Appendix 16

Meadowbank and Whale Tail 2021 Geomechanical Inspection Implementation Plan

MBK Annual Wall Inspection Recommendation Implementation Plan

Recommendations from 2021 located at P:\Engineering\05-Geotechnic\14- Amaruq\09- Audit & External Inspection\3- Annual Ground Control Inspection\2021\MBK

2021 MBK Annual Wall inspection received end of February 2022

Recommendation Number	Priority Level [1]	Location	Year [2]	Recommendation	Action Plan/Follow-up	Status	Responsible	Due date
2021_MAW_01	P-2	Portage B Dump	2021	It is not clear if the topography and bedrock profile below the B Dump and West road result in a scenario where a failure of the dump could impact the road. The topography andbedrock profile should be reviewed. If the road could be plausibly impacted, stability analyses should be completed.	A mandate to evaluate the stability of the west road as the water level rise will be evaluated in 2023 by the geotechnical team. (CT-2022/03/24)	Open	LC/PG	2023-12
2021_MAW_02	P-2	Pit A East ramp	2021	Restrict or close access to the ramp.	Restrict or close access to the ramp.	Open	TD/GB	2022-09
		Portage B Dump	2021	Restrict or close area to the upper platform.	Restrict or close area to the upper platform.			2022-09
		Vault in-pit dump	2021	Restrict or closeaccess to the in-pit dump.	Restrict or closeaccess to the in-pit dump.			2022-09
		Vault WRSF	2021	Restrict or close access to Vault WRSF.	Restrict or close access to Vault WRSF.			2022-09
		Phaser/BB Phaser	2021	Restrict or close the access road between BB Phaser and Phaser Pit.	Restrict or close the access road between BB Phaser and Phaser Pit.			2022-09
2021_MAW_03	P-2	Vault ring road	2021	The need for continued access to the Vault Pit Ring Road should be reviewed and berms constructed to restrict entrance to areas where access is no longer required. In particular, review the need for berms to prevent access to the areas of subsidence adjacent Pond D and Vault Lake.	Restrict the access with cones or block the area permenently with a berm	Open	TD/GB	2022-09
2021_MAW_04	P-2	Vault ring road	2021	The Vault Pit Ring Road has subsided adjacent Pond C and represents a hazard to vehicle traffic and access is still required. The area should be filled and graded or the area should be clearly marked with pylons.	Restrict the access with cones or block the area permenently with a berm	Open	TD/GB	2022-09
2021_MAW_05	P-2	Portage C Dump	2021	The ABF Garage has been constructed on top of the C Dump. Settlement of the dump, and potential structural damage to the garage, is likely once the water level in Pit A and Pit E reaches the base of the dump and the potential for thaw of the waste rock increases. The garage and its associated infrastructure should be relocated away from the waste rock dumps and the tailings management areas. Once the garage has been relocated, construct berms to prevent access to the C Dump platform.	The plan is to remove ABF garage of Portage C Dump in summer 2022 . (CT-2022/03/24)	Open	E&I	2022-12
2021_MAW_06	P-2	General	2021	The Ground Control Management Plan (GCMP) for the Meadowbank Site was last updated in 2018 and does not reflect the current state of operations or ground control activities. The GCMP should be reviewed and updated. The GCMP could be consolidated with the one for the Amaruq Site.	In the 2022 revison of AMQ GCMP a section for MBK will be included	Open	CT	2022-12
2021_MAW_07	P-3	General	2021	Continue the monthly visual inspections of the Goose Pit, Portage Pit A, Portage Pit E, Vault Pit, B Dump, C Dump and D Dump.	This is already being done. (CT-2023/03/22)	Close	TD/GB	-
2021_MAW_08	P-3	Amaruq road between Phaser and Vault Pit	2021	The Amaruq AWR crosses a rockfill embankment between the Vault and Phaser pits. The stability of the embankment could be adversely impacted if the water level in the Phaser pit increases and water ponds behind the embankment. The monthly visual inspections should consider the presence of seepage below the Amaruq AWR Embankment at the Vault Pit as well as the water level in the Phaser Pit.	This is already being done. (CT-2021/03/22)	Close	TD/GB	-
2021_MAW_09	P-3	Ramps (Goose pit, Portage Pit A, Vault Pit, Phaser Pit)	2021	Goose Pit, Portage Pit A, Vault Pit and Phaser Pit are currently not included in the monthly visual inspections. Visual inspections of the ramps should be completed prior to access or as part of the monthly inspections. In addition to the ramp, the inspections should continue to consider the open pit slopes and in-pit waste dumps. The Ring Road adjacent Vault Lake should be inspected prior to accessing the Vault Pit due to the potential for inrush from Vault Lake to the Vault Pit. If the hazard was mitigated (e.g., by breaching the Ring Road) the inspections of the Ring Road could be stopped.	Pit A ramp already being inspect every month. Add goose Pit to the monthly inspections. Phase and BB Phaser inspection before accessing only. (CT-2021/03/22)	Open	TD/GB	2022-09

