

Mackenzie Valley Land and Water Board
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Staff Report

Applicant: Aboriginal Affairs and Northern Development Canada – Contaminants and Remediation Directorate (AANDC-CARD)	
Location: Giant Mine	Application: MV2012L8-0010
Date Prepared: September 9, 2013	Meeting Date: September 19, 2013
Subject: Field Paste Testing Plan – Component of the Underground Stabilization Program	

1. Purpose/Report Summary

The purpose of this report is to present a request to the Mackenzie Valley Land and Water Board (the Board/MVLWB) made by Aboriginal Affairs and Northern Development Canada – Contaminants and Remediation Directorate (AANDC-CARD), to approve field paste testing that is required to further refine and inform the backfill work described in the accepted application for the underground stabilization program (MV2012L8-0010).

2. Background

- July 26, 2013 – Field Paste Testing Plan received;
- August 2, 20213 – the Field Paste Testing Plan was sent to reviewers for comment;
- August 23, 2013 – comments from reviewers due;
- September 6, 2013 – responses from AANDC-CARD due; and
- September 19, 2013 – presented to the Board.

3. Discussion

Part H, Item 3 of Water Licence MV2012L-0010 states that:

The Licensee shall, 45 days prior to starting backfilling of stopes or chambers, construction of new bulkheads or repair of existing bulkheads in the Underground Work Stabilization Area, submit to the Board for approval a detailed Underground Work Stabilization Plan.

As part of this requirement, AANDC-CARD has informed the Board that:

Ongoing design of the interim underground stabilization program for the Giant Mine site has indicated that field testing is required to further refine the backfill work described in the accepted application for Water Licence (WL) MV2012L8-0010. The underground stabilization program involves backfilling the underground voids with paste tailings. The field test would be used to test various paste tailings mixes and foams to understand their engineering characteristics and performance for the purposes of optimizing the approach prior to emplacement of backfill underground.

As such, AANDC-CARD is seeking approval to carry out the field test, and has submitted a Field Paste Testing Plan (the Plan) that outlines the test methodologies proposed. The results of the field test would inform the underground stabilization program and will be provided to the Mackenzie Valley Land and Water Board.

Primary components of the proposed test include the following:

Test Location: The field test will take place entirely in the South-Central Tailings Ponds basin and will involve manufacturing paste tailings in a mixer truck. The test pastes will be pumped into C-cans also staged entirely within the South Tailings Pond so that their engineering characteristics can be determined. No paste tailings will be pumped into the underground as part of the field test.

Test Start: Early August.

Test Duration: Approximately nine days.

Water Use: As required by Part C, Item 1 of the WL, only treated minewater from the Polishing Pond will be used. The total volume of treated minewater required for the test is approximately 400 m³, with a maximum daily use rate of approximately 30 m³.

Materials Use: Approximately 500 m³ of tailings will be used to complete testing. Crushed rock, cement, cement binders and expanding foams will also be used.

Dust Control: As no fresh rock will be quarried on-site as part of the test, dust control will be required only during tailings excavation. Dust control will be achieved by wetting the tailings with treated minewater from the Polishing Pond. All equipment will be washed prior to leaving the tailings basin to prevent the spread of tailings around the site.

Spill Contingency: As required by Part F, Item 2 of the WL, the approved General Contingency and Emergency Response Plan will be adhered to during the test.

Water Management: As the entire test will take place within the South Tailings Pond basin, any water generated during paste manufacture, dust control, or equipment washing will be captured and controlled by the existing flow paths within the South Tailings Pond.

Waste Management: C-cans containing hardened paste tailings and other waste products will be stored at the Temporary Waste Storage Area constructed on the Central Tailings Pond. Final disposal will be approved through the main Type A licensing process.

The Plan was sent out for review. The comments received from reviewers, and the proponents responses are described below.

4. Comments

AANDC-CARD sent a draft Plan to interested parties for review and comment before formally submitting the Plan to the Board. Alternatives North (AN) provided comments on this draft directly to AANDC-CARD on August 16, 2013 (comments attached). AANDC-CARD responded on August 22, 2013 to the comments made by AN (response attached).

