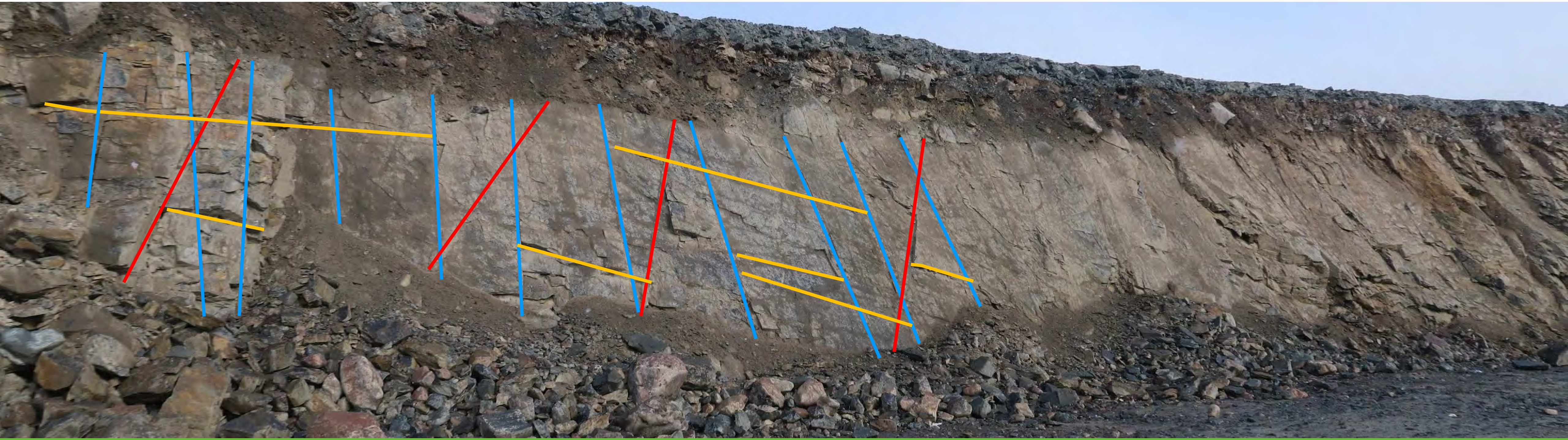
Northeast Wall

- First bench of the final pit wall in the Greywacke. Design Sector A1.
- The bench performance is controlled by the dip of the foliation, as expected. Bench face angle is approximately 65°, consistent with design.
- Recommend using Maptek Scanner to document bench performance and foliation dip.

Observed Slope Performance

Northeast Wall – Observed Structure

- Joint Set A (Foliation) – Defines the bench face. Dips to the south at approx. 65° (to be confirmed with Maptek). Persistent at 7 m bench scale.
- Joint Set D – Vertical set perpendicular to the foliation. Persistent at 7 m bench scale. Approx. 2 m Spacing.
- Joint Set C – Sub-horizontal set. Dips to the north. Variable persistence and spacing.
- New Set – Dips to the West at approx. 60°. Persistent at 7 m bench scale. Approx. 4 to 5 m spacing. Need to monitor and see if this set is common.



Observed Slope Performance

South Wall

- Interim Wall in the Diorite
- A 21 m bench has been established. There is a 7 m bench of till and fractured bedrock above, offset by a 30 to 80 m temporary step-out. The till has slumped along most of the length of the wall but has been contained by the step-out.
- The 21 m bench is performing very well, with half-barrels visible.
- A potential loose block was observed at the western end of the wall (circled in red), adjacent a previous FoG that has been blasted. There is a berm directly below the block but it should be scaled down if possible.
- There is a nose at the eastern end of the wall (circled in yellow). The nose has ravelled and there are a large number of loose blocks on the crest of the south/western side of the nose. The area has been flagged as a hazard requiring scaling and a berm but neither has been completed to date.

Observed Slope Performance

South Wall - Details

- Potentially loose block at west end of South Wall shown at right. The area is bermed.
- Loose blocks adjacent nose at east end of South Wall shown below. The area is not bermed.

Observed Slope Performance

South Wall - Till

- The till at the crest of the South wall has slumped repeatedly, in one instance reaching the berm of the road at the crest of the pit.
- The mine has kept the failed material in place at the toe of the slope to act as a buttress.
- The till slope and the road are inspected as part of the bi-weekly open pit inspections. If further slumps are observed, the inspection frequency should be increased and consideration given to closing the road.
- It is understood that the till will be covered with a thermal cap once the final wall position is established.

Observed Slope Performance

East Wall

- Interim wall with current exposures of the Diorite, Mafic Volcanics, Komatiite (South Limb), Chert and Iron Formation (from South to North). Eventually the Komatiite (North Limb) and Greywacke will be exposed at the northern end of the wall. As a result, this wall provides a good opportunity to observe the characteristics of the different lithologies at a bench scale.
- The Mafic Volcanics (below) have performed relatively well, aside from loose at the crest. The rock mass is similar to the Greywacke. The bench geometry is often controlled by structure, particularly the foliation. However it does not have the well-defined orthogonal structure of the Diorite.
- The Chert, Iron Formation and Komatiite are shown on the next slide. The Diorite is shown on the slides for the South Wall.

Observed Slope Performance

East Wall

- Komatiite (South Limb) is shown at lower right. Chert and/or Iron Formation (difficult to visually distinguish between them) is shown at lower left.
- There has been significant blast damage to these units. No pre-shear was used as it is an interim wall. It is also understood that a higher powder factor was used in these areas. Need to use a different approach for the final walls if the design geometry is to be achieved.
- The Komatiite is highly disturbed. The foliation is prominent and several shears were observed. It is soft enough that teeth marks from the shovel are visible in places. This is more consistent with the expected characteristics of the Komatiite (compared to the Northwest Wall).
- The Chert and/or Iron Formation has performed much more poorly than expected, with numerous small (tens of cm) tabular blocks. This may be due to blast damage, though a few small shears (<5cm) were observed parallel to the foliation. It is important to document how other walls in this unit perform.

Observed Slope Performance

East Wall Buttress

- East wall is approximately 80 to 100 m from Whale Tail Lake.
- Dewatering of the lake is behind schedule, and over the summer the lake was within 0.1 m of the crest elevation of the open pit. The lake is currently several meters below the crest.
- The till in the uppermost bench of the east wall was saturated and the geotechnical team identified the potential for a slope failure. A waste rock berm ~3 m high was placed against the till (outlined in red at right) and regular inspections were implemented.
- If there is a potential for the water level to rise again, recommend completing a simple stability analysis to confirm the buttress design.

