From:	Tyree Mullaney
To:	"Permits"
Subject:	FW: Tundra Mine Water Licence Amendment
Date:	Wednesday, July 03, 2013 9:05:43 AM
Attachments:	YELLOWKN-#572718-v1-TUNDRA_WL_AMENDMENT_IMPACT_MITIGATION_TABLE_(RISK_MATRIX)_DOCX.DOCX YELLOWKN-#571061-v1-TUNDRA_EROSION_SEDIMENT_AND_DRAINAGE_CONTROL_PLAN_REVISION_14_DOCX.DOCX YELLOWKN-#572738-v1-Tundra_Regulatory_-_Mill_Pond_Drawdown_correlation_with_volume_and_surface_area.DOCX

From: Julie Ward [mailto:Julie.Ward@aandc-aadnc.gc.ca]
Sent: June 28, 2013 11:19 AM
To: Alison Heslep; Rick Walbourne
Cc: Joel Gowman; Morag McPherson; Tyree Mullaney
Subject: Re: Tundra Mine Water Licence Amendment

Good morning Rick,

As a followup to your outstanding questions on our Water Licence amendment please accept the following information. Attached is an email with the correlation between the draw-down of water in Mill Pond (up to 1.5m) and the volume and surface area exposed. Also attached is an updated mitigation table that identifies the potential concern of erosion along the exposed surface area and our commitment to monitor the area and apply mitigation as required.

Lastly, I've attached our updated Sediment and Erosion Control Plan for your initial review. The Sediment and Erosion Control Plan will also be distributed for review by the MVLWB as per our requirements under our Water Licence.

This information completes our response to your questions. If there is any additional questions or concerns you have with respect to the amendment please do not hesitate to contact us.

Thank you,

Julie Ward M.Sc., PMP
Program Manager, Contaminants and Remediation Directorate
Aboriginal Affairs and Northern Development
Waldron Building
5103 48th Street P.O Box 1500
Yellowknife NT X1A 2R3
Tel: 867.669.2418
Fax: 867.669.2721
Cell: 867.445.5226
>>> Alison Heslep 6/18/2013 1:37 PM >>>
Good Afternoon Rick,

Thank you for your questions. I am waiting on answers from our Departmental Representative (AECOM) for the first couple of questions. Answers to the remaining questions are below in blue.

Regards,

Alison Heslep
Project Officer
Contaminants and Remediation Directorate
AANDC, Yellowknife, NT
tel: (867) 669-2769
fax: (867) 669-2721
>>> "Walbourne, Rick" <Rick.Walbourne@DFO-MPO.GC.CA> 6/7/2013 3:55 PM >>>
Good morning Alison/Joel,

I have had an initial review of the Tundra WL amendment and have some questions of the de-watering of Mill Pond prior to submitting my formal comments to the Board on June 24th. I thought it would be best if I could get some of these out to you today. As I mentioned, I will be out of the office June 10-18, so there is no urgency to provide a response before then.

Mill Pond

Thank you for providing the bathymetric survey of Mill Pond. I reviewed the document this morning and based on an initial review, it is unclear if all water volumes/maps are accurate. For example, the amendment and report state that a drawdown of 1.5m will be required which will result in the discharge of 132,000 cubic metres of water from a total volume of ~300,000 cubic metres (approximately half the volume(44%) of Mill Pond). A cursory review of Drawing No. 5 in the bathymetry report does not appear to indicate that a drawdown of areas at 1.5m depth would result in a reduction of this proportion. DFO requests additional information on how these details were calculated with reference to calculated volumes per area (above and below 1.5) and the bathymetry map in Figure 5.

Additionally, DFO requests that CARD provide a calculation on loss of surface area (elimination of zones <1.5m) in comparison to the current surface area of Mill Pond to determine potential impacts to fish habitat (littoral zone).

As well, there are several references to restoring Mill Pond to its "original and natural pre-mining level" and that the existing drainage channel from Mill Pond to Upper Pond will be restored. DFO requests that CARD provide any information on pre-mining conditions/water levels at Mill Pond to which these statements refer.

It was noted that removal of the East Upper Dam (EUD) will restore pre-mining drainage because;

- Aerial photos of mining operations in the 1960's, prior to filling of Upper Pond with tailings, shows a natural lake within the current extent of Upper Pond. The lake hydraulically connects Mill Pond and the pre-mining Lower Pond Lake. As the pre-mining Lower Pond lake drained into Hambone Lake, this pre-mining Upper Pond Lake drained Mill Pond into the Pre-mining Lower Pond Lake.
- An aerial photo from 1981 shows tailings filling the location of Upper Pond and extending into Lower Pond. Prior to the construction of New Dam in the mid 1980's all the tailings are

aerially exposed and light in color. These light colored tailings also spill into Mill Pond, east of the Upper East Dam. Visual evidence from Upper Pond tailings excavations against the west side of East Upper Dam show that EUD was constructed on top of tailings deposits. EUD was presumably constructed to contain the tailings west of Mill Pond, and to create an equipment access route.

- Currently (particularly during freshet), Mill Pond water abuts the east face of East Upper Dam. If EUD was not in place, the water level in Mill Pond would be governed by the pre-mining discharge flow elevation into the pre-mining Upper Pond Lake.

Diversion Channels

A "defined channel" will be constructed to transfer water from Mill Pond into Upper Pond and armoured with locally sourced riprap materials. Have design plans for this channel been finalized? DFO requests information on anticipated flows and velocities through this channel once natural drainage is restored and a description of how construction materials (riprap sizing) and design will account for these values.

The exact arrangement for the 'defined channel' between Mill Pond and Upper Pond has not been designed due to the uncertainty surrounding the final surface topography and geology after removal of East Upper Dam. The objective would be to provide a Mill Pond discharge route that minimizes erosion and sedimentation. If (once all tailings beneath EUD are removed) a consistent bedrock surface or channel is uncovered, creating a defined channel with rip-rap will not be necessary. If, however, relatively soft natural sediments are the uncovered surface, the discharge flows will be channeled through an area of rip-rap. Rockdams or other permanent sedimentation control features may also be necessary.

Additionally, there is reference to a constructed diversion channel around the TCA through a diversion channel into Hambone Lake. Are these existing structures or will these be constructed within these works as well? If these are newly constructed channels, DFO requests similar information to that requested for the Mill Pond to Upper Pond channel.

The 'Diversion Ditch' that will channel flows in Lower Pond around the south and east sides of the constructed Tailings Containment Area (TCA) is designed and the design is detailed in the September 20912 IFC Drawings. The design of the 'Discharge Channel' from Lower Pond to Hambone Lake is similarly detailed in the September 2012 IFC Drawings. Please refer to the Tailings Containment Area Design available on the MVLWB Online registry.

Reclamation Plan

It is stated that details of the EUD removal and reclamation of the natural plan will be included within an updated reclamation plan. DFO requests timelines on the finalization of this plan.

The restoration plan is currently being drafted. If you have any recommendations/operational

statements that would assist us, please send them along as it would assist us with finalizing a comprehensive plan. The reclamation plan is to be submitted 90 days prior to commencing reclamation activities as per Annex A Schedule Part B, Item 9 of the Tundra Water Licence.

Monitoring

Section 10 includes a brief discussion on monitoring with the following statements:

- "**regula**r monitoring of any increased erosion and potential channel modification in the downstream drainage pathway during discharge"
- "If monitoring identifies any **significant** erosion problems…."
- "**periodic** monitoring of water quality.."

DFO requests clarification on the words bolded above, however this can be later quantified at the Board's discretion within the Water Licence.

AANDC is currently updating the sediment and Erosion Control Plan as it relates to the Water Licence amendment for Discharge of Mill Pond, and it will be submitted shortly. Sedimentation/Erosion Monitoring activities will be outlined within this plan. All reviewers, including DFO, will have up to 45 days to review the plan, as per Annex A Schedule Part D, Item 9 of the Tundra Water Licence. AANDC welcomes any recommendations based on the activities proposed with respect to monitoring and erosion control.

Sediment and Erosion Control

Section 10 also states that the Sediment and Erosion Control Plan will be revised to include the removal of EUD and associated activities within the amendment application. DFO requests timelines on the finalization of this plan to ensure appropriate measures are in place prior to commencement of discharge including, but not limited to, stabilization/reveg of the excavation areas between Mill and Upper Ponds. DFO will provide more detailed recommendations at such time as the revised plan is made available.

AANDC is currently updating the sediment and Erosion Control Plan as it relates to the Water Licence amendment for Discharge of Mill Pond, and it will be submitted shortly. All reviewers, including DFO, will have up to 45 days to review the plan, as per Annex A Schedule Part D, Item 9 of the TUndra Water Licence. AANDC welcomes any recommendations with respect to stabilization/re-vegetation are welcomed and would assist in the finalization of a comprehensive plan.