Board staff note that the Plan includes testing of expanding foam as backfill material. Part H, Item 7 of Water Licence MV2012L-0010 states that:

The Licencee shall only use tailings paste, waste rock from mine development, or existing inert rock material stockpiled on the surface to backfill the chambers and stopes unless otherwise approved by the Board.

If the proponent decides to use expanding foam to backfill chambers and stopes, they will need to get approval from the Board to do so.

5. Review Comments

During the Board's online review process, comments were received from AN. AN's comments included:

- Request for improved communication (via a communication protocol or plan) with the general public;
- Request for an updated schedule of the Giant Mine By-pass construction and an assessment by an engineer that the blasting associated with the road work will not interfere with the field testing;
- Request for information on how AANDC-CARD will evaluate various paste mixes, the criteria that will be used, and an explanation of the decisions made (including cost considerations and any trade-offs made); and
- Request for information on any municipal permits or approvals that are required or have been acquired.

On September 6, 2013, AANDC-CARD submitted responses to all of the comments made by AN.

All comments and responses are in the attached Online Review System Comment Summary Table for your review.

6. Security

n/a

7. Conclusion

In reviewing the comments submitted during the review period and the responses made the by the proponent, it is Board staff's assessment that AANDC-CARD has adequately addressed the concerns that have been raised.

8. Recommendation

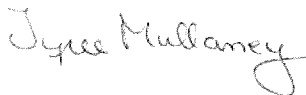
Board staff recommends that the Board approve the field paste testing program as detailed in the Field Paste Testing Plan submitted by AANDC-CARD.

The Board may wish to remind the proponent that they will need approval from the Board if they plan to use expanding foam to backfill mine chambers or stopes.

9. Attachments

- [Field Paste Testing Plan](#)
- **Online Review System Comment Summary Table**
 - [Alternatives North Initial Comments submitted August 16, 2013 with AANDC-CARD response \(blue font\) dated August 22, 2013](#)
 - [Alternatives North Comments dated August 23, 2013](#)
- **Draft Issuance Letter**

Respectfully submitted,



Tyree Mullaney
Regulatory Officer

Review Comment Table

Board:	MVLWB																				
Review Item:	MV2012L8-0010 - AANDC CARD - Field Paste Testing Plan																				
File(s):	MV2012L8-00010																				
Proponent:	AANDC																				
Document(s):	MV2012L8-0010 - Field Paste Testing Plan (IMB)																				
Item For Review Distributed On:	Aug 1 at 15:49 Distribution List Aug 1 at 15:53 Distribution List																				
Reviewer Comments Due By:	Aug 23, 2013																				
Proponent Responses Due By:	Sep 6, 2013																				
Item Description:	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Organization</th> <th style="text-align: center;">Contact Name</th> <th style="text-align: center;">Contact Position/Title</th> <th style="text-align: center;">Email/Fax</th> </tr> </thead> <tbody> <tr> <td>Fort Resolution Métis Council</td> <td>Trudy King</td> <td></td> <td>(867)394-3322; Fieldworker_fmcs3@northwestel.net; (867)874-4472;</td> </tr> <tr> <td>Hay River Metis Council</td> <td>Wally Shuman</td> <td>President</td> <td>hsmc@northwestel.net; (867)872-2772;</td> </tr> <tr> <td>[NWT Metis Nation - Not for Canadian Zinc Files]</td> <td>Tim Heron</td> <td>NWTMN IMA Coordinator</td> <td>rcc.nwtmn@northwestel.net; (867)872-5154;</td> </tr> <tr> <td>Smith Landing First Nation</td> <td>Andrew Wanderingspirit</td> <td>Chief</td> <td>chief@slfn196.com;</td> </tr> </tbody> </table>	Organization	Contact Name	Contact Position/Title	Email/Fax	Fort Resolution Métis Council	Trudy King		(867)394-3322; Fieldworker_fmcs3@northwestel.net ; (867)874-4472;	Hay River Metis Council	Wally Shuman	President	hsmc@northwestel.net ; (867)872-2772;	[NWT Metis Nation - Not for Canadian Zinc Files]	Tim Heron	NWTMN IMA Coordinator	rcc.nwtmn@northwestel.net ; (867)872-5154;	Smith Landing First Nation	Andrew Wanderingspirit	Chief	chief@slfn196.com ;
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Smith Landing First Nation	Andrew Wanderingspirit	Chief	chief@slfn196.com ;																		
General Reviewer Information:	Please find attached Field Paste Test Plan. If you have any questions please feel free to contact me at tyree@mvlwb.com or 867-766-7464.																				
Contact Information:	Tyree Mullaney 867-766-7464																				