Observed Slope Performance

AP5

- AP5 is currently flooded. A detailed inspection was not completed.
- Geotechnical inspections should be completed by the mine during and immediately after dewatering.

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Observed Slope Performance

Quarry 1

- Quarry 1 is currently flooded. A detailed inspection was not completed.
- Geotechnical inspections should be completed by the mine during and immediately after dewatering.

Review of Three-Month Plan

Review of Three-Month Plan

General

The monthly plans for the open pit until the end of 2019 were reviewed from a geotechnical perspective. The plans will most likely change, but the objective was to identify key risks and opportunities. The review is summarized on the following slides. A more detailed review of the Phase 2 and Phase 3 open pit designs was completed on July 26, 2019 (ref NB19-00591).

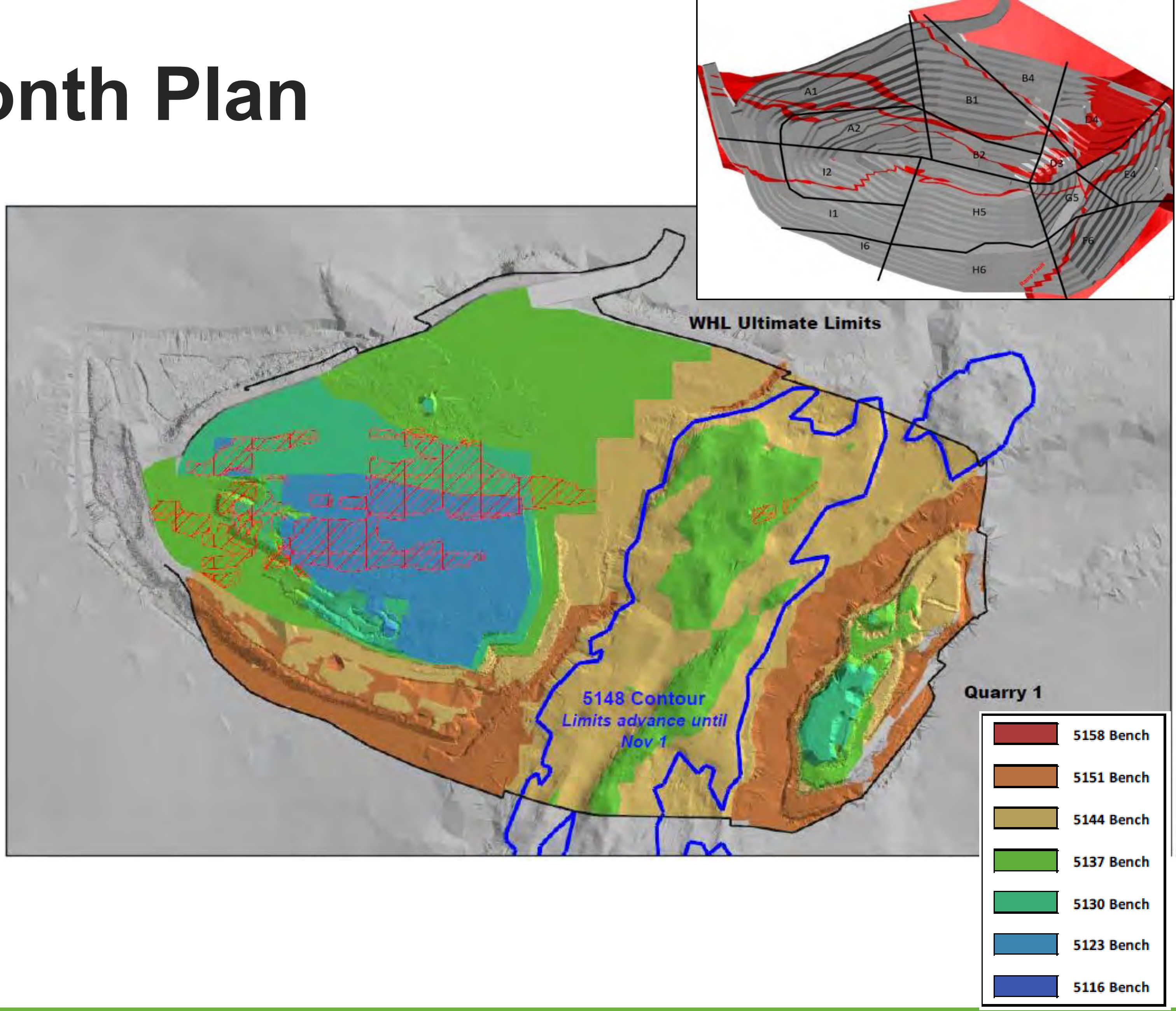
The following general design considerations were also discussed:

- Establishing the final walls early in the mine life puts a premium on the proper implementation and validation of the bench and inter-ramp slope design. This limits the opportunity to refine blasting practices and to consider adjustments to the slope design based on the performance of the interim slopes (either to steepen them or shallow them out). This is discussed further in the Design Validation section.
- Good communication between the geotechnical team and the planners and geologists is critical.
- Regular review of, and feedback on, interim designs by the geotechnical team is important. For example, avoiding brittle structures immediately behind interim walls, establishing interim walls within the Komatiite, awkward geometry, etc. This is discussed later in this section.

Review of Three-Month Plan

September

- Starting to establish final walls in Sectors A1 and B1 / B4. Important to start evaluating whether potential for planar failure on these walls is consistent with the FS. Especially since this is one of the last months where we have an opportunity to map / use the Maptek before winter.
- Along the East Wall, managing groundwater inflows and the potential for an inrush of surface water due to the proximity to the remainder of Whale Tail Lake has been an on-going issue. It is understood that conditions have improved significantly, though monitoring will be required until the lake is fully dewatered.