2021_MAW_10	P-3	General	2021	The visual inspections are currently completed on a monthly basis, regardless of the identified hazards. A formal mechanism should be developed to increase the frequency of visual inspections in response to defined criteria.	Depending on the hazards identified, the inspections will be adjusted. (CT-2022/03/22)	Close	LC/PG	2022-04
2021_MAW_11	P-3	General	2021	The visual inspections are completed by the Geotechnical Group. While several members of the group have experience monitoring open pit slopes, the group's focus is on the management of the dykes and tailings facilities. Recommend implementing an annual visual inspection of the open pits and in-pit waste rock dumps by the Rock Mechanics Group.	Annual inspection by Rock Mech will be carried out at the same moment as the annual OP Geomechanical inspection with Ben Peacock. (CT-2022/03/22)	Close	CT	-
2021_MAW_12	P-3	Pit D Dump	2021	Continue to monitor the wireline extensometers at the D Dump.	This is already being done. (CT-2023/03/22)	Close	TD/GB	-
2021_MAW_13		General	2021	The hazard assessment map captures many, but not all, of the hazards identified during the annual inspection. Comments have also been provided on several of the risk ratings. The hazard map should be reviewed and updated to reflect the outcome of the annual inspection.	Update to hazard map to include hazards identified during the inspection.	Open	TD/GB	2022-04
2021_MAW_14	P3	General	2021	Record and report (as appropriate) rockfall events that occur within the open pits used for tailings and water management in areas where there is the potential for worker access.	This is already being done. (CT-2023/03/22)	Close	TD/GB	2022-09
2021_MAW_15	P4	In pit dumps	2021	Implement an annual subsidence assessment of the Goose Pit Waste Rock Dump, B Dump, C Dump, D Dump and Vault Pit Waste Rock Dump using photogrammetry.	Drone implementation is currently being tested at MBK/AMQ. When drone inspection will be up and running, the dumps will be considered on the list of infrastructures to monitor. (LC-2022/03/24)	Open	LC/CL	2022-12
2021_MAW_16	P4	Pit B Dump	2021	Grade the upper and lower platforms of the B Dump and fill the sinkholes/depressions in order to prevent water ponding and limit infiltration.	The correction will be done this summer.	Open	TD/GB	2022-09
2021_MAW_17	P4	Vault in pit dump	2021	Include the Vault Pit North Waste Rock Dump in the monthly visual inspections, focussing on the area of settlement.	Area to be inspected prior to access vault pit for water sampling.	Close	-	-
2021_MAW_18	P4	Goos pit	2021	Review the need to periodically monitor the VWPs and thermistors installed in the east wall of the Goose Pit from an environmental perspective given the potential for future tailings deposition in the open pit.	VWP and TH are being monitored by the geotechnical group as part of the Goose dike monitorining.	Close	-	-
2021_MAW_19	P4	Phase/BB Phaser	2021	Approach the WSCC about ending the third-party annual inspections of the Phaser and BB Phaser Pits. The exposed rock slopes and associated hazards are limited.	The pits are being sampled by the ENV. Inspections must continue before water sampling activities.	Close	-	-

AMQ Annual Wall Inspection

Recommendations from 2021 located at: P:\Engineering\05-Geotechnic\14- Amaruq\09- Audit & External Inspection\3- Annual Ground Control Inspection\2021\AMQ