Comment Summary

Proponent General File(s)	
ID	Proponent General File Comment
1 (doc)	Cover Letter
2 (doc)	Attachment A - Addendum to Comment Summary Table (AN2)
3 (doc)	Attachment B - Engineer's Assessment, Blast Vibrations
4 (doc)	Attachment C - Objectives and Criteria for Slope B1-18

Alternatives North: Kevin O'Reilly				
ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Response
1	General File	Comment (doc) Cover Letter Recommendation		
2	On page 1 of the Plan, the following statement is found: "The field test will be structured to determine the engineering requirements for the following: Suitable multiple mix designs for placement of low slump cemented paste tailings backfill barricades and high slump lightly cemented paste tailing	Comment The Ingraham Trail realignment is taking place close to the Giant Mine at the same time as the planned field tests. As we understand it, there will be blasting involved for the realignment and some of this is to take place relatively close to the field test area. We are concerned about the effects of this blasting on the field tests, current underground stability and any attempt to begin the underground work during the blasting. We are of the August 16 AANDC response to our preliminary concerns on the field test plan and believe that the answers provided should be updated or supplemented with additional evidence. Recommendation Please provide an updated construction schedule for the Giant Mine bypass construction and an assessment by a qualified engineer that blasting associated with the road work will not have an effect on the field testing in relation to vibrations.	Sep 6: The Project Team agrees that blasting near unstable crown pillars could potentially increase the instability within the underground workings, which is one of the reasons why stabilizing the underground workings is critical. For this reason, the Project Team must be responsive to any on-site effects caused by road realignment but cannot direct road realignment activities. As confirmed in the Project Team's August 16 responses, the Project Team is aware of the road realignment work and is in contact with the GNWT-DOT as part of the field test planning. Blasting schedules typically change over time and are best confirmed within 24 hours, rather than a number of weeks in advance of work. The attached signed letter from Golder Associates (Attachment B), the design engineer for the field test work, confirms the following: 1) that the design team is aware of the blasting being carried out and that field test procedures include being in contact with the blaster for the GNWT highway contractor on a daily basis during the test program to obtain blast information prior to starting field test work at the start of each day. 2) the short term nature of the field test provides flexibility to work around the blast schedule so that the field test work is not effected by blasting. 3) no field test work will take place within the blast radius as determined by the blaster for the GNWT highway contractor to protect worker health. 4) vibrations generated by blasts should not compromise the results of the field test.	Board staff are satisfied with the response from the proponent.
3	On page 2 of the Plan, the following statement is found: "The purpose of this testing would be to try and find a cheaper alternative to cement while achieving the same strength and deposition results."	Comment Alternatives North is concerned that AANDC has simply emphasized it is looking for a cheaper alternative paste backfill mix. It is not clear how cost will be traded off against other criteria such as environmental safety and longevity. We are aware of AANDC Aug. 16 response to our preliminary concerns and believe that aspects of the original questions remain unanswered. Recommendation AANDC should provide additional information on how it intends to evaluate the various mixes (including design criteria such as the ability of the backfill to withstand earthquakes and blasting and the expected frequency of such events, e.g. a 1 in 500 year event), an explicit list of the criteria and weighting that will be used and a clear statement that costs will not drive the selection of the selected mix above other important criteria such as longevity of the backfill and environmental safety. AAANDC should provide a full explanation	Sep 6: For the complete response, please refer to Attachment A - Addendum to the Comment Summary Table and to Attachment C - Closure Objectives and Criteria for Stope B1-18. <u>AN Comment 2</u> The recommendation has multiple parts, each of which are addressed separately below. <u>Mix Evaluation</u> The field paste test will both inform and be informed by design of the underground stabilization program because design includes the paste mix itself, the operational performance of the paste mix, and stabilization success criteria. The field paste test will increase the design engineer's understanding of how different mix designs will behave and identify the characteristics of paste tailings mixes during backfilling operations. To gaining a better understanding of the behavior of different	Board staff are satisfied with the responses made by the proponent. Board staff note that once defined, the objectives and criteria for the remaining stopes and chambers should be provided to the Board before the work is conducted.