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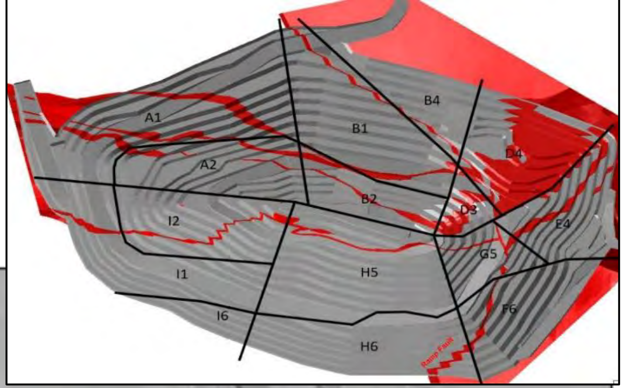
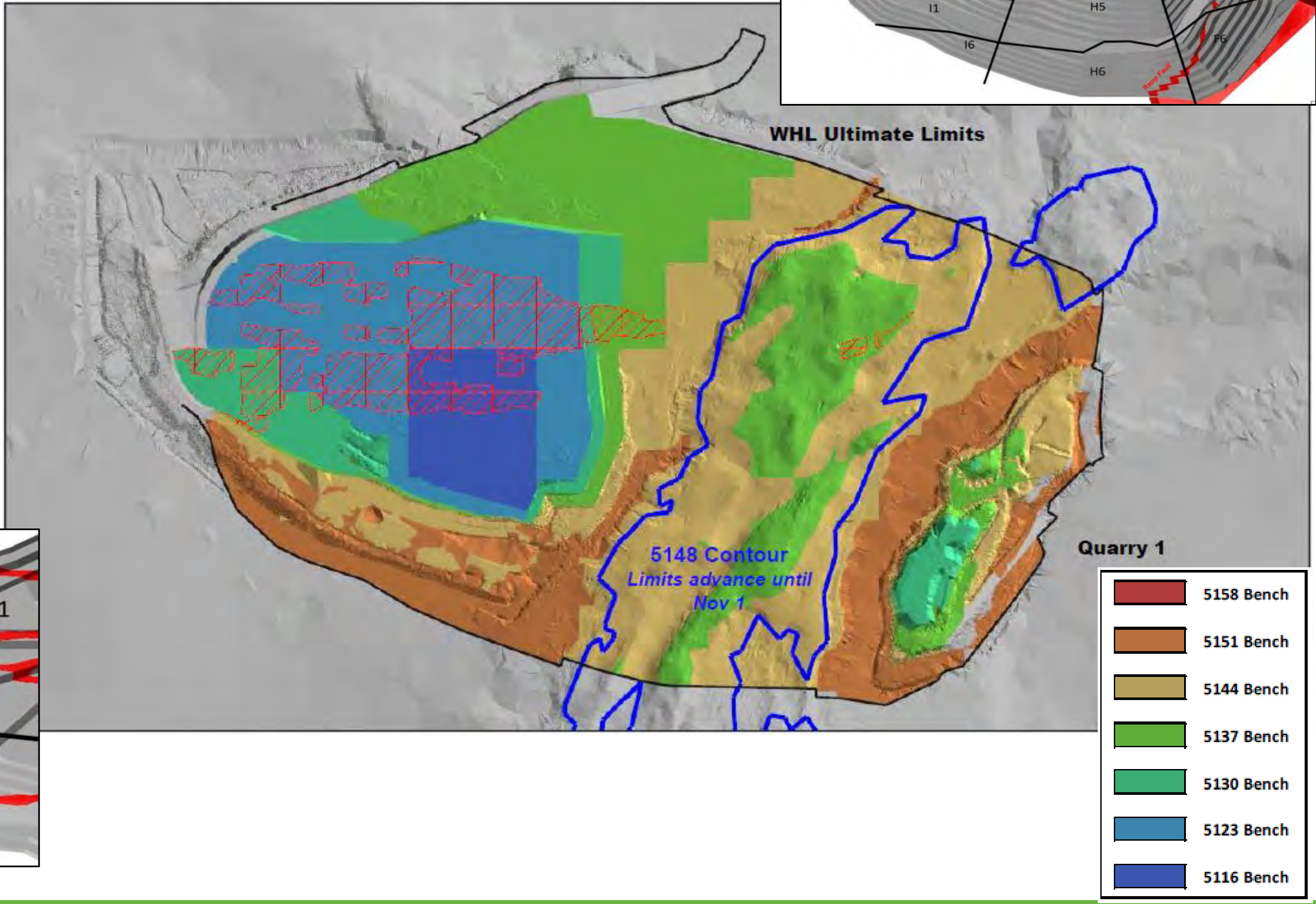
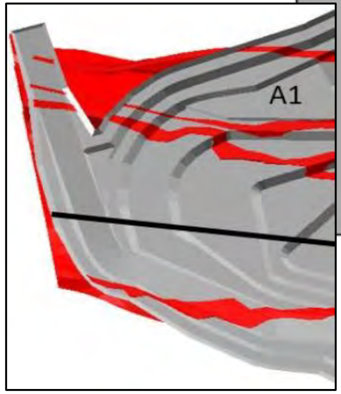
Review of Three-Month Plan

October

- Look for opportunities to further review bench performance in final walls (planar failure and blasting effects). Are we on the right track?
- Several benches of the final wall established in Sector A1. Brittle structures are predicted to intersect this area (see inset). This presents a good opportunity to assess their characteristics and possible effects. The nose at the ramp could deteriorate.