Thanks,

Rick

Rick Walbourne

Fisheries Protection Biologist
(867) 669-4926 | facsimile/ télécopieur (867) 669-4940
Rick Walbourne@dfo-mpo.gc.ca

Fish Habitat Management, Western Arctic Area | Gestion de l'Habitat du Poisson, Secteur de l'Arctique de l'Ouest
Central and Arctic Region | Région Centrale et de l'Arctique
Fisheries and Oceans Canada | 301-5204 50th Ave, Yellowknife, NT, X1A 1E2
Pêches et Océans Canada | 301-5204 50e Ave, Yellowknife,T.N.-O, X1A 1E2
Government of Canada | Gouvernement du Canada

All,

In light of our inability to convert the bathymetry data into a useable format, we performed a manual interpolation of the depth contours. Utilizing our base model, we imported, scaled and transposed the 2D contour model from SLR/AKS and recreated the upper few contours. This allowed us to recreate as much data as needed to get a scope of scale surface area of the anticipated exposed shoreline and associated volumes after dewatering.

Our September 2, 2012 survey revealed that the water elevation was 444.009 masl, therefore we used 444 masl as our water surface (note that the bathymetry was not geodetically referenced and therefore we had to assume a surface water elevation).

Considering the assumptions that up to 1.5m of water would need to be removed from Mill Pond we looked at all 0.5m iterations from 444 masl to 442.5 masl. That being said, we have learned that the "shelf" adjacent to the EUD area is typically 0.6-0.7m deep. We also know from our recent hand augers that bedrock/permafrost is evidenced near the shoreline of mill pond to be 0.8-1.0m below the current water table. All of these assumptions do require confirmation and further analysis, but these facts do infer that the full depth of 1.5m may not require discharge. The likely scenario is a 1m reduction in elevation (443.0 masl) with 1.5m elevation reduction (442.5 masl) being the worst case.

Our scope of scale calculations are as follows:

444.0 masl – 98,000 sq.m surface area – volume was not calculated as only the top few contours were imported and transposed.

443.5 masl – 83,000 sq.m surface area (15,000 sq.m of exposed shoreline) – 59,000 cu.m required to be discharged.

443.0 masl – 67,000 sq.m surface area (31,000 sq.m of exposed shoreline) – 81,000 cu.m required to be discharged. Note that approximately 7,000 sq.m of exposed shoreline is the "shelf" near EUD

442.5 masl – 62,000 sq.m surface area (36,000 sq.m of exposed shoreline) – 117,000 cu.m required to be discharged

Best regards,

Warren Bebeau, P.Eng., CPESC
Project Manager, Environment
D: 780.486.7648
C: 780.915.8457
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Table 1 – Matrix of Predicted Impacts and Proposed Mitigation Measures

Construction Risk		Consequence	Mitigation
Aquadam failure **prior** to commencement of excavations in EUD and adjacent soft sediments	Aquadam split/ rips and results in rapid failure of dam and release of retained Mill Pond Water Installed Aquadam rolls or moves on soft foundation and allows significant water discharge from beneath Aquadam Freshet or strong rains increase elevation of Mill Pond and leads to overtopping of Aquadam	• Damage to, or loss of, Aquadam sections. • Temporary flooding of Mill pond water over some of the low ground east of EUD, possibly disturbing and displacing sediment/ tailings within or around Aquadam foundations. • H+S risk to workers	• Foundation surface is inspected and potential sharp objects (sticks, rocks etc) are removed prior to Aquadam placement. Sharp equipment or implements keep away from Aquadam. • Aquadam foundation ground to be level with small buttress berm of material against downstream face of dam to provide support against Aquadam rotational and translational movement. • Locate Aquadam such that the Mill Pond retained water level is 100mm lower than typical retained water level for this Model of Aquadam. Survey during 2012 showed that Mill Pond water level in June (immediately following freshet) was 200mm higher than in September. • Silt fence and other sedimentation mitigation measures deployed such that any entrained sediments are not able to wash back into Mill Pond.
Aquadam failure **during** excavations in EUD	Aquadam split/ rips and results in rapid failure of dam and release of retained Mill Pond Water Installed Aquadam rolls or moves on soft foundation allows significant water discharge from beneath Aquadam Freshet or strong rains increase elevation of Mill Pond and leads to overtopping of Aquadam	• Damage to, or loss of, Aquadam sections. • Uncontrolled discharge of Mill Pond water through EUD, Upper Pond and TCA diversion ditch and into Hambone Lake. • Discharging Mill Pond water erodes sediments and tailings from EUD and surrounding low ground and carries the material into Upper Pond and potentially into the TCA diversion ditch. • H+S risk to workers.	• Foundation surface to be inspected and potential sharp objects (sticks, rocks etc) removed prior to Aquadam placement. Sharp equipment or implements kept away from Aquadam. • Aquadam foundation ground to be level with small buttress berm of material against downstream face of dam to provide support against Aquadam rotational and translational movement. • Conduct Aquadam installation after freshet has dissipated. • Locate Aquadam such that the Mill Pond retained water level is 100mm lower than typical retained water level for this model of Aquadam. Survey during 2012 showed that Mill Pond water level in June (immediately following freshet) was 200mm higher than in September. • Conduct dam removal work only after Upper Pond has been confirmed clear of tailings. • Conduct dam removal work only after TCA diversion ditch has been constructed and armoured. • Excavate EUD such that a defined spillway/channel is created prior to bulk dam excavation. This channel would confine potential Aquadam failure flows rather than have them wash across a broad area of soft, exposed sediments. The defined spillway/ channel would be excavated down to bedrock and the sides would be armoured with riprap to minimise erosion/ sedimentation. • Install rockdams and other sediment control measures across the east portion of Upper Pond to confine but slow flows. • Ensure the low point in Upper Pond is free of standing water at time of Aquadam

			decommissioning. This low area in Upper Pond will provide a sediment trap and buffer flow volumes and velocities entering the TCA diversion ditch.
Failure of the Aquadam after complete removal of EUD and soft ground tailings **or** The discharge of water during Aquadam decommissioning at flows greater than planned.		• Potential erosion and sediment mobilisation into Upper Pond and into the TCA diversion ditch. • Potential erosion and damage to TCA diversion ditch. • Higher water flow volumes/ velocities into Hambone Lake than currently allowed for treated water discharge.	• Conduct dam removal work after Upper Pond has been confirmed clear of tailings. • Create a defined spillway/ channel across ground conditions remaining after removal of EUD and all tailings in the low, soft ground. Unless excavated to bedrock, the base of the channel will be armoured with riprap. Channel side slopes will be armoured with riprap. • Install rockdams and other sediment control measures across the east portion of Upper Pond to confine but slow flows. • Ensure the low point in Upper Pond is free of standing water at time of Aquadam decommissioning. This low area in Upper Pond will provide a sediment trap and buffer erosive flows entering the TCA diversion ditch. • If required, construct a temporary berm between the aquadam and EUD. This would act to contain Mill Pond water discharged in the event of a breach. A gated culvert could be installed through the berm to allow restricted discharge upon Aquadam removal.
Potential for erosion of shoreline areas exposed during drawdown of Mill Pond.		• Sedimentation rich erosive water flows enter Mill Pond water	• Decommission Aquadam over period of approximately three weeks such that the rate of Mill Pond water drawdown is not rapid enough to cause erosion of progressively exposed areas directly from retreating Mill Pond water movement. • During Mill Pond drawdown, exposed shoreline areas will be inspected. Areas prone to erosion (i.e. un-vegetated, silty ground conditions with little or no natural granular material cover) will be identified and monitored during and after Mill Pond drawdown. • If erosion occurs, the mitigation chosen would depend on its location in order to minimize impacts outside of the current footprint. Mitigation approaches could include promoting revegetation or armouring shoreline.
Downstream impacts to surface water in downstream lakes during decommissioning		Work will restore natural discharge of Mill Pond into Upper Pond and on into Hambone Lake.	• Decommission Aquadam over period of approximately three weeks so that the rate of Mill Pond water discharge into Upper Pond and on into Hambone Lake is no greater than currently allowable Water Treatment Plant treated water discharge to Hambone lake.
Effect on downstream water bodies of increased catchment area (including Mill Pond)		Greater catchment area for precipitation and snowmelt flowing into TCA Diversion Ditch and on into Hambone Lake	• Removal of EUD will restore pre-mining catchment situation and thus downstream lakes already have morphology to accommodate additional catchment. • Presence of lake (Mill Pond) within Mill Pond catchment severely retards precipitation and snowmelt transmission times into Upper Pond. This natural retardation and the length of travel between EUD and Hambone lake means increase in flow volume and velocity into Hambone lake from Mill Pond catchment will be insignificant.

Erosion, Sediment and Drainage Control Plan

(Rev 14)

PROJECT ID: *TUNDRA MINE PHASE 2 REMEDIATION*

DATE OF RE-SUBMISSION:

SUBMITTED BY: Leigh Gauthier (TLICHO)

SUBMITTED TO: Janice Lee (PWGSC)

1.0 INTRODUCTION

Herein is contained the details of TLICHO's Erosion, Sediment and Drainage Control Plan for the Tundra Mine Phase 2 Remediation Project. This plan has been revised to cover all remediation activity for the duration of the project.