		<p>of any trade-offs that are made. We also request that the report(s) on evaluation and selection of paste backfill mixes be filed with the Board.</p>	<p>paste mixes, the design engineer will measure and test paste mixes as appropriate to determine the following properties (previously provided on August 16, 2013 in responses to Alternatives North on Field Paste Test Work Plan).</p> <ul style="list-style-type: none"> a) Index testing including Particle Size Distribution, Specific gravity, pH and mineralogy and chemistry – index testing measures the ‘fingerprint’ of the feed material. Ultimately each of the index tests governs the ultimate behavior of the paste so it will need to be frequently checked to make sure changes are noted <ul style="list-style-type: none"> a. PSD – defined by ASTM D4464 b. S.G. – defined by ASTM D854 c. pH – defined by ASTM D4972 d. Mineralogy and chemistry – defined by ASTM standard b) 28 day uniaxial compressive strength – is a measure of the strength profiles over time of each recipe/mix design. UCS is conducted in accordance with ASTM standard D2166 c) Rheology – is a measure of the flowability and behavior of the material during mixing and pumping. Rheology includes yield stress and viscosity measurements. Viscosity is conducted in accordance with DIN 53018 and DIN 53019 d) Slump (characterizes the mix designs sensitivity to water addition and flowability once deposited into the stope). Slump tests are completed in accordance with CSA standard A23.2-5C e) Water bleed measures the amount of water coming off the mix once deposited – this test is completed in accordance with Golder proprietary standards. <p>The objective of the mitigation is to backfill the selected and targeted underground voids so that the propagation of rock failure is limited to the extent that potential surface impacts (e.g. subsidence) do not compromise public and worker safety and critical surface infrastructure on the mine property, and limits surface water infiltration into underground workings. Closure criteria for each particular underground void will be unique as each void has a unique configuration and characteristics, including but not limited to: void geometry, crown pillar geometry, and crown pillar rock mass quality. The above information will be coupled with information obtained by drilling and other surveys (e.g. stope geometry, and size) to develop a set of design criteria for each stope and chamber within the scope of the license (except Stope B1-18 - see below under the objectives and criteria heading). Criteria will be set as to the amount of backfill required</p>	
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			<p>to meet the closure objectives measured as the minimum distance between the top of the backfill and the top of the void. In selecting the paste mixes that will be placed in each underground stope or chamber (i.e. voids), the following factors will be considered:</p> <ol style="list-style-type: none"> 1. Conformity to criteria: Backfill design will aim to ensure that earthquakes (see note 1 below on design earthquake) and nearby blasting can only destabilise the paste before it is cured, which should take between 12 hours and 7 days. Once the paste has cured it is resistant to liquefaction and although seismic loads may cause backfill damage it will remain in place and retain its design function. 2. Operational paste characteristics: A variety of pastes mixes are required to address differing void configuration and characteristics and the position of paste delivery boreholes and pipelines, including those with high slump paste, which will be used for the majority of the backfilling, and low slump paste used for plugging up exits to voids. 3. Binder availability: The availability of binders in the quantities required at the time of backfill will influence which binder is used. 4. Cost: The consideration of costs in paste evaluation is detailed below. <p><u>Objectives and Criteria</u> Sufficient information is available for Stope B1-18 such that closure objectives and criteria, including criteria for the paste mix, were able to be developed. Stope B1-18 closure objectives and criteria are defined in Attachment C. Drilling and field paste testing of mixes is still required to assist with setting criteria for the remaining stopes and chambers within the scope of Water Licence MV2012L8-0010. Once defined, the objectives and criteria will be provided to parties and the MVLWB with updated work plans that require approval under the licence.</p> <p><u>Costs</u> From an engineering standpoint, appropriate backfill could be achieved through the use of making paste using tailings alone, which would be the cheapest solution. However, the decision has been made to use additives such as Portland cement and other binders to improve the strength and durability of the backfill material which is already an added cost. With respect to Stope B1-18, Portland cement will be an additive, making it one of the more costly mixes. Therefore, the Project Team is already</p>	