Recommendation Number	Priority Level [1]	Location	Year [2]	Recommendation	Action Plan/Follow-up	Status	Responsible	Due Date
2021_AAW_1	P-2	Whale Tail Pit - North Wall	2021	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, a block was observed on the north wall. The material represents a rockfall hazard and should be removed.	Block was scaled following the inspection.	Closed	-	-
2021_AAW_2	P-2	Whale Tail Pit - South Wall	2021	A potentially unstable wedge has been identified below the ramp in the south wall. Radar data suggests that the wedge is deforming in response to blasting. Instrumentation (e.g., a crackmeter) should be installed to allow the deformation to be more accurately monitored. A Trigger Action Response Plan (TARP) should be developed for the instrumentation. If deformation of the wedge continues, options for stabilizing the wedge should be reviewed.	Potential wedge is currently stable and is being monitored with radar.	Closed	Rock mechanics team	-
2021_AAW_3	P-2	Whale Tail Pit - Phase 1 ramp	2021	The Phase 3 pushback has resulted in overspill and rockfall on the ramp and the benches above the ramp. A rockfall berm has been constructed along the inside of the upper portion of the ramp. However, the berm is now close to being full and does not cover the lower portion of the ramp. The rockfall berm should be extended so that the full length of the ramp below the Phase 3 pushback is protected. The existing berm should be cleaned out to re-establish March 24, 2022 3 of 6 NB22-00214 adequate capacity for future rockfall and periodic inspections of the berm completed in order to identify if future cleaning is required.	The berm was extended along the full length following the inspection and is being cleaned periodically.	Closed	-	-
2021_AAW_4	P-2	Whale Tail Pit - Phase 3	2021	A temporary wall was developed in the blocky diorite without pre-shear. The bench face represents a rockfall hazard and a rockfall berm should be established below the temporary wall.	A berm was installed following the inspection.	Closed	-	-
2021_AAW_5	P-2	IVR 1 - Northwest wall	2021	The poor performance of the bench faces and the reduced catch bench width in this sector represent a rockfall hazard and a rockfall berm should be established below the wall.	A berm will be installed prior rockfall seasion 2022	Open	CT/VD	2022-05
2021_AAW_6	P-2	IVR 1 - Northeast wall	2021	Several potentially unstable wedges were observed on the north wall. The wedges represent a rockfall hazard and should be removed.	The wedges were scaled until solid rock portions were reached.	Closed	-	-
2021_AAW_7	P-2	Whale Tail Pit - NE Wall	2021	Additional rock mass characterization and stability analyses are planned in order to confirm the revised slope design for this design sector. This study should be completed. On-going structural mapping of the pushback is recommended to support this process.	Stuctural mapping was completed and further studies are ongoing	Closed	CT	-
2021_AAW_8	P-2	IVR 1 - Nortwest wall	2021	The benches in this sector have not performed as expected. Variable bench performance and reduced catch bench width appear to be associated with variations in lithology and rock mass structure, as well as drill and blast practices. A trial of a revised bench design is planned and is endorsed. The performance of the wall should be reviewed.	Trials were performed and are really conclusives. Review by KP currently ongoing.	Open	CT	2022-05