2.0 REVISION LIST

The following table tracks the process of Erosion, Sediment and Drainage Control Plan revision and ensures that all stakeholders have the most up to date copy. The table must be updated each time a revision is made to the document.

Figure 1 Plan Revision Table

REVISION NO.	TLICHO REVIEW	DATE	CROWN REVIEW	DATE	SECTIONS REVISED	REVISION DISTRIBUTION DATE
1	Bob Johnson	July 1, 2010	INAC	July 2nd, 2010		
2	Reuben Makohoniuk	July 7, 2010	Environment Canada	July 28, 2010	1.4 Acts Regulations and Guidelines 1.10 Contingency Plans	July 7, 2010
			Fisheries and Oceans Canada	July 29, 2010		
3	Karen Lau	August 6, 2010			All	August 6, 2010
4	Karen Lau	January 4, 2011	PWGSC / INAC	January 7, 2011	All	January 4, 2011
5	Peter Stenne	January 14, 2011	INAC	January 18, 2011	Revised as per comments from Crown	
6	Karen Lau	January 21, 2011	AECOM	January 27, 2011	Revised as per comments from Crown	January 21, 2011
7	Karen Lau	January 31, 2011	INAC / DFO	February 14, 2011	Revised as per comments	January 31, 2011

REVISION NO.	TLICHO REVIEW	DATE	CROWN REVIEW	DATE	SECTIONS REVISED	REVISION DISTRIBUTION DATE
			Environment Canada	February 23, 2011		
8	Karen Lau	March 2, 2011			Revised as per comments	March 2, 2011
9	Karen Lau	March 16, 2011			Revised as per comments	March 16, 2011
10	Justin Bunz	February 1, 2012			1.5 Contact Numbers 1.8.1 Erosion due to wind	February 1, 2012
11	Brett Sach/ Greg Haist	May 22, 2013			1.5 Contact Numbers 1.8.10 Excavating and Deconstructing Upper Pond Water Treatment Facility 1.8.11 Excavating Upper East Dam	May 22, 2013
12	Jocelyne Plourde/ Leigh Gauthier	May 23, 2013			Revised as per comments	May 24, 2013
13	Jocelyne Plourde/ Leigh Gauthier	May 29, 2013			Revised as per comments	May 31, 2013
14	Leigh Gauthier	June 2, 2013			Revised as per comments	June 2, 2013

Table of Contents

List of Tables

➢ Erosion, Sediment and Drainage Control Plan

1 Roles and Responsibilities

The following outlines the roles and responsibilities of employees with respect to the Response to Erosion, Sediment and Drainage Concerns.

Table 1 Roles and Responsibilities for Response to Erosion, Sediment, and Drainage Concerns

POSITION	RESPONSIBILITY
Project Manager	Preparing Plan to control Erosion, Sediment and Drainage Protection and ensuring the necessary resources are available to efficiently implement the plan.
Mine Manager	Implement and monitor the Erosion, Sediment and Drainage Protection Plan at site when required (i.e., Primary Designate)
	Ensure that monitoring inspections are conducted.
	Consult with Project Manager for mitigation measures in response to potential issues.
	Maintain communications with Project Manager to ensure monitoring and responses are appropriate.
Earthworks Supervisor	Implement and monitor the Erosion, Sediment and Drainage Protection Plan at site when required (i.e., Secondary Designate)
Field Engineer	Write Erosion Report for submittal
Site Team Members	Install erosion measures as directed by supervisor
	Report to supervisor immediately of any erosion concerns

2 Training

Employees will be trained on the erosion control measures as outlined in this plan and will be responsible for installing the measures as required under instruction from the supervisor. Employees will also be required to be trained on any safe work plans that are associated with the installation of these erosion control measures.

3 Acts, Regulation and Guidelines

The Erosion, Sediment and Channel Protection Plan has been developed in accordance with:

- requirements set forth in the Water License,
- requirement set forth in the Land Use Permit
- Specification put forward by PWGSC for this project.

For additional information, please reference AANDC's monitoring plan, "Development of Tundra Mine Construction Monitoring, Long Term Monitoring, and Status of the Environment Programs". The Development of Tundra Mine Construction Monitoring, Long Term Monitoring, and Status of the Environment Programs will provide data from additional monitoring work, including tests for turbidity, TSS and TDS at various locations during the discharge.

4 Environmental Protection Supplies

Environmental protection supplies on-site will include the following:

1. 3000 ft of silt fence
2. 1000 ft of silt curtains
3. 500 ft of sorbent booms
4. Spill Kits
5. Wooden stakes, native rocks (found on-site)
6. ATV and trailers will be on site to facilitate the installation of sediment and erosion controls if found required.
7. Heavy equipment will be on site to facilitate the installation of sediment and erosion controls if found required.

5 Contact Numbers

Table 2 Overall List of Contact Numbers

Name	Position	CONTACT #	ORGANIZATION
PROJECT MANAGEMENT			
Julie Ward	Project Manager	Ph: 867-669-2418 Fax: 867-669-2721	AANDC, CARD
Janice Lee	Project Manager	Ph: 867-766-8364	PWGSC
Giselle Cotta	Project Manager, Senior Environmental Engineer	Ph: 780-497-3839	PWGSC
Carl Zaminer	Regional Construction Safety Coordinator	Ph: 780-497-3712 Fax: 780-497-3607	PWGSC
Karl Chance **Ben Reich** **Brendon Norrie**	Department Representative	Site Phone: 403-692-9924	AECOM
Greg Haist	Project Manager	Ph: 867-669-9481 Fax: 867-669-9482	TLICHO
Leigh Gauthier	Mine Manager	Site Ph: 403-692-9923 Cell: 867-444-9291	TLICHO
Jim Way	Site Superintendent	Site Ph: 403-692-9924 Office Ph: 867-669-9481	TLICHO
Brett Sach/ Jocelyne Plourde	Field Engineer	Site Ph: 403-692-9928	TLICHO
Clint Baptiste/ Jackie Chase	Site Administration	Site Ph: 403-692-3855 Fax: 403-692-9927	TLICHO
Donna Palmer	Health and Safety Manager	Fax: 867-920-7328 Ph: 867-669-9481 Cell: 867-446-0904	TLICHO
Nicole Slowsky/Barb Clarke	Health & Safety Adviser/Medic	Site Ph: 403-692-9925	TLICHO

6 Potential Issues

The following scenarios are possible Erosion, Sediment and Drainage risks on this project:

1. Erosion due to wind
2. Erosion from bridge installation at Sandy Lake crossing
3. Erosion associated with construction and road repair
4. Erosion due to other reclamation activities
5. Erosion from tailings water treatment activities
6. Working near water
7. Erosion from tailings movement within Upper and Lower Pond containment area
8. Erosion from excavations outside tailings dams
9. Erosion from excavating and deconstructing water treatment facility
10. Erosion from removal of Upper East Dam excavation
11. Erosion from installation of Aqua dam
12. Erosion and Drainage issues from discharge of Mill Pond water due to decommissioning of Aqua dam
13. Erosion from blasting of diversion ditches around tailings contaminated area (TCA)

Erosion measures have been identified for each of the listed risks and will be discussed below.

7 Sediment and Erosion Measures Prior to Reclamation Activities

Prior to reclamation activities, an assessment of areas (outside of the tailings containment area) which are prone to excessive erosion will be made. Based on that assessment, recommendations on control measures and monitoring frequency will be made. The various control measures to be implemented are discussed in detail in the next section. When reclamation work will be near a water body and there is risk that sediments may migrate to the water body, baseline turbidity tests will be performed and recorded on an "Erosion and Sediment Assessment Sheet" for reference. The sediment and erosion assessment team will consist of the Mine Manager, Field Engineer and Earthworks Supervisor.

The determining factors for erosion risk (low/med/high) are:

1. Proximity to neighboring water body
2. Erodibility of soils
3. Level of difficulty to prevent/contain erosion

4. Potential of concentrated flow through the area

The factors of concern in each reclamation area will be recorded in the "extra notes" section of the Erosion and Sediment Assessment Sheet.

The following is an example of the Erosion and Sediment Assessment Sheet. Modifications to the sheet may be made on-site should further information be required for records.

Date	
Reference Area	
Type of activity (excavation, infrastructure upgrade, re-grading etc.)	
Erosion Assessment	
Ground Conditions	
Size and type of material	
Slopes	
Vincinity to water body	
Soil moisture conditions	
Vegetation type and density	
Type of erosion area is prone to (wind, water, traffic, etc.)	
Type of activity occuring in/around area	
Erosion Matrix Table - Active Measures	
Type of activity	
Risk of erosion (Low, Medium, High)	
Control Measures	
Type of monitoring required	
Frequency of monitoring required	

Extra Notes

8 Sediment and Erosion Measures During Reclamation Activities

The following sections discuss all the erosion types which are expected to be encountered during reclamation activities, as well as their respective control measures for mitigation.