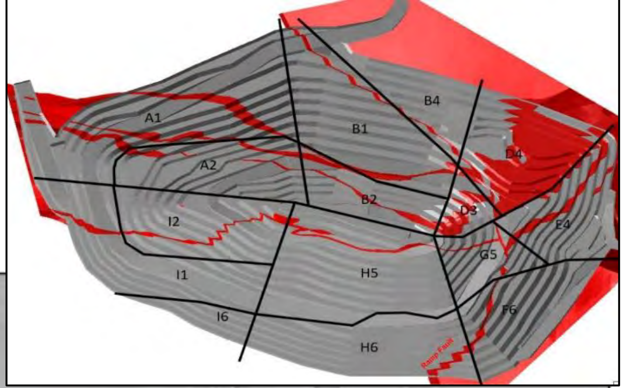


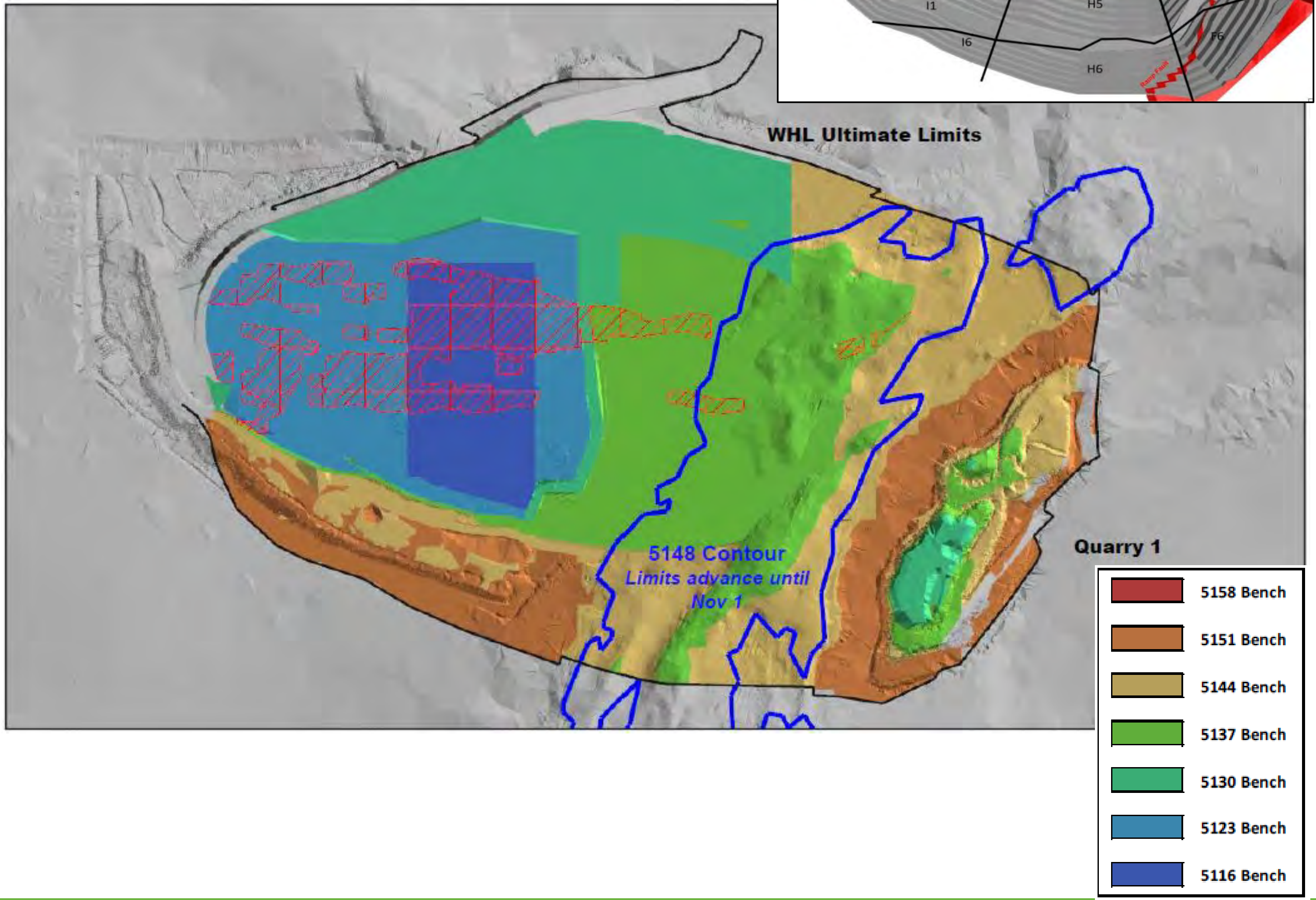


Review of Three-Month Plan

November

- Lake dewatered. Mining starting to extend into footprint of main portion of Whale Tail Lake. Managing the lake bed sediments will be an important consideration.
- Further establishment of final walls in sectors A, B1 and B4. Note that the structure in B4 is predicted to be more favourable than B1 – it will be important to verify this.
- The Ramp Fault may also be exposed where the northern ramp meets the 5130 bench.