2021_AAW_9	P-2	General	2021	Brittle, bench-scale failures and rockfalls are the most likely failure mode at the mine. As Slope Stability Radar (SSR) is not well suited to predicting these failures in advance, managing these failures relies on bench design, scaling and visual inspections. Additional measures for managing the risk associated with these failures have been discussed. Complete a risk-based review of the management of rockfalls at the mine to select the appropriate monitoringtool(s), operational practice(s), or design solution.	Evaluate the other slope monitoring tools available. Anaylse the feasibility to mine areas prone to rockfall outside of the freseht season when conditions are more favorable.	Open	CT	2022-12
2021_AAW_10	P-2	General	2021	The mine does not currently monitor any geomechanical or hydrogeological instrumentation in the vicinity of the open pits. Develop and implement an instrumentation program, including vibrating wire piezometers, thermistors, and instruments that can monitor sub-surface deformation (e.g., inclinometers or Time Domain Reflectometry cables). The instrumentation program should be developed using a risk-based approach.	Instrumentation monitoring plan developped. 2022 installation of VWP and TH at the south wall. 2023 install inclinometers/TDR/TH/VWP at the NE wall.	Open	CT	2023-12
2021_AAW_11	P-2	General	2021	AEM has committed to reviewing the performance of the open pit slopes every four months. A review has not been completed in the last year and should be undertaken and documented. The review should include a discussion of the major geomechanical hazards (including any slope failures), a comparison of the planned and achieved slope geometry, as well as a comparison of the collected geomechanical data to the design basis that was used to develop open pit slope geometry recommendations.	Quaterly report to be put in place in 2022.	Open	CT/MN	2022-12
2021_AAW_12	P-2	General	2021	Drill and blast practices have been a factor in poor bench performance in both of the open pits, including increased backbreak, undercutting of the bench face and hard toes. The blast design does not vary to account for different lithologies or the orientation of the foliation and quality control is limited. A blasting study is on-going and should be completed. It is recommended that opportunities to sequence blasts away from the final open pit walls be considered.	External consultant recommendations were made and are currently bieng implemented	Closed	Drill and blast	2022-12
2021_AAW_13	P-2	General	2021	The role and responsibilities of each member of the rock mechanics team should be clearly defined. There are competing claims on the available resources, and commitments are sometimes missed. Consider completing a time study to track the time staff spend on individual tasks.	Following the visit, roles and responsabilities were clarified. Additional manpower ressources were also added.	Closed	-	-
2021_AAW_14	P-3	Whale Tail Pit - Phase 2 SE Wall	2021	Several potentially unstable blocks have been identified along the crest of one of the benches on this wall. The area was previously scaled by a rope crew. The blocks should be included in the regular visual inspections. As the blocks are difficult to observe, the inspections should be periodically supplemented with monitoring using the drone.	Area is close and portion will be mined in the phase 3 sequence of the mine plan.	Closed	-	-
2021_AAW_15	P-3	Quarry 1	2021	Surface water is ponding at the base of the former Quarry 1. Access to the area is restricted. Infiltration of this water may be associated with seeps in the southeast wall and could contribute to slope instabilities. The regular visual inspections should document the ponded water.	Area is close and portion will be mined in the phase 3 sequence of the mine plan.	Closed	-	-
2021_AAW_16	P-3	IVR 1- NE & SE Wall	2021	Persistent cross-cutting structures have locally limited the achieved bench geometry on the southeast wall and are associated with the wedges identified on the northeast wall. These structures should be mapped so that potential instabilities on future benches can be anticipated. access to AP5 is	If unfavorable stuctures are identifed, remedial actions will be taken.	Closed	-	-
2021_AAW_17	P-3	AP5	2021	As access to AP5 is not currently required, recommend constructing a berm at the top of the ramp to restrict access.	Access to AP5 is currently being used to reclaim water for UG.	Closed	-	-

2021_AAW_18	P-3	General	2021	The bench approval process is an integral part of the mine's management of rockfall hazards. The process is well established but has not been formally defined and whether or not a bench has been approved is not tracked. A formal procedure and/or checklist should be developed and a method established for tracking which benches have been approved.	Procedure for bench approval is currently inplace and is working well.	Closed	-	-
2021_AAW_19	P-3	General	2021	Hazard maps for the open pit slopes are issued after each inspection, documenting the observed hazards and recommended mitigation measures. While the maps are an effective tool, they primarily consider hazard rather than risk. The maps form the basis for AEM's risk-based Work Close to Pit Wall procedure, which is a key process used by the mine to manage geotechnical risk. There is a potential disconnect between the risk-based procedure and the hazard map. It is recommended that the mine provide additional guidance on assessing the risks associated with the identified hazards, accounting for the consequences of a hazard occurring and the mitigating measures in place. This will help identify areas requiring additional mitigation. Consider developing a Trigger Action Response Plan (TARP) to assist with the categorization of common hazards.	Optimisation of the hazard classification and internal training will be provided.	Open	CT/VD	2022-12
2021_AAW_20	P-3	General	2021	The mine commits to monthly drone inspections of the catch benches between May and September, but these are not regularly completed. The commitment should be reviewed and aligned with current needs and capabilities. For example, the drone inspections could focus on specific identified hazards and be supplemented by a biannual or quarterly inspection of the catch bench condition.	The next revision of the GCMP will revise this commitment.	Open	CT	2022-12
2021_AAW_21	P-3	General	2021	The current strategy for the SSR involves adjusting the alarm parameters on a case-by-case basis. This process is informal and relies on an experienced operator who is familiar with the historical slope performance and is comfortable interpreting the data. With the recent addition of new staff to the rock mechanics team, recommend providing more detailed guidance on the selection and adjustment of alarms. It is understood that a draft memo is in progress. The default alarms should continue to be regularly reviewed.	Guidelines and training on radar will be given to new members of the rock mechanics team before next rockfall season . This will include radar alarm.	Open	CT/VD	2022-05
2021_AAW_22	P-3	General	2021	The SSR is a key component of the mine's monitoring program. As a result of the Phase 3 pushback, the radar that covers the northern walls of the Whale Tail Open pit will need to be moved repeatedly in 2022. The mine plan should be reviewed from the perspective of radar placement and coverage.	The radar positionning will be adressed in the quarterly report.	Open	CT/VD	2022-05
2021_AAW_23	P-3	General	2021	The monitoring of surface deformation is limited to the SSR. An additional method of monitoring surface deformation is recommended to complement the SSR. The objective is to determine the true vector of any displacement and to establish a long-term baseline. Options include survey prisms or GPS beacons.	To be evaluated in 2022.	Open	CT	2022-12
2021_AAW_24	P-3	General	2021	The mine does not currently monitor any geomechanical or hydrogeological instrumentation in the vicinity of the open pits. There is a need to develop and implement an instrumentation program, including vibrating wire piezometers, thermistors, and instruments that can monitor sub-surface deformation (e.g., inclinometers or Time Domain Reflectometry cables). The instrumentation program should be developed using a risk-based approach.	Instrumentation monitoring plan developped. 2022 installation of VWP and TH at the south wall. 2023 install inclinometers/TDR/TH/VWP at the NE wall.	Open	CT	2023-12