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			<p>demonstrating that cost is not the primary driver for selecting mixes. Rather, the operational performance of the paste performance will be the primary driver for selecting an appropriate mix design.</p> <p>Multiple binders are available but they all have different characteristics and create slightly different changes to the paste, specifically: slump, setup time, and strength (UCS) gain. Different paste mixes will be required in different specific void areas. Engineering criteria will be set and the most economic and efficient blend of various binder additives will be used to meet those criteria.</p> <p><u>Reporting:</u></p> <ul style="list-style-type: none"> • Summary results will be provided in the monthly water licence reports using the template provided in Attachment C. • A final report on the field test program will be filed with the MVLWB prior to the end of November 2013. • As required by Schedule 1, Item 1(o), "As-Built Statement of Risk Mitigation" letters stamped by professional engineers that confirm the mitigation of risks associated with the Underground Stabilization Work Area will be submitted to the MVLWB as part of the semi-annual reports. <p>Note 1 – Design Earthquake: Previous documentation(IR MVEIRB 13, Round 1, May 2011)describing a "credible" seismic event over the duration of the project included a historical search of earthquakes occurring within radii of 100 km, 200 km, and 300 km and centered at Yellowknife resulted in four M1 to M2 earthquakes and fourteen M1 to M4 earthquakes. This indicates that the subject site is in a region of low historical seismicity. The 4th Generation Seismic Hazard Maps developed for the 2010 NBCC indicate a peak horizontal ground acceleration of 0.036 g for ground motions with a return period of 2,475-years. The 4th generation models consider both the historical and regional seismicity models and the acceleration values are provided for the worst case scenario. A peak horizontal ground acceleration of 0.036 g for the 2,475-year return period confirms low levels of seismic activity and forms the design basis for natural earthquake activity for the work described herein.</p> <p><u>Underground Stabilization Closure Objectives and Criteria for Stope B1-18</u></p> <p>Presented below are closure objectives and criteria for Stope B1-18 as that is the void targeted for backfilling under the August 2013 Underground Stabilization Work Plan. Once the results of the work in B1-18 are evaluated, the criteria for the remaining</p>	
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			<p>stopes and chambers within the scope of the Water Licence will be provided. The information will be submitted over the winter 2013/2014 as the criteria of each area becomes available, which would align with the requirement to submit updated work plans to the MVLWB for approval for those stopes and chambers. Closure criteria for each particular underground void will be unique as each void has a unique configuration and characteristics, including but not limited to: void geometry, crown pillar geometry, and crown pillar rock mass quality.</p> <p>Long-term project remediation and closure criteria for the greater Giant Mine Remediation Project such as: the ultimate location of Baker Creek; public accessibility to areas on the mine site and in particular to areas above the backfilled stopes; backfill design; and long-term monitoring commitments have yet to be determined and will be finalized following completion of the environmental assessment. The goal of the proposed work outlined in the August 2013 Underground Stabilization Work Plan is to reduce the risks of possible mine instability in the short term. When long-term closure objectives for the underground portion of the overall project are set, additional enhancements or backfilling of the areas to be managed in 2013/early 2014 may possibly be required.