8.1 Erosion due to wind

Dust and wind blown tailings are a concern on-site for worker health and safety during the summer months when the roads and tailings pond are not frozen or covered by a layer of snow. Therefore, dust suppression will be on-going during the summer construction season in areas of work activity. There will be a water truck on-site dedicated to keeping dust to a minimum. It is anticipated that water will be sufficient for dust control. If water isn't sufficient, then we will utilize an environmentally friendly chemical dust suppressant.

Originally, Soil Sement® was approved and mobilized to site during the 2011 winter road season but due to a manufacturers recall on the product, the supplier would like to replace with an alternative product. The dust suppressants that TLICHO would like to utilize is NEWTROL™ supplied by Midwest Industrial Supply, INC. NEWTROL™ is an environmentally sound dust palliative developed for use on helicopter landing pads, open areas, and roadways. NEWTROL™ is a green product formulated with renewable resources enhanced to maintain long term dust suppression. The multi-component system works to agglomerate loose particles and hold moisture on the surface thereby reducing dust on the open areas.

Alternatively, TLICHO will have Soil Sement® as the primary back up product as this product was approved for use last year. Each products specification and supporting documentation is appended to this document.

8.2 Erosion from bridge installation at Sandy Lake crossing

The bridge is planned to be mobilized on the winter ice road and will be installed in frozen conditions. As the ground and water will be frozen, migration of any silt or disturbances to the stream will be at a minimum. The existing bridge crossing will be kept in place. An approach will be built on both ends of the crossing, at least one meter from the stream, and the new bridge will be installed on a foundation constructed with 4x4" lumber. This installation will not create disturbances to the area (ie. no excavation work), and as such, we do not anticipate any erosion concerns at the time of installation and when freshet occurs.

In the event that the bridge cannot be installed in frozen conditions, silt fence will be utilized to protect the stream. Silt fence will be installed 5 meters upstream and 10 meters downstream of the construction area. The bridge will be installed in the same way as described above. Erosion will be minimal since the existing bridge will be kept in

place and the foundation will be constructed from lumber, so there will not be any large disturbances to the ground near the stream.

TLICHO will contact DFO prior to the installation of the bridge for specific advice to minimize impacts to fish and fish habitat. TLICHO has also reviewed the *Clear-Span Bridge Northwest Territories Operational Statement* issued by DFO.

8.3 Erosion associated with construction and road repair

Erosion due to construction will consist of removing ice bridges on winter road to allow normal water flows during freshet. Travel can be restricted to night travel to mitigate rutting and ponding of water on ice road. When construction begins on upgrading haul roads, silt fences will be placed near areas where the ground is marshy and near water bodies. Work on construction and road repair will temporarily stop if there is continual down pour of rain to create very saturated ground conditions. Control measures will be implemented to contain un-stabilized areas prior to anticipated heavy rain events.

8.4 Erosion due to other reclamation activities

All other reclamation activities will have excavations sloped at a ratio of 2V:1H: All tailings contaminated water will be treated at the water treatment plan. Silt fences, booms, snow fences, and dust suppressant will be utilized to mitigate impacts of erosion.

8.5 Erosion from Tailings Water Treatment Activities

The water level at Lower Pond will be monitored and recorded. The monitoring of discharge points and flow pathways in Upper Pond will be performed on a daily basis.
Water will need to be moved from Lower Pond to Upper Pond and then recirculated in Upper Pond during the batch treatment. In order to help prevent erosion silt fences will be set up in-front of the discharge lines in order to help prevent erosion.
There will also be daily and weekly visual inspections along the dam roads by the superintendent. As well, an inspection of dam roads will be performed immediately after heavy rainfall.

The inspection will look for:

1. Rutting
2. Cracking
3. Ponding water
4. Washouts/slumping on side of dam

All inspections will be reported to the Departmental Representative. Inspections are to monitor the structural integrity of the road dam. The Superintendent will stop heavy traffic on the roads during heavy rainfall periods to prevent further structural degradation.

8.5.1 Intake and Discharge Lines

The field team will conduct inspections on the intake and discharge lines associated with the tailings water treatment plant. There will be spare parts (valves, lines, etc) in the event that repairs are needed. If major repairs are needed, parts of the water treatment plant, intake, or discharge lines will be shut down. The superintendent will decide when this is necessary and notify the Departmental Representative immediately. All crew will be trained to shut off the intake and discharge pumps. Only Water Treatment Plant Operators will be allowed to perform any actions on the Water Treatment Plant.

A large water catchment area will be put in place to catch the water flowing out of the Geotubes. The catchment volume will be at least 55ft x 55ft x 4ft deep and be located within the Upper Pond catchment. This volume is large enough to buffer any water treatment output fluctuations should they occur, and allow the discharge pump to continually pump the treated water at a steady velocity. Velocity fluctuations cause stress to the discharge lines. This will greatly minimize the risk of breakage in the discharge lines. A flow meter is in place to monitor the discharge rate. The catchment area will also allow for the discharge pump to be shut down in the event that a discharge line does have to be replaced. This catchment area is located within the catchment of Upper Pond, which will be deconstructed, filled, covered with uncontaminated material, and graded as per specifications set out in the contract.

Two discharge lines are set up to pump from the catchment area for discharge at Hambone Lake. One discharge line will be set up to re-route water back into Upper Pond for emergency overflow situations.

8.5.2 Treated Water Discharge

The water license allows a discharge rate of 300m^3/hour. The contract specification allows TLICHO to discharge at 275m^3/hour.

Plan A

The plan is to discharge directly into Hambone Lake. The line will be held on floats so that water dissipates on the top of the lake with a diffuser to prevent sediment stir-up. The diffuser would dissipate the energy of the water being discharged. This will be frequently monitored during start up to ensure that water is being diffused properly and that it is not causing sediment stir-up at Hambone Lake. If sediment stir-up is noticed, more diffusers will be installed, or a second discharge line into Hambone Lake will be installed.

Plan B

Should any issues arise with Plan A, Plan B will be implemented for discharge until such time that the issues have been mitigated and discharge directly into Hambone Lake can

be reinstated. Plan B is discharge at the wetlands that drain into Hambone Lake. The following picture shows the rock outcrop that spans over 200m at the wetlands before Hambone Lake (shown in picture below at top left).

TLICHO will be putting the two discharge lines along this rock outcrop, the distance between the two lines at least 15-20m apart to prevent channel flow.

By discharging at an outcrop in the wetlands prior to Hambone Lake, it will have the following advantages:

- maximize energy dissipation prior to entering the wetland and maximize the filtration through the wetland prior to entering Hambone Lake.
- The rock acts as a water diffuser so when the discharge water reaches the wetland, the velocity is tranquil and the flow has been reduced to laminar with little to no erosive force.
- Longer water lines require a higher pressure to move the water. By reducing the length of the line, the pressure will reduce, which will minimize and mitigate against line blowouts along the discharge.

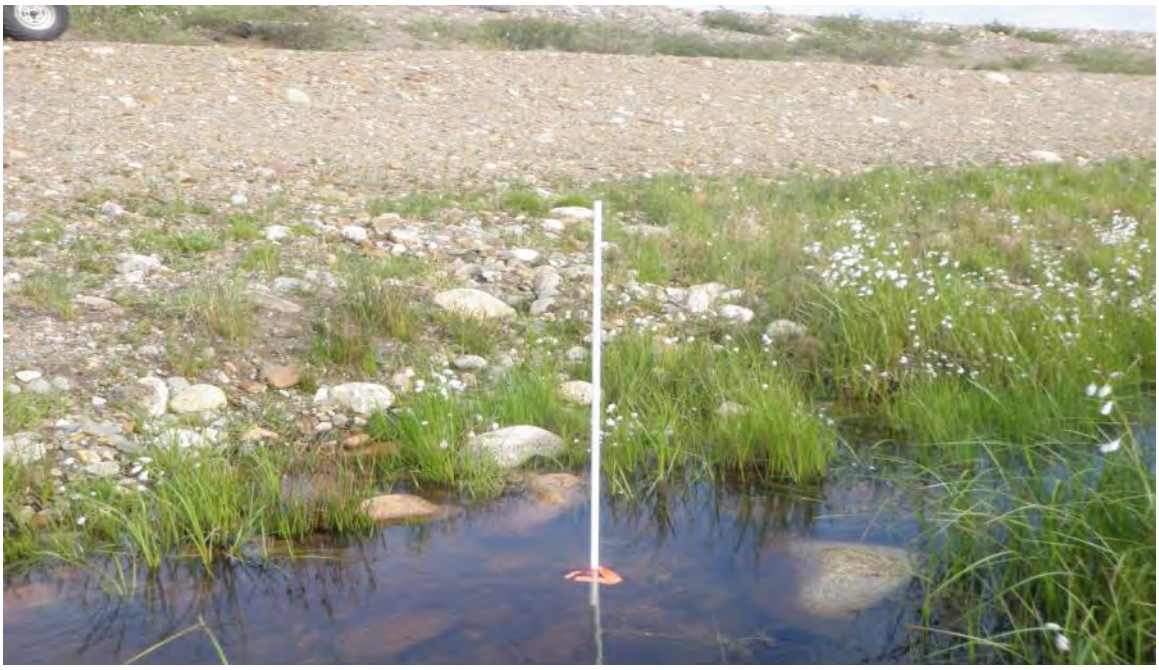
This rock outcrop wetland location was chosen in 2010 and did not have any visual erosion impact, nor did it increase water levels at downstream locations for the duration of the water treatment season.