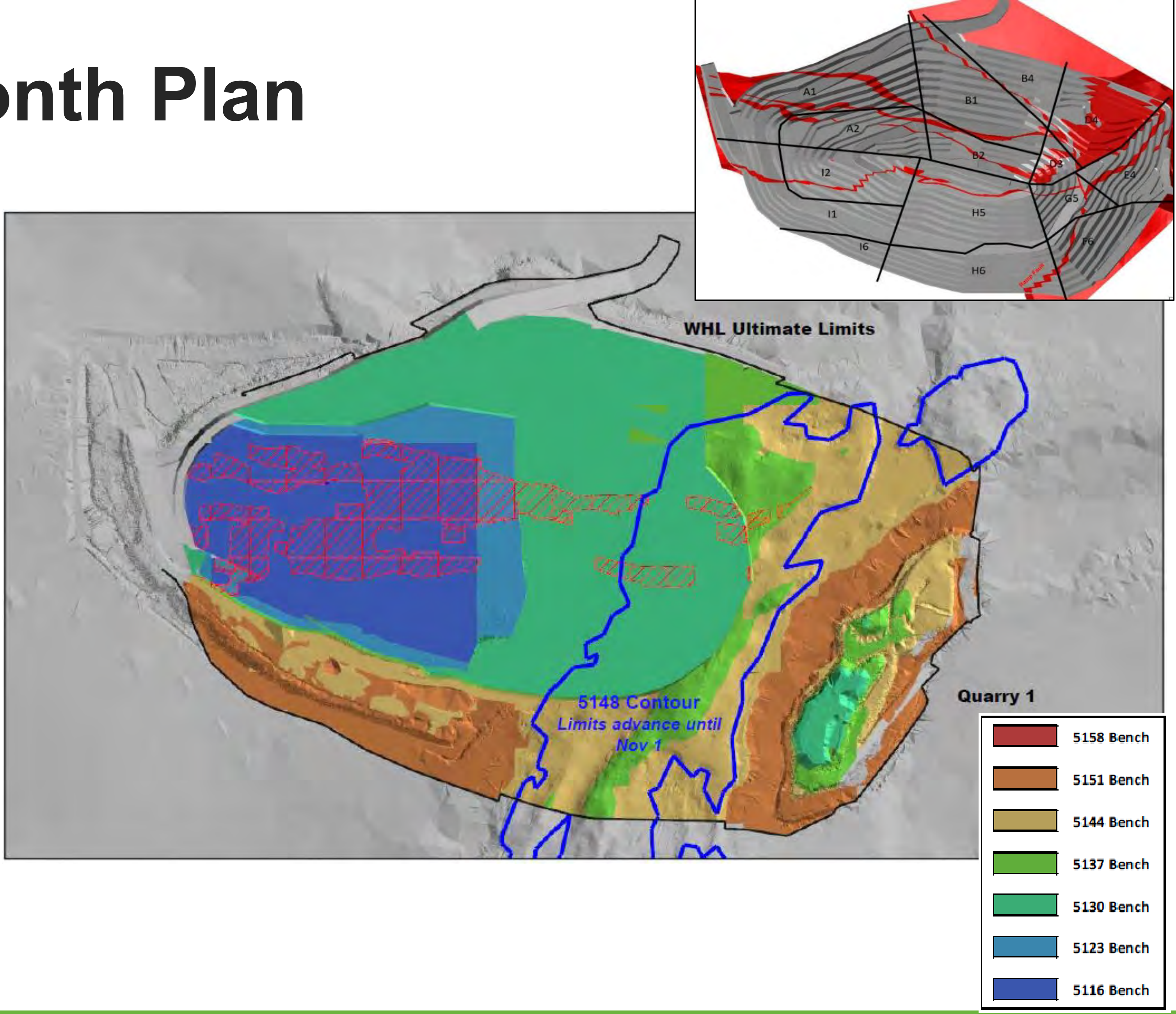




Review of Three-Month Plan

December

- Establishing first benches within Sector H (south wall of the open pit within Whale Tail Lake footprint). The structure in this sector is unusual, as it is expected to dip to the North. It will be important to verify this.
- Mining continues within footprint of main portion of Whale Tail Lake. Managing the lake bed sediments will continue to be an important consideration. Excavation in winter should help.
- Need to review potential for inflows on south wall. Do we have a plan in place to manage ice walls if they form?
- Will have several benches of the final wall established in Sector A1.



Review of Three-Month Plan

Design Sign-Off

- Regular review of, and feedback on, interim designs by the geotechnical team is important. The mine is in the process of developing a form for the different technical disciplines to sign off on changes to the open pit design. This is consistent with industry practice. Ground control factors requiring consideration include:
  - The structural domain(s) involved, including the presence of adverse structure and whether the conditions deviate from expectations
  - The rock mass quality domains involved, including the presence of weak units (Komatiite and overburden) and whether the conditions deviate from expectations
  - Whether the proposed design is consistent with the slope geometry recommendations (bench scale and inter-ramp scale)
  - Whether the slope geometry recommendations are applicable (see first two points). Is a specific analysis required (by the mine or a consultant)?
  - Possible interactions with faults (e.g. will a fault intersect or lie directly behind the slope)
  - Possible interactions with existing or predicted slope instabilities
  - Possible interactions with talik or surface water (e.g. the formation of an ice wall or potential for significant inflows)
  - The creation of adverse slope geometry (e.g. a nose)
  - Potential impacts on and of nearby infrastructure (e.g. ramp, roads at pit crest, attenuation pond, etc.)
  - Is instrumentation or a specific monitoring plan required?
- Also important to have geotechnical input on regular design considerations, such as the drill polygons / layouts. Recommend incorporating the geotechnical team into the sign-off process for these.

Monitoring and Inspections

Monitoring and Inspections

Inspections

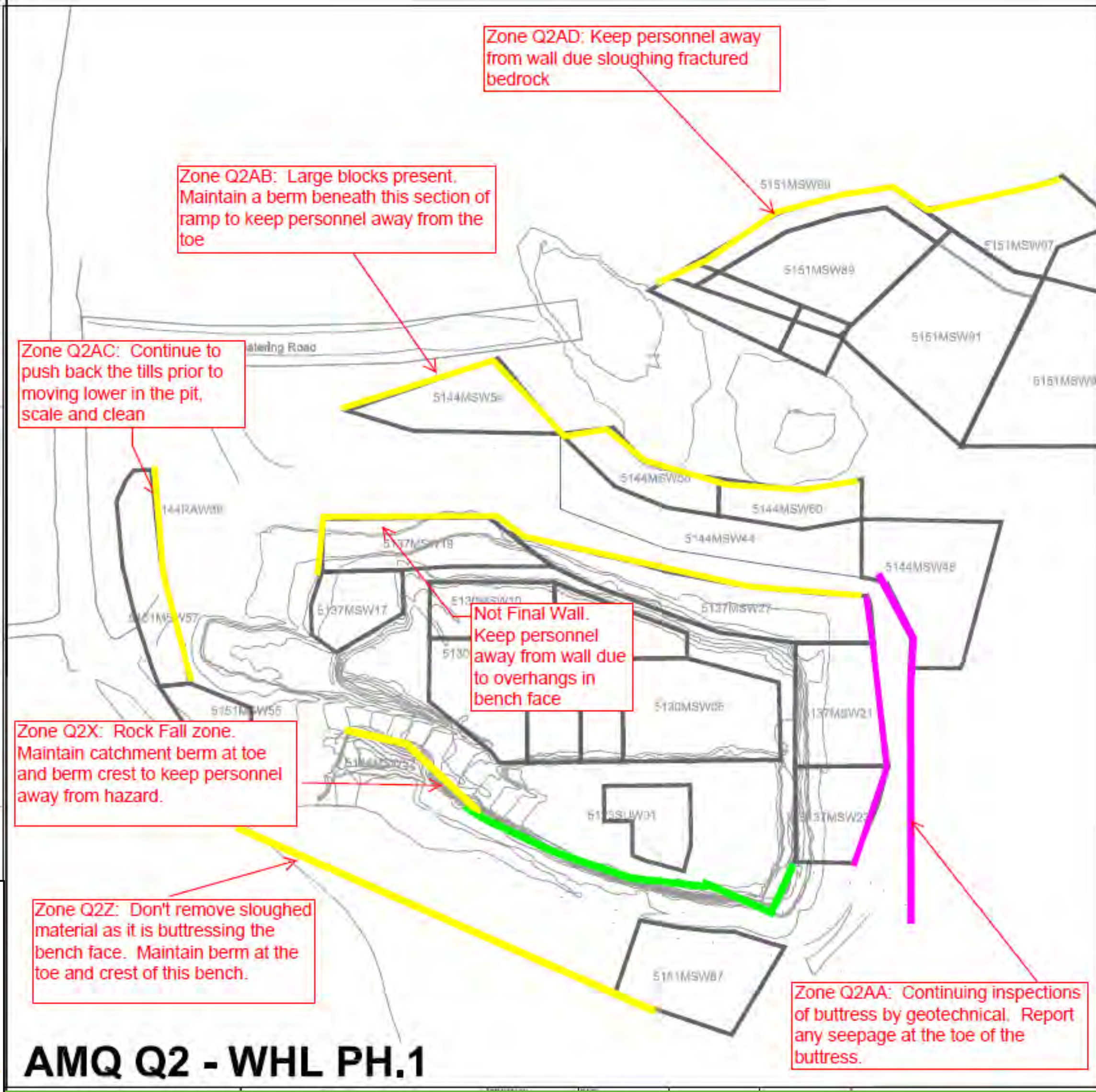
- Formal visual inspections are completed by the geotechnical team twice a month and a hazard map issued. Additional inspections are completed and the hazard map updated as required.
- A selection of the inspection reports were reviewed and the following discussed:
  - Taking a series of standard photos from the same positions each visit allows changes to be tracked over time. This is in addition to the regular day-to-day photos. Need to work on photo quality; hard to see what is going on in some of them.
  - The mine is implementing a sign-off system as confirmation that the remediation work requested in the inspection reports has been completed as specified. This is an important practice.
  - The surveillance reports for the berm/seepage above the East wall berm are a good tool. In some cases, very small changes are being flagged as changing conditions (e.g. piezometric level changing by <= 1 cm). Suggest having a cut-off for changing conditions so the focus is on significant changes.
- There should be a formal mechanism in place to increase the frequency of inspections in the event that an instability is observed or, for example, particular deformation limits are observed.
- If the mitigation measures recommended for a hazard won’t be completed in the near term (e.g. the area is not an active mining area) then access to that area should be prevented (e.g. with a berm). The hazard and required mitigation measures should be documented for future reference but do not necessarily need to be shown on the hazard map.