</p> <p>The closure objective for Stope B1-18 is as follows:</p> <ul style="list-style-type: none"> ▪ Backfill the selected and targeted underground voids so that the propagation of rock failure is limited to the extent that potential surface impacts (e.g. subsidence) do not compromise public and worker safety and critical surface infrastructure on the mine property, and limits surface water infiltration into underground workings. <p>Backfill design will aim to ensure that earthquakes (see note 1 below on design earthquake) and nearby blasting can only destabilise the paste before it is cured, which should take between 12 hours and 7 days. Once the paste has cured it is resistant to liquefaction and although seismic loads may cause backfill damage it will remain in place and retain its design function.</p> <p>Closure criteria for Stope B1-18 are as follows:</p> <ul style="list-style-type: none"> ▪ Individual stope voids will be filled to within a minimum vertical distance (minimum vertical measurement between back of stope to paste position) equivalent to less than or equal to 1/20 of the crown pillar thickness. 	
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			<ul style="list-style-type: none"> ▪ Stope void to be backfilled with paste with a minimum 28 day uniaxial compressive strength (UCS) of 100 kPa containing a minimum of 1% (by weight) of normal Portland cement, and/or clean-rock fill (sourced from offsite). ▪ Drift barricades will be designed to withstand the load placed upon them by paste after initial placement and for 24 hours. <p>Paste backfill quality assurance and verification:</p> <ul style="list-style-type: none"> ▪ Visual confirmation that the void is filled to achieve design criteria will be achieved through the use of volumetric assessment checks, camera monitoring surveys and void laser scans as practically possible. ▪ Slump paste testing to check that operational parameters for viscosity for any one particular pour are met. ▪ Paste Unconfined Compressive Strength testing for each pour to check that minimum backfill design criteria are being met. ▪ As required by Schedule 1, Item 1(o), "As-Built Statement of Risk Mitigation" letters stamped by a professional engineer that confirm that the mitigation objectives have been met for each void backfilled in the Underground Stabilization Work Area will be submitted to the MVLWB as part of the semi-annual reports. This as-built record will include the assumptions and methodology for determination of the closure criteria and include the records of paste tailings testing carried out during the work and documentation of the verification that the stope was filled to the required level. <p>Note 1: Previous documentation (IR MVEIRB 13, Round 1, May 2011) describing a "credible" seismic event over the duration of the project included a historical search of earthquakes occurring within radii of 100 km, 200 km, and 300 km and centered at Yellowknife resulted in four M1 to M2 earthquakes and fourteen M1 to M4 earthquakes. This indicates that the subject site is in a region of low historical seismicity. The 4th Generation Seismic Hazard Maps developed for the 2010 NBCC indicate a peak horizontal ground acceleration of 0.036 g for ground motions with a return period of 2,475-years. The 4th generation models consider both the historical and regional seismicity models and the acceleration values are provided for the worst case scenario. A peak horizontal ground acceleration of 0.036 g for the 2,475-year</p>	
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			return period confirms low levels of seismic activity and forms the design basis for natural earthquake activity for the work described herein.	
4	Municipal permit and licences for the testing	<p>Comment AANDC does not have a good track record in both applying for or obtaining municipal permits and licences for work that it is undertaking at Giant Mine. The field test work would appear to require a development permit as it involves a change in the intensity and use of lands at the site.</p> <p>Recommendation AANDC should provide information on whether it applied and has secured any permits or approvals from the City of Yellowknife for the field testing.</p>	<p>Sep 6: We assess this as outside the MVLWB's areas of mandate and interest in this process. In the past when municipal permits were required (e.g., 2012 mill conveyor demolition and 2013 roaster deconstruction), the team has applied for and obtained the necessary approvals from the City of Yellowknife. With respect to the field paste test, we are not aware of any unmet municipal permitting requirements. Should MVLWB wish additional information on other permitting processes, we are available to discuss.</p>	Board staff are satisfied with the response from the proponent.