8.5.3 Erosion Monitoring along discharge path

Monitoring of the water levels and the effect of discharging up to 275m^3/hr from the Tundra Mine WTP on the Hambone Lake tributary network will begin as soon as discharge commences. Monitoring will be performed only by the Superintendent or the Field Engineer. A Water Treatment Plant Operator may be trained later on in the program to perform monitoring.

Stakes will be installed in three locations along the flow path to monitor any change in water elevation along the streamline. Photographs will be taken to provide a baseline of current flow channels and provide a visual reference for any direct effect of this increase in flow through the system. Stakes with flagging at the baseline water elevation will be installed at 3 locations:

1) The wetland upstream from Hambone Lake, at toe of east dam (lower pond):



Monitoring Station 1: Wetland

2) At the road crossing between Powder Mag Lake and Sandy Lake:

Monitoring station 2: upstream, Sandy lake crossing

3) stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake:

Monitoring station 3 Down stream, Sandy lake crossing

Monitoring protocol is established such that if there is an increase in the water elevation at any upstream station, the monitor would proceed along the flow path to the next monitoring station checking for signs of any erosion occurring. This process will continue until there is no change in water elevation at the next monitoring station up to the inlet to Whale Tail Lake.

Reports will be submitted to the Departmental Representative weekly.

8.5.4 Summary of Possible Erosion/Sediment Areas and Mitigative Measures

The following areas have been identified as potential places where erosion and sedimentation may occur due to the tailings water treatment program:

1. wetlands upstream of Hambone Lake and Hambone Lake
2. road crossing between Powder Mag Lake and Sandy Lake
3. and the stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake

If erosion and sedimentation occurs, the following mitigative measures for the areas identified above will be:

1. wetlands upstream of Hambone Lake and Hambone Lake
    a. the two discharge lines will be spread further apart from each other to prevent channel flow
    b. silt fence will be installed along the water drainage paths
    c. Relocate a discharge line to outflow directly into Hambone Lake, the line will be held on floats so that water dissipates on the top of the lake with a diffuser to prevent sediment stir-up

2. road crossing between Powder Mag Lake and Sandy Lake
    a. install naturally occurring cobble stones along these areas, they will be hand placed along the shoreline
    b. silt curtain installation along the shoreline
3. the stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake
    a. install naturally occurring cobble stones along these areas, they will be hand placed along the shoreline
    b. silt curtain installation along the shoreline

Should erosion measures be required to be installed along the road crossing between Powder Mag Lake and Sandy Lake and the stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake, DFO will be notified. TLICHO will provide information on the quantities and precise locations of installed erosion measures prior to completion of these works.

8.6 Working Near Water

There is site activity planned which will involve working near water. Such instances include the following:

- Borrow source development
- Hydrocarbon excavation
- PAG rock excavation
- Bridge installation at Sandy Lake Crossing
- Installation of Aqua dam
- Excavation of tailings under and next to East Upper Dam

The erosion prevention at the bridge installation at Sandy Lake Crossing has already been discussed. For the other scenarios, if there is a danger of a material spillage within 5 meters of a water body, it will trigger the implementation of environmental protection supplies. The environmental protection supplies can be seen in Section 1.4.

Silt fence and silt curtains will be used as a preventative measure to prevent migration of sediments into a water body. Sorbent booms and spill kits will be on hand to protect water bodies from any uncontrolled release of sediments. Access to shoreline excavations by machinery should be limited to the top of the bank to minimize bank erosion. Efforts will be made to retain riparian vegetation along the shoreline to minimize erosion and enhance bank stability.

8.7 Erosion from tailings movement at Upper and Lower Pond

The main concerns include tailings dust caused by movement in and around Upper and Lower Pond; and tailings dams stability under heavy traffic. Any work performed in Upper and Lower Pond is within containment and not expected to generate any uncontrolled release of sediments or contaminants into an adjacent water body.

Dust suppression has already been discussed. Further actions to minimize the generation of tailings dust will include tailings movement in its frozen state, and dividing Lower Pond into a sectional grid with berms in order to keep a layer of water over most of the tailings. In addition water will be sprayed over the tailings in order to ensure it remains frozen through the winter. Tailings movement at Upper Pond will commence during the winter/spring season and it is expected that all tailings will be removed in the frozen state to Lower Pond. The dams will be frozen and there should not be any tailings dust generated. In Lower Pond, berms will be built across the pond. This will divide Lower Pond into smaller areas for water treatment, and will allow a shallow pool of water to remain in each area to cover the tailings and prevent dust.

The dam roads will be upgraded to accommodate more traffic and larger heavy equipment. This is of minimal concern as the dam stability may be improved as the water table is drawn down. Upper Pond tailings excavation is expected to occur in the winter/early spring season, at which time the dams will be frozen for added stability.

All equipment and supplies used within the tailings pond will be decontaminated prior to working in a new area outside of the tailings ponds.

8.8 Erosion from excavations outside tailings dams

There work required which will involve excavating areas outside of the tailings dams. Such instances include the following:

- Borrow source development
- Hydrocarbon excavation
- PAG rock excavation
- Tailings to be recovered outside of Upper and Lower Pond areas

If there is a danger of a material spillage within 5 meters of a water body, it will trigger the implementation of environmental protection supplies. The environmental protection supplies can be seen in Section 1.4.

Silt fence and silt curtains will be used as a preventative measure to prevent migration of sediments into a water body. Sorbent booms and spill kits will be on hand to protect water bodies from any uncontrolled release of sediments. Dust suppression to be utilized in these areas as required.

All equipment and supplies that have come into contact with hydrocarbon, PAG or tailings contamination will be decontaminated prior to work in a new area.

During all of these excavations TLICHO will try to reduce or prevent erosion from occurring at all. This will be done by minimizing slopes wherever possible and providing positive drainage to allow water to naturally flow while minimizing erosion.

8.9 Accessing Matthews Lake

This area will be accessed in the winter time to set up a pump to supply water to the camp from Matthews Lake. The ground and water is expected to be frozen and covered with snow so erosion and sediment concerns are at a minimum. Once the pump and lines are installed, we would access the area to turn on the pump, and also for maintenance and refueling. This work can be achieved by access to the pump on foot or via quad transportation. Access to the turn on the pump and visual inspections will be daily, and refueling will be weekly. Pump maintenance will be on an as required basis.

The red and yellow lines show the different routes that could be taken to access the pump. The red line is an overland route over the tundra and the yellow line represents the route that follows an existing path that will provide access to the pump. The path is made of crushed mine rock and should not pose any erosion issues from traversing on it via

quad. It is expected that the crossing between Bulldog Lake and Matthews Lake will not have to be crossed to reach the pump.

TLICHO's plan is to use the yellow route (existing route made of crushed rock). The red route (tundra overland) is a backup route should we encounter access issues with the yellow route. TLICHO does not expect to have to use the red route.

8.10 Excavating and Deconstructing Upper Pond Water Treatment Facility

In order to conduct final cleaning of Upper Pond we will use re-circulated water to wash down upper bedrock surface while the WTP is still operational. Then the final wash water volume can be treated and the residual tailings that gathered at the base of Upper Pond from washing can be transferred to Lower Pond. Once the water treatment in Upper Pond is finished it will be necessary to clean up any and all the buildings/equipment associated with the water treatment facility.
In addition silt fences and booms will be set up on any applicable slopes to mitigate the impacts of erosion on Upper Pond. Erosion from tailings movement and dust suppression has already been discussed above and the applicable erosion controls will be put in place.

8.11 Removal of East Upper Dam Excavation

East Upper Dam is now proposed to be removed and if the go ahead is given erosion controls will be put in place. In the case that this excavation is approved, a temporary Aqua Dam will be utilized in-between Mill Pond and East Upper Dam in order to prevent any water from Mill Pond from entering the excavation and causing any sedimentation or erosion to occur. Any standing water in the excavation will be pumped into drums and transported off-site for treatment and disposal. As well silt fences and booms will be set up as needed to mitigate any potential erosion. Erosion from material movement and dust suppression has already been discussed above and the applicable erosion controls will be put in place.

8.12 Installation of Aqua Dam

The installation of the Aqua dam will possibly be done by a subcontractor. The Aqua dam will be filled with the treated water from the Water Treatment Facility to avoid contamination if the Aqua dam was to leak. Erosion may be caused during the installation of the dam from the workers, transport of dam material to the Lower Pond/ TCA, and the possible disruption to the soft sediments that the Aqua dam will be placed on.
TLICHO will use silt fences on the downstream side of the Aqua dam to control any seepage or erosion issues, if one were to occur. Erosion controls will be put into place to prevent these situations from occurring.