Monitoring and Inspections

Hazard Mapping

- The hazard ratings used on the hazard maps produced by the geotechnical team were discussed. There is inconsistency between the ratings being applied.
- One possible approach discussed (though others are possible):
  - Low Risk – Personnel to perform self-assessment of work area and accesses, no particular concerns.
  - Medium Risk – Hazard would ideally be removed prior to working near the wall. If the hazard is not removed, precautionary measures (e.g. a spotter, geotechnical inspection, etc.) required.
  - High Risk – Remedial measures (e.g. scaling, berm, etc.) required before work can be completed near the wall.
  - Very High Risk – Exceptional circumstance requiring a specific action plan from the engineering department. Area must be bermed off and access prevented.
- Consider developing a TARP to help with a consistent approach to identifying and rating risks.

August 3, 2019 Inspection



- Very High Risk, NO ENTRY
- High Risk – Requires Remedial Measures
- Medium Risk – Precautionnary or Remedial Measures
- Low Risk – Perform assessment before entering
- Wall not exposed during inspection

Monitoring and Inspections

Monitoring Options

- The mine currently does not have any instrumentation in the pit. Slope instrumentation options were discussed during the site visit and are summarized below. It is understood that the SSR from Meadowbank will be brought to Amaruq this year and that a second radar has been budgeted.