2021_AAW_25	P-4	General	2021	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 of particular areas based on the observed slope performance (e.g., if a deformation rate is exceeded) and the risk associated with a particular slope.	If a hazard is identified inspection frequency is adjusted case by case.	Closed	-	-
2021_AAW_26	P-4	General	2021	Photos are taken as part of the inspections. It is recommended that a series of standard photos (i.e. similar perspectives) be incorporated into the formal inspections to facilitate the tracking of changes in the slope performance over longer time periods.	Take photos at same angle and similar position.	Open	CT/VD	2022-12
2021_AAW_27	P-4	General	2021	Identified hazards and the associated corrective measures are tracked in a database along with the due date and associated risk rating. This is a good practice. However, overdue items are not flagged. A mechanism should be developed to flag overdue corrective measures.	Overdue items can be classified in Excel and looked at particularly.	Closed	-	-
2021_AAW_28	P-4	General	2021	Rock falls are documented in a database along with key characteristics (e.g., rock type, failure mode, discontinuity orientation, tonnage, etc.). This is an important practice, but the data are sometimes incomplete. The data should be consistently collected for all documented failures (to the extent possible) to facilitate back-analyses and a review of possible trends.	Validate that all entries are done when possible	Open	CT/VD	2022-12
2021_AAW_29	P-4	General	2021	The rock mechanics team regularly provides input to the mine planning and design process. In some cases, this input is not formally documented or is only briefly summarized. It is recommended that input to the Four Month Rolling (4MR) Mine Plan be formally documented and that the reviews completed for the Budget Mine Plan be documented in greater detailed.	Document all reviews and recommendations on mine plan.	Open	CT	2022-12
2021_AAW_30	P-4	General	2021	Consider developing a monthly dashboard report to summarize key statistics and providing a brief overview of key hazards. The objective is to summarize the work completed by the team and to demonstrate compliance with the commitments in the GCMP. This will also help determine whether additional resources are required to meet these commitments.	This is will be implemented in 2022	Open	DS	2022-12
2021_AAW_31	P-4	General	2021	Several new staff have joined the rock mechanics team in the past year. Consider developing a skills matrix to help identify training needs.	None	Closed	-	-
2021_AAW_32	P-4	General	2021	The Ground Control Management Plan (GCMP) is well-written and suitable document but has not been updated since July 2020. Several opportunities to improve the GCMP were identified during the site visit and discussed with the rock mechanics staff. These include adding a brief overview of the deposit geology and mine plan and clarifying several points. The GCMP should be reviewed and updated annually.	This will be incorporated in 2022 GCMP revision	Open	CT	2022-12

1 : Priority Level Descriptions

P-1: A high priority or actual structure safety issues considered immediately dangerous to life, health, or the environment, or a significant risk of regulatory enforcement.

P-2: If not corrected could likely result in structure safety issues leading to injury, environmental impact, or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.

P-3: Single occurrences of deficiencies or non-conformance that alone would not be expected to result in structure safety issues.

P-4: Best Management Practice – further improvements are necessary to meet industry best practices or reduce potential risks.

2 : Previous year recommendations are kept only if they are outstanding