8.13 Discharge of Mill Pond during Decommission of Aqua Dam

Treated water from the Upper Pond Treatment Facility will be used to inflate the Aqua dam. Following construction of a defined channel, decommissioning the Aqua dam will

be conducted by incrementally releasing water from the Aqua dam such that the height of the dam drops and retained Mill Pond water overtops the dam and flows into Upper Pond. Depending on the arrangement of the Aqua dam sections, and dam stability considerations, the whole length of dam, or only one section of dam will be lowered. Lowering the dam will be conducted over the course of approximately three weeks (21 days) so that the total Mill Pond water volume to be discharged (approximately 132,000m^3) enters Upper Pond (and is channeled onto Hambone Lake) at a rate of less than 300m^3/ hour (averaged over 24 hours). This discharge rate to Hambone Lake is the same as that already authorized for treated tailings water. Tailings water treatment and discharge operations will have concluded prior to decommissioning of the Aqua dam. During the Aqua dam's decommissioning the treated water in the Aqua Dam will be pumped back into Hambone Lake as the license stipulates all treated water must be discharged there. Potential erosion may rise when the Aqua dam is removed from the Mill Pond, disrupting its bedding which could cause sedimentation issues as well. Proper erosion controls will be put into place to prevent this.

8.14 Blasting of Diversion Ditch around Tailing Contaminated Area (TCA)

A diversion ditch will be built around the TCA in Lower Pond area to provide adequate draining of water to Hambone Lake, and to prevent future potential contamination. Blasting has been conducted to create portions of the diversion ditch through bedrock outcrops and could lead to contamination and erosion through dust and material movement, which have already been discussed above. The applicable erosion controls will be put into place to limit the blasting's impact including placement of blast mats through the use of a small excavator. During the construction of the channel, any pooling water in the channel will be pumped into Upper Pond to be treated in the water treatment facility. The blast mats will also act to mitigate dust and material movement. Once the water plant has been decommissioned, the pooling water will be pumped into drums and shipped off-site for treatment and disposal. Any contaminated material in the diversion channel will be hauled and placed underneath the liner in Lower Pond. Upon completion of the diversion channel construction to design specifications, only clean water will be allowed to flow into Hambone Lake.

9 Sediment and Erosion Measures after Reclamation Activities

Erosion and sediment controls will be installed during the reclamation activities where and when required. Erosion control measures will remain in place until the Mine Manager, Field Engineer, Departmental Representative (DR) and Earthworks Supervisor agree in writing that the erosion control measures for that area are no longer required.

TLICHO will monitor the site during construction activities throughout the duration of the project. Long term monitoring of the site will be performed by Aboriginal Affairs and Northern Development Canada.

10 Water Management Plan

TLICHO's site wide water management plan comprises of the following 7 areas where we see a need for water management:

- ***Controlling surface runoff from entering the excavation.*** TLICHO will pay special attention to the potential of freshet impacts to the surface flow rates. The surface runoff may be controlled utilizing surface ditches, earth dams, Geosynthetic dams, culvert installation and pumping stations.

- ***Controlling ground water.*** TLICHO will complete a preliminary drill hole with the Minuteman drill to locate the sub-surface ground water table. The concern here is that a high ground water table may quickly drain into the excavation creating a significant environmental issue by contaminating water which may travel into the adjacent ground water. In areas where the ground water table is higher than the expected bottom of the excavation, TLICHO will implement the following controls:
  - ditching to divert ground water
  - pumping to lower ground water
  - locating the source and diverting the source of ground water

- ***Degradation of Permafrost.*** Any time ground is disturbed over permafrost, especially when this changes surface or ground water characteristics, there is significant potential for permafrost degradation. In-order to control permafrost degradation, the ground and surface water must be properly managed. TLICHO has a geotechnical engineer with over 20 years experience in cold regions who will identify areas on-site where permafrost may be located. When permafrost is encountered at an excavation site, all efforts will be made to divert any water which may enter the excavation and propagate the degradation of permafrost. The excavation site will be accessed as quickly as possible and recovered immediately after work is completed. This will minimize the disturbance to the permafrost.

- ***Precipitation Mitigation.*** TLICHO will not excavate during heavy rain. Areas with a high potential for erosion will be inspected to ensure controls are in place and maintained prior to anticipated rain events.

- ***Plan for controlling sediments created by the excavation.*** TLICHO will install silt curtains and silt fences to ensure that the excavations will not impact the local water bodies or streams.

- ***Installation and decommission of Aqua dam.*** TLICHO has consulted two companies to provide the installation and decommission the Aqua dam as well as provide technical support for it. The Aqua dam will be filled with treated water from the water treatment plant which would provide a quicker and easier method to inflate the Aqua dams.

- ***Management of Water between Aqua Dam and Excavation.*** TLICHO intends to install silt fences, and any pooling water will be pumped into drums and shipped off-site for treatment and disposal.

The water management plan will protect the environment from contaminants which will be exposed during the excavation process as well as minimize the migration of sediments due to water movement. When performing excavation work, a combination of the above 7 approaches will be utilized to control water, depending on what is encountered. The construction supervisor will decide which control to implement in order to properly manage water to prevent any sediment and erosion issues.

TLICHO understands the potential to increase input of sediment-laden water to nearby water bodies when attempting to divert water around excavation sites. When performing an assessment of a site, the erosion assessment team will take into consideration the impact to surrounding water bodies which may be affected when installing control measures to divert water. If there is potential of increased input of sediment-laden water to nearby water bodies, silt fences will be installed to prevent any sediment from entering any water body. Pumping stations could also be utilized to control any clean pooling water by pumping it indirectly back into Mill Pond. The water would be pumped onto the tundra in the Mill Pond catchment area, and travel through silt fences to ensure little to no sediments enter Mill Pond. Therefore by diverting as much water as possible from excavated areas through diversion channels and pumping clean water back into Mill Pond the amount of erosion occurring should be minimized. DFO will also be contacted when there is a chance of impact to surrounding water bodies.

11 Monitoring Program

A monitoring program will be put in place to ensure the effectiveness and maintenance of all sediment and erosion control measures. An erosion assessment will first be performed prior to commencement of work to determine the risk of erosion, determine control measures to put in place, type of monitoring and frequency of monitoring required during work. The assessment includes an “Erosion Matrix Table” which evaluates the risk level of erosion, and then recommends the following active measures:

1. type of controls to install
2. type of monitoring required
3. frequency of monitoring required

Next, an erosion tracking sheet will be kept for each active area by the field engineer. This will track the effectiveness of the erosion control measures installed at each active site. Documentation of the monitoring program will be kept on-site by the field engineer. A close out assessment will be made to evaluate the area stabilization after activities to determine if further monitoring and/or erosion protection would be required after work has ceased. This assessment will be performed by the assessment team made up of the

Mine Manager, Field Engineer, Earthworks Supervisor, and the Departmental Representative. This assessment will be recorded in a close out assessment sheet and filed for record. If the assessment sheet recommends that it is stabilized, controls will be removed after reclamation activities have finished. If the assessment sheet recommends further monitoring, it will extend to freeze up time at the end of each summer construction season.

TLICHO will monitor the site during construction activities throughout the duration of the project. Long term monitoring of the site will be performed by Aboriginal Affairs and Northern Development Canada.

12 Contingency Plan

The preliminary assessment performed on areas (outside of the Tailings Containment Area) which are prone to excessive erosion should identify any sediment and erosion issues which may arise. All issues identified will have mitigation and control measures installed. They are summarized in the following potential problems and corresponding mitigative measures table.

Problem	Mitigative measure
Ground water in excavation	TLICHO will use the Minuteman drill to locate the sub-surface ground water table. If there is a high water table, solutions include ditching to divert ground water and pumping to lower the ground water.
Dust from excavation	There will be a water truck on-site to dampen work areas thereby minimizing dust creation from excavations
Degradation of permafrost	When permafrost is encountered at an excavation site, all efforts will be made to divert any water which may enter the excavation and propagate the degradation of permafrost. The excavation site will be accessed as quickly as possible and re-covered immediately after work is completed. This will minimize the disturbance to the permafrost.
Precipitation	TLICHO will not excavate during heavy rain. Areas with a high potential for erosion will be inspected to ensure controls are in place and maintained prior to anticipated rain events.
Sediment migration in areas outside of tailings containment dams (including, from excavation work, road upgrades, borrow	TLICHO will install silt curtains and silt fences to prevent sediment migration. TLICHO will also minimize traffic around

Problem	Mitigative measure
source development)	excavation sites so the ground disturbances are minimal.
Sediment and water migration within the tailings containment dam area	The tailings dams will always have at least a 1m freeboard so that it will prevent any sediment and water migration outside of its containment.
Erosion due to water treatment activities at the wetlands upstream of Hambone Lake and Hambone Lake	The two discharge lines will be spread further apart from each other to prevent channel flow. Silt fence will be installed along the water drainage paths. Relocate a discharge line to outflow directly into Hambone Lake, the line will be held on floats so that water dissipates on the top of the lake to prevent sediment stir-up
Erosion at the road crossing between Powder Mag Lake and Sandy Lake	Install naturally occurring cobble stones along these areas, they will be hand placed along the shoreline. Install silt curtain along the shoreline. DFO will be notified if erosion controls are required to be installed along the road crossing between Powder Mag Lake and Sandy Lake.
Erosion at the stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake	Install naturally occurring cobble stones along these areas, they will be hand placed along the shoreline. Install silt curtain along the shoreline. DFO will be notified if erosion controls are required to be installed at the stream crossing at Sandy Lake and small unnamed lake prior to Whale Tail Lake.