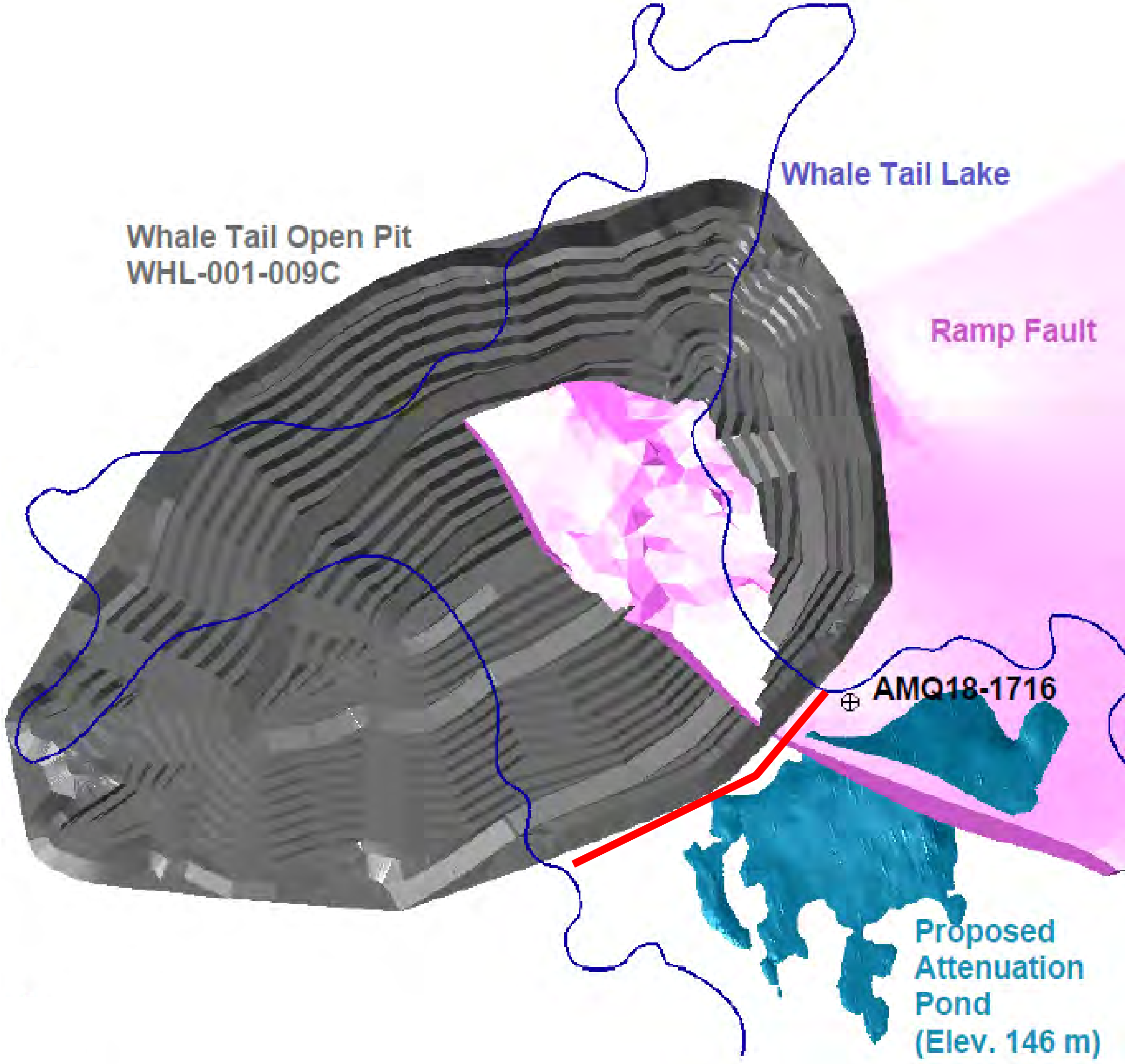
Tactical ↔ Strategic

Instrument	Advantages	Disadvantages	Overall
Tilt Meters	Simple	Extremely localized, expensive, only detects rotation	Limited suitability based on expected failure modes
Crack Meters*	Relatively inexpensive, simple	Limited to a length of ~ 1m, only works for well defined blocks / failure limits	**Possible tactical solution for wedges**
MPBX*	Provides information at depth, relatively inexpensive, equipment to install available	Safe installation and reading difficult	**Possible tactical solution for wedges or multi-bench failure**
Inclinometers	Provides information at depth	Better suited to circular/large failures, expensive, typ. requires access to read	Not suitable, based on expected failure modes
TDR	Easier to install than inclinometers, remote reading	Low accuracy; more of a trigger	Limited suitability based on expected failure modes
Laser Scanner (Maptek)*	Creates detailed 3D surface, portable	Ineffective in snow/rain. Accuracy of comparisons between scans?	**Possible tool for multi-bench or inter-ramp failure.** Follow-up required.
Slope Stability Radar*	Real-time monitoring of a large area, proven ability at Meadowbank	Relative displacement only, expensive	**Primary monitoring tool**
Prisms*	Simple, inexpensive and flexible, can be automated	Ineffective in snow/rain. Mine has indicated that they freeze over and have been ineffective.	**Still worth considering, at least for summer months**
InSAR	Very large area of coverage	Ineffective when snow on the ground	Not practical for WHL

Monitoring and Inspections

Instrumentation

- The installation of piezometers and thermistors to monitor the pore water pressures and thermal conditions behind the open pit walls was discussed.
- The area of focus should be the south wall of the open pit below the footprint of Whale Tail Lake. The other walls of the open pit are expected to be within permafrost based on the available thermistor data and the 3D thermal model.
- The following conceptual instrumentation plan was discussed:
  - 3 drillholes along the south wall of the open pit, between the open pit and the attenuation pond (roughly along the red line at right). Approx. 5 piezometers and a thermistor string in each drillhole. The drillholes should extend to the base of the talik zone (approx. 100 m below surface)
  - 1 drillhole between the open pit and the Whale Tail Dyke (south of the attenuation pond) with 3 to 5 piezometers. This drillhole is a lower priority than the others.



Design Verification

Design Verification

General

- The open pit is in the very early stages of mining. In many cases, the deposit rock masses are being exposed at a bench scale for the first time. This provides an opportunity to improve/confirm our understanding of the rock mass and how it will perform in the open pit. There is also more flexibility to refine the slope design at this stage in the mine life.
- The geomechanical design recommendations for the open pit were primarily based on data from drill core. While numerous geomechanical drillholes were completed, drilling ultimately only allows us to characterize a small sample of the deposit rock masses. The exposures in the open pit provide an invaluable opportunity to verify the rock mass characteristics on which the slope design is based.
- There is also an opportunity to review the bench design and blast designs based on the actual bench geometry achieved in the initial benches. The objective is to improve safety and efficiency.
- As noted earlier, the current mine plan calls for establishing the final West, North and East walls as mining advances. Establishing the final walls early in the mine life makes the proper implementation and verification of the bench and inter-ramp slope design a critical consideration. This limits the opportunity to refine blasting practices and to consider adjustments to the slope design. It also means that we will have to live with any failures or unaddressed hazards for the duration of the mine life.

Design Verification

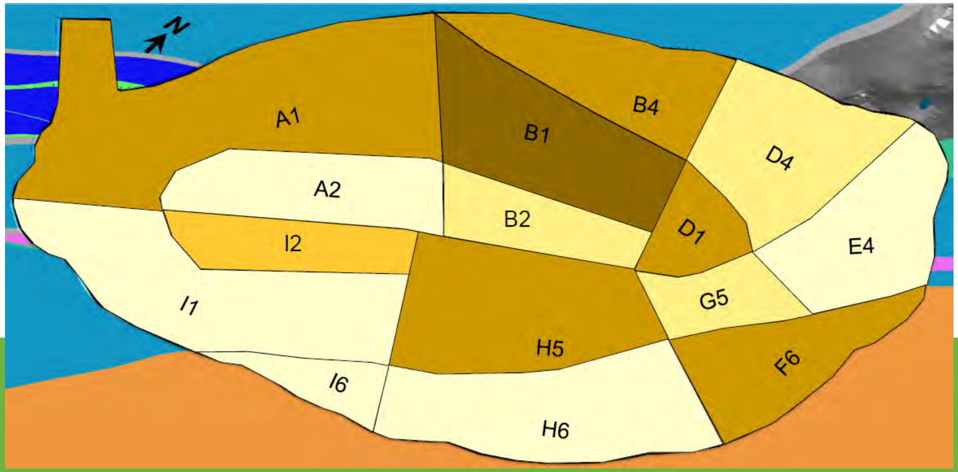
Geomechanical Data

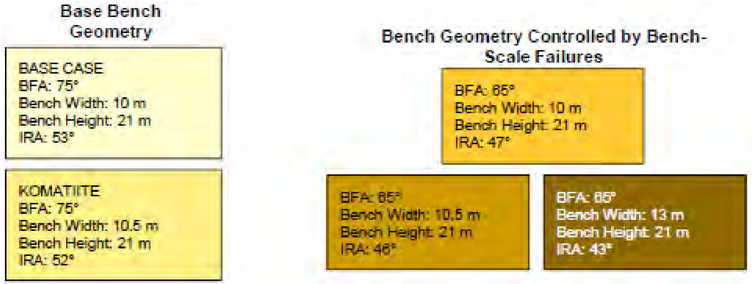
- The exposures in the open pit provide an opportunity to verify the rock mass characteristics on which the slope design is based. This includes:
  - The orientation, persistence and large-scale roughness (e.g. planar, stepped, undulating) of the foliation
  - The prominence, spacing and orientation of other joint sets that could result in wedge failures
  - The rock mass quality of the various lithologies, particularly the Komatiite
  - The position, orientation, thickness and characteristics of the faults, particularly the Brittle Structures
- Opportunities to collect these data include:
  - Discontinuity orientations, persistence, spacing and large-scale roughness can be collected from spot or line mapping or using the Maptek (or drone, if it has the capability for photogrammetry)
  - Rock mass quality and characteristics of the faults can be assessed visually (e.g. spot mapping)
  - The position and orientation of the faults can be obtained from Geology
- The long winter means that there is a limited window of opportunity to collect some of these data.
- The collected data should be compared to key design inputs (e.g. foliation orientation, foliation strength, joint sets identified, etc.)