Having a monitoring program in place will provide information on the effectiveness of the sediment and erosion controls. If it is noticed during the monitoring program that the installed control measures are not sufficient, a re-assessment of the impact area will be made and further control measures will be installed.

APPENDIX A-Dust Suppressant Literature

NEWTROL™

Dust Palliative

TECHNICAL DATA SHEET

DESCRIPTION

NEWTROL™ is an environmentally sound dust palliative developed for use on helicopter landing pads, open areas, and roadways. NEWTROL™ is a green product formulated with renewable resources enhanced to maintain long term dust suppression. The multi-component system works to agglomerate loose particles and hold moisture on the surface thereby reducing dust on the landing pads and open areas.

APPLICATIONS

NEWTROL™ is used to control dust on helicopter landing pads, open areas and roadways. Dust suppression on helipads is difficult because of the intensive influx of air and wind as the chopper is landing and taking off. Dust generated during helipad use can cause brownouts, limiting visibility making take off and landing dangerous. A dust palliative product must not only control dust from blowing but keep foreign object debris (FOD) from entering critical parts of the chopper. NEWTROL™ controls dust and keeps FOD from flying at all the critical times.

PHYSICAL PROPERTIES

Boiling Point:	>212^{0}F (100^{0}C)
Specific Gravity:	1.10 – 1.20 (Kg/Litre)
Weight per Gallon (US)	9.16 – 10.00 pounds/gallon (US)
Appearance:	clear to cloudy liquid
Odor:	sweet
Solubility in Water:	dilutable
Incompatibilities:	Strong acids or bases
Flammability:	non-flammable, non-combustible
Stability:	stable under normal handling conditions
Corrosive:	non-corrosive.

Users/public/r&d/technical spec/New 2009/NEWTROL

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1101 Third Street Southeast • Canton, Ohio 44707 USA
Emergency Phone Number: 330-456-3121

NEWTROL™ Series
MATERIAL SAFETY DATA SHEET

SECTION I -- IDENTIFICATION OF SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

TRADE NAME:	NEWTROL™ SERIES of PRODUCTS
CHEMICAL NAME:	ENHANCED DUST SUPPRESSANT
SYNONYMS:	DUST RETARDANT
CHEMICAL FAMILY:	N/A
MOLECULAR WEIGHT:	N/A
FORMULA:	N/A
CAS REGISTRY NO.:	PRODUCT A BLEND - NO NUMBER ASSIGNED

SECTION II -- COMPOSITION/INFORMATION ON INGREDIENTS

NAME	CAS REG. NO.	WT. %
Proprietary Ingredients	Non-Hazardous	< 20%
Glycerin	56-81-5	> 20 %
Water	7732-18-5	> 30 %

SECTION III -- HAZARDS IDENTIFICATION

Glycerin Mists may be mildly irritating to respiratory tract
TLV: mist 10mg/M^3 as TWA (ACGIH 2005)

HMIS:	NFPA:
Health = 1	Health = 1
Flammability = 0	Flammability = 1
Reactivity = 1	Reactivity = 1

SECTION IV -- FIRST AID MEASURES

EYES:	Flush eyes with flowing water at least 15 minutes, get medical attention.
INHALATION:	Move subject to fresh air.
SKIN:	Flush with large amount of water or wash with soap and water.
INGESTION:	Give water to drink. Call a physician. **NEVER GIVE FLUIDS OR INDUCE VOMITING. IF PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS.**

SECTION V -- FIRE FIGHTING MEASURES

FLASH POINT (TEST METHOD):	N/D
AUTOIGNITION TEMPERATURE:	N/A
EXTINGUISHING MEDIUM:	Water spray or alcohol resistant foam, dry powder or carbon dioxide.
SPECIAL FIREFIGHTING PROCEDURES:	Avoid breathing vapors or fumes. Wear self contained breathing apparatus and turn out gear. Frothing may occur when using water spray or foam to extinguish fire, caution

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should be used. Individuals should perform only those fire fighting procedures for which they are trained.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Material can splatter above 212°F. Dried polymer film can burn but will not support combustion. Firefighters should wear self-contained breathing apparatus in the positive pressure mode with full face piece when there is a possibility of exposure to smoke or hazardous decomposition products.

SECTION VI - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK PROCEDURES: Dike and control spill. Transfer liquid to containers for recovery or disposal. Keep spills out of sewers and open bodies of water. Comply with local, state and federal reporting regulations.

SECTION VII -- HANDLING AND STORAGE

STORAGE: Keep in a cool, dry, ventilated storage area and in closed containers. Avoid freezing temperatures. Minimize contact with the air to prevent microorganism contamination and reduce the formation of skins on the surface.

HANDLING: Handle in a well-ventilated workspace.

SECTION VIII -- EXPOSURE CONTROL/PERSONAL PROTECTION

RESPIRATORY PROTECTION: Where exposure levels are expected to exceed acceptable criteria use NIOH / OSHA approved respiratory equipment.

VENTILATION: Mechanical exhaust at point of contaminant. Local exhaust as needed.

EYE PROTECTION: Chemical splash goggles recommended.

PROTECTIVE CLOTHING: Impervious gloves recommended.

OTHER: Under normal handling conditions, the risk of exposure to residual monomer is negligible.

SECTION IX -- PHYSICAL AND CHEMICAL PROPERTIES

BOILING/MELTING POINT @ 760 mm Hg:	212°F
VAPOR PRESSURE mm Hg @ 20°C:	17
SPECIFIC GRAVITY OR BULK DENSITY:	1.05 to 1.25
SOLUBILITY IN WATER:	Dilutable
APPEARANCE:	Clear to cloudy liquid
ODOR:	Characteristic sweet odor
pH:	6.0 to 9.0

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SECTION X -- STABILITY AND REACTIVITY

STABILITY:	Stable
CHEMICAL INCOMPATIBILITY:	No hazardous reactions are expected to occur under normal industrial conditions.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition in the presence of air may yield carbon monoxide and/or carbon dioxide, water and corrosive fumes of acrolein.
HAZARDOUS POLYMERIZATION:	Does not occur
CONDITIONS TO AVOID:	Heat, sparks, open flame.
OXIDIZER:	No

SECTION XI -- TOX ICOLOGICAL INFORMATION

EFFECTS OF OVEREXPOSURE

INHALATION:	Vapor from stored, undiluted product can cause headache and nausea. Higher temperatures may generate vapor levels sufficient to cause irritation.
SKIN:	Stored, undiluted product is slightly irritating to skin.
EYES:	Slightly irritating to eyes.
INGESTION:	May be irritating to digestive tract.

Toxicity studies have not been performed on NEWTROL, however, data on individual components is as follows:

Acute toxicity: Ingestion; LD50, Rat 17,000 – 27,200 mg/kg
Skin Absorption; LD50, Rabbit > 10,000 mg/kg
Inhalation; LC50, Rat 6 hour aerosol >4 mg/L

Repeat dose toxicity: Excessive exposure to glycerin may cause increased fat levels in blood in gastrointestinal tract in animals.

Carcinogenicity: Did not cause cancer in laboratory animals.

Developmental Toxicity: Did not cause birth defects or any other fetal developmental effects in lab animals.

Reproductive Toxicity: Reproductive effects in female animals are believed to be due to altered nutritional states resulting from extremely high doses of glycerin in the diet. Similar effects have been seen in animals fed synthetic diets.

Genetic Toxicity: In vitro genetic studies were negative.

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NEWTROL™ Series
MATERIAL SAFETY DATA SHEET

SECTION XII -- ECOLOGICAL INFORMATION

When released into the environment (soil / water) this material is not expected to have a negative impact. Ecological studies have not been performed on NEWTROL; however, data on individual components is as follows:

Movement and Partitioning:

Bioconcentration potential in low (BCF less than 100 or log Pow less than 3).
Potential for mobility in soil is very high (Koc between 0 and 50)
Given its very low Henry's constant; volatilization from natural bodies of water or moist soil is not expected to be an important fate process

Persistence and degradation:

Material is readily biodegradable. Passes OECD test(s) for ready biodegradability
OECD 301C test; 14 days, 63% biodegradation

Ecotoxicity:

This material is relatively non – toxic to aquatic life, LC50/EC50 >100 mg/kg in most sensitive species.
LC50; fathead minnow (Pimephales promelas), static, 96 hr, 44,000 mg/L
LC50; water flea (Daphnia magna), 24 hr, >10,000 mg/L
EC50; micro-organisms, OECD 209 test, activated sludge, respiratory inhibition, 3Hr >1000mg/L

SECTION XIII -- DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD:

Dispose of solids and contaminated diking material according to local, state and federal regulations.

CONTAINER DISPOSAL:

Do not re-use containers. Do not weld on metal containers.

SECTION XIV -- TRANSPORTATION INFORMATION

D.O.T. PROPER SHIPPING NAME (49CFR172.101):	None
D.O.T. HAZARD CLASSIFICATION (49CFR172.101):	Non-regulated
D.O.T. PLACARDS REQUIRED:	None
BILL OF LADING DESCRIPTION:	Liquid NOS, contains glycerin

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SECTION XV-- REGULATORY INFORMATION

NEWTROL™ is not a restricted article according to the Department of Transportation and International Air Transport Association regulations.

EPA SARA Title III hazard class:	None
OSHA HCS hazard class:	Irritant (glycerin) (29CFR1910.1200)
Toxic Chemicals present in quantities greater than the "de minimus" level are:	None
TSCA:	All the ingredients are on the TSCA (Toxic Substance Control Act) inventory or are not required to be listed on the TSCA inventory.
Canadian DSL:	All the ingredients are in the Canadian DSL (Domestic Substance List) or are not required to be on the list.
Canadian WHMIS:	irritant.

SECTION XVI -- OTHER INFORMATION

ABBREVIATIONS AND SYMBOLS:

N.D. - Not Determined	N.A. - Not Applicable	N.T. - Not Tested
< - LESS THAN	> - MORE THAN	

MATERIAL SAFETY DATA SHEET

Soil-Sement®

Midwest Dust Control

SECTION I — IDENTIFICATION OF SUBSTANCE/PREPARATION AND COMPANY/ UNDERTAKING

TRADE NAME:	Soil-Sement®
CHEMICAL NAME:	Polymer Emulsion
SYNONYMS:	Dust Retardant
CHEMICAL FAMILY:	N/A
MOLECULAR WEIGHT:	N/A
FORMULA:	Aqueous Acrylic Vinyl Acetate Polymer Emulsion
CAS REGISTRY NO.:	Product A Blend - No Number Assigned

SECTION II — COMPOSITION/INFORMATION ON INGREDIENTS

NAME	CAS REG NO.	WT. %
Acrylic & Vinyl Acetate Polymer	Non-hazardous	5-50
Water	7732-18-5	95-50

SECTION III — HAZARDS IDENTIFICATION

ACRYLIC & POLYVINYL ACETATE POLYMER	Non-hazardous
Water	Non-hazardous

SECTION IV — FIRST AID MEASURES

EYES:	Flush eyes with flowing water at least 15 minutes, get medical attention.
INHALATION:	Move subject to fresh air.
SKIN:	Flush with large amount of water or wash with soap and water.
INGESTION:	Give water to drink. Call a physician

NEVER GIVE FLUIDS OR INDUCE VOMITING. IF PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS.

SECTION V — FIRE FIGHTING MEASURES

FLASH POINT (TEST METHOD):	Non-Combustible
AUTOIGNITION TEMPERATURE:	N/A
EXTINGUISHING MEDIUM:	N/A
SPECIAL FIREFIGHTING PROCEDURES:	N/A
UNUSUAL FIRE AND EXPLOSION HAZARDS:	Material can splatter above 212°F. Dried polymer film can burn but will not support combustion.

SECTION VI - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK PROCEDURES:	Dike and control spill. Transfer liquid to containers for recovery or disposal. Keep spills out of sewers and open bodies of water.

SECTION VII — HANDLING AND STORAGE

STORAGE:	Keep in a cool, dry, ventilated storage area and in closed containers. Minimize contact with the air to prevent microorganism contamination and reduce the formation of skins on the surface. KEEP FROM FREEZING
HANDLING:	Handle in a well-ventilated workspace.

SECTION VIII — EXPOSURE CONTROL/PERSONAL PROTECTION

RESPIRATORY PROTECTION:	None required if good ventilation is maintained.
VENTILATION:	Mechanical exhaust at point of contaminant.
EYE PROTECTION:	Chemical splash goggles recommended.
PROTECTIVE CLOTHING:	Impervious gloves recommended.
OTHER:	Under normal handling conditions, the risk of exposure to residual monomer is negligible.

SECTION IX — PHYSICAL AND CHEMICAL PROPERTIES

BOILING/MELTING POINT @ 760 mm Hg:	212°F
VAPOR PRESSURE mm Hg @ 20°C:	17
SPECIFIC GRAVITY OR BULK DENSITY:	1.01 to 1.15
SOLUBILITY IN WATER:	Dilutable
APPEARANCE:	Milky White Liquid
ODOR:	Characteristic Acrylic odor
pH:	4.0 to 9.5

SECTION X — STABILITY AND REACTIVITY

STABILITY:	Stable
CHEMICAL INCOMPATIBILITY:	No hazardous reactions are expected to occur under normal industrial conditions.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition in the presence of air may yield carbon monoxide and/or carbon dioxide and water.
HAZARDOUS POLYMERIZATION:	Does not occur
CONDITIONS TO AVOID:	N/A
CORROSIVE TO METAL:	No
OXIDIZER:	No

SECTION XI — TOXICOLOGICAL INFORMATION

EFFECTS OF OVEREXPOSURE	
INHALATION:	Vapor from stored, undiluted product can cause headache and nausea.
SKIN:	Stored, undiluted product is slightly irritating to skin.
EYES:	Slightly irritating to eyes.
INGESTION:	May be irritating to digestive tract.

SECTION XII — ECOLOGICAL INFORMATION

Toxicological evaluation of Soil Sement® utilized EPA methods for both acute and chronic toxicity determination for aquatic organisms. LC50 values were determined for each of the species. The table below contains a synopsis of the results.

SOIL SEMENT AQUATIC TOXICITY TEST RESULT

- Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, EPA/600/4-90/027F.
- Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA/600/4-91/002.
- Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms, EPA/600/4-91/003.

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SECTION XII — ECOLOGICAL INFORMATION - continued

	Ceriodaphnia dubia	Fathead minnow	Americamysis bahia	Rainbow trout
ACUTE/SURVIVAL (mg/L)				
LC50	>1000	>1000	>1000	320
NOEC	1000	1000	1000	
LOEC	>1000	>1000	>1000	
CHRONIC/SURVIVAL (mg/L)				
LC50	>1000	>1000	>1000	510
NOEC	1000	1000	1000	340
LOEC	>1000	>1000	>1000	700
CHRONIC/GROWTH/ REPRODUCTION (mg/L)				
LC50	>1000	>1000	>1000	540
NOEC	1000	1000	1000	340
LOEC	>1000	>1000	>1000	700

See attached test results:
1. ABC Laboratories, Inc. Americamysis bahia, Fathead minnow, Ceriodaphnia dubia.
2. BAR Invironmental, Inc. Rainbow trout
3. EnviroScience Inc. Rainbow Trout, Chronic (New Data)

LC50 - Lethal Concentration, 50%
NOEC - No Observable Effects Concentration
LOEC - Lowest Observable Effects Concentration

Comparison of the EPA guidelines to the LC50 levels of all species show that Soil Sement® is practically non-toxic to all species.

SECTION XIII — DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Coagulate the emulsion by the stepwise addition of ferric chloride and lime or the addition of sand or other absorbent material. Remove the clear supernatant liquid and flush to a chemical sewer or landfill. Incinerate solids and the contaminated diking material according to local, state and federal regulations.

CONTAINER DISPOSAL: Do not re-use containers. Do not weld on metal containers.

SECTION XIV — TRANSPORTATION INFORMATION

D.O.T. PROPER SHIPPING NAME (49CFR172.101): None
HAZARDOUS SUBSTANCE (40CFR116): N/A
REPORTABLE QUANTITY (RQ): N/A
D.O.T. HAZARD CLASSIFICATION (49CFR172.101): Non-regulated
D.O.T. PLACARDS REQUIRED: None
POISON CONSTITUENT (49CFR173.343): N/A
BILL OF LADING DESCRIPTION: Liquid plastic, NOS
C NO.: N/A
UN/NA CODE: N/A

SECTION XV— REGULATORY INFORMATION

SOIL-SEMENT® is not a restricted article according to the Department of Transportation and International Air Transport Association regulations.

EPA SARA Title III hazard class: None
OSHA HCS hazard class: Non-OSHA hazardous (29CFR1910.1200)
Toxic Chemicals present in quantities greater than the "de minimus" level are: None
TSCA: All ingredients are on the TSCA (Toxic Substance Control Act) inventory or are not required to be listed on the TSCA inventory.
California Proposition 65: This product contains no trace amount of chemical(s) known to the state of California to cause cancer of birth defects.
Canadian DSL: All ingredients are in the Canadian DSL (Domestic Substance List) or are not required to be on the list.
Canadian WHMIS: This product is not a "controlled product" under the Canadian Workplace Hazardous Material Information System (WHMIS)

SECTION XVI — OTHER INFORMATION

ABBREVIATIONS AND SYMBOLS:
N.D. - Not Determined
N.A. - Not Applicable
N.T. - Not Tested
< - Less Than
> - Greater Than

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