Design Verification

Bench Design and Performance

- The bench designs in design sectors A1, B1, B4, D1, F6, H5 and I2 are limited by the potential for planar failure on the foliation. Several of these sectors (e.g. A1, B1 and H5) have a strong effect on open pit economics. As the bench face is expected to fail to the foliation, the achievable bench geometry is sensitive to the dip of the foliation. The orientation of the foliation should be tracked using the Maptek, mapping (if safe to do so) and the results of the definition drilling (the foliation is parallel to the lithology contacts). If the average dip of the foliation deviates significantly from the feasibility study structural domains, the slope design should be revisited.
- The bench designs incorporate a minimum allowance for back break of 2.5 m in the Komatiite and 2 m in the other domains based on the performance of the benches at Meadowbank. This allowance has been applied to design sectors where the bench width is not strongly limited by kinematic failures. This includes sectors A2, B2, D4, E4, G5, H6, I1 and I6. The back break in these sectors should be tracked by comparing the planned vs actual slope geometry (e.g. by using the Maptek). If it differs significantly form these values, the design should be revisited.
- Blast design can have a strong influence on bench performance. The design will need to vary between some of the lithologies (e.g. Komatiite vs Diorite), and pre-shear blasting will be needed for the final walls. Interim pit walls provide an opportunity to refine the blast design and determine what provides the best results for the performance of the final walls. Backbreak can be used as one of the metrics for comparing designs.





Other Considerations

Other Considerations

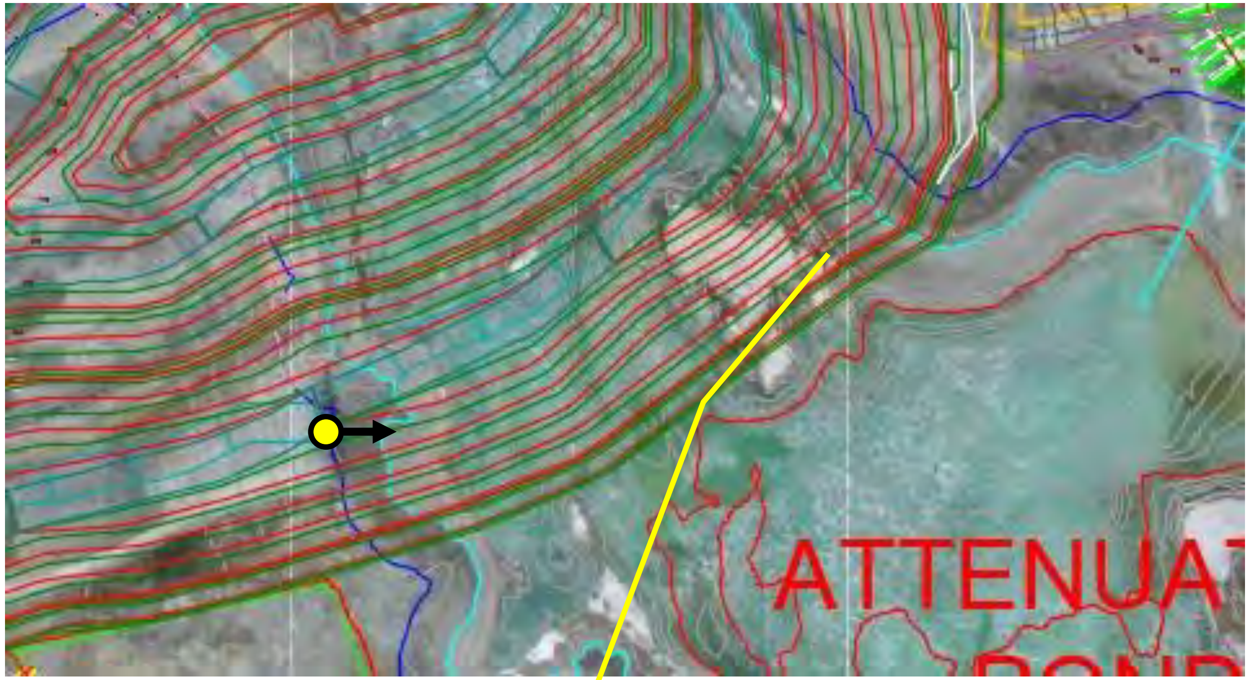
Fall of Ground

- The Fall of Ground that occurred on the southwest wall of the open pit on June 9, 2019 was reviewed.
- A wedge of approx. 385 tonnes failed along the sub-horizontal Joint Set C (38° / 258°, dip / dip direction). The orientation of the second release plane is not clear. It may be the foliation, which is subvertical and dips into the wall in this area.
- The area as since been blasted.
- As a note, the Rock Fall Log is a good tool for documenting slope performance and provides an opportunity to learn from previous failures. It would be helpful to document the Failure Mode (e.g. planar, wedge, rockfall, circular failure, etc.) and, for kinematic failures, the Joint Sets involved.

Other Considerations

Proximity to Attenuation Pond

- The south wall of the Phase 3 WHL pit is in close proximity to the planned attenuation pond. The likely challenges associated with this (e.g. increased seepage and the formation of ice walls in the pit) have been previously discussed with AEM.
- It is understood that AEM is considering alternatives for the attenuation pond. This is strongly endorsed.
- Silt fence is shown in yellow on both images for reference. Approximate photo location and perspective is shown on the plan at right. Note that the pit limits have not been cut to topography and there will be a larger offset than shown.



THANK YOU