Nanisivik Mine Rock Piles and Open Pits Closure Plan

prepared for:
CanZinco Ltd.

prepared by:
Gartner Lee Limited

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February 6, 2004

Mr. Robert Carreau
Breakwater Resources Limited
95 Wellington Street West, Suite 2000
Toronto, ON M5J 2N7

Dear Mr. Carreau:

Re: 23635 – Nanisivik Mine Rock Piles and Open Pits Closure Plan

Gartner Lee Limited is pleased to submit the above-referenced report.

We trust that you will find the closure plan to be technically sound. If you wish to discuss any aspect of the report, please do not hesitate to contact us.

Yours very truly,
GARTNER LEE LIMITED

per

Eric Denholm, B.A.Sc., P. Eng.
Senior Mining Consultant, Principal

Table of Contents

Letter of Transmittal

List of Tables

List of Figures (back of Report)

Appendices

Executive Summary

Mining operations at the Nanisivik mine permanently ceased in 2002. CanZinco Ltd., the mine owner, is submitting a Reclamation and Closure Plan to the Nunavut Water Board in the format specified in the Water Licence. This report, the Rock Piles and Open Pits Closure Plan, fulfills the requirements for Part G, Item 8 of the Nanisivik Water Licence and represents one component of the Closure and Reclamation Plan submission.

Underground and open pit mining operations necessitated the development of surface stockpile areas for development waste rock. The rock types represented in the surface rock piles are a mixture of the various rock types encountered in the underground and open pit mines. This mixture includes a range of rock types from the host carbonaceous rock types to massive sulphide waste containing predominantly pyrite (iron sulphide) mineralization. The acid rock drainage characteristics of the waste rock varies from strongly potentially acid generating to acid consuming. All of the waste rock contains substantial neutralizing potential, due to the carbonaceous host rocks, and the acid generation potential is largely controlled by the sulphur content.

CanZinco has undertaken progressive reclamation of the surface rock piles for more than decade. Waste rock and rejects from the dense media separation plant have been relocated from surface into, primarily, the underground workings mine and, since approximately 2000, into the East Pit and Oceanview open pits. This work was linked to both mine operations, where waste rock was required as backfill for mining, and to progressive reclamation of the open pits as the placement of waste rock contributed to backfilling of the pits. The progressive reclamation of rock piles has effectively relocated in the order of 178,000 m^3 (approximately 70%) of the total volume of waste rock that was on surface. The current volume of waste rock remaining in the various rock piles is estimated to be 69,641 m^3.

The open pits contain exposures of massive and disseminated sulphides (predominantly represented by pyrite mineralization) in the walls and floors. These exposures are largely discreet zones within the carbonaceous host rocks that generally form the bulk of the exposed rock. A large portion of the backfilling requirement at the East Open Pit and Oceanview Pit was completed during the progressive reclamation program.

The specific reclamation objectives for rock piles and open pits are:

1. Minimize the risk of ARD or metal leaching; and
2. Provide a safe surface environment that matches the natural conditions.

A review of ARD characterization information led to the following relative risk classification of the rock piles and open pits:

1. Highest Risk: K-Baseline and 09-South rock piles;
2. Moderately High Risk: West Adit/02 South rock pile, East Open Pit and (assumed) East Adit Trench;
3. Moderate Risk: East Adit rock pile, Area 14 rock pile and (assumed) DMS rejects storage area;
4. Low Risk: West Open Pit; and
5. Lowest Risk: West Adit Access Road, Oceanview rock pile and (assumed) Oceanview Open Pit.

The overall approach to achieving the reclamation objectives is to apply the most appropriate combination of one or more of the following reclamation measures:

1. Relocate waste rock to eliminate or reduce the requirements for surface reclamation at the pile location;
2. Fill open pits to achieve a smooth surface contour that prevents surface ponding and provides a safe surface environment;
3. Provide a thermal cover such that the covered materials freeze into permafrost;
4. Assess the net negative effects of intrusive reclamation work against the potential long term environmental risk; and
5. Institute a monitoring and contingency program.

Where a thermal barrier cover is to be placed, the proposed cover design is the same as proposed for the landfill facility as follows:

1. The maximum slope of a cover will be 3H:1V or 18 °;
2. A two-layer thermal cover with a total thickness of 2.20 m will be placed above the waste;
3. The upper erosion-resistant capping layer shall consist of a durable, erosion resistant material with a thickness of 0.25 m. The selected material is the Twin Lakes sand and gravel;
4. The underlying layer will be shale with a thickness of 1.95 m to provide a minimum total thermal cover thickness (in combination with the surface layer) of not less than 2.20 m.
5. A quality control program will be implemented to ensure that cover materials meet the design specifications and are constructed in accordance with the design drawings. This program will include survey control, materials testing, construction monitoring and documentation.

The main objective of the performance monitoring program is to monitor the reclamation cover's performance in each location under three areas (seepage water quality, ground temperature, and physical stability) and to report the results. The program is to be conducted during the 2-year reclamation period and the 5-year closure period.

In the event that the covers do not perform as expected, then some or all items of the contingency plan should be implemented. The components to the contingency plan that should be considered for implementation depending on the specific circumstances include:

- increased frequency of sampling/monitoring and data review by a technical professional;
- repair of any erosion of the cover;
- placement of additional cover material to increase the cover thickness; and
- extension of the period of performance monitoring.

1. Introduction

1.1 Overview of Development of the Nanisivik Mine Final Closure and Reclamation Plan

The Nanisivik mine (Figures 1 and 2) began production of zinc and lead concentrates in 1976. The current owner of the mine, CanZinco Ltd. ("CanZinco"), has been in possession of the mine since 1998.

Prior to mid-2001, the Nanisivik Mine was scheduled to operate until the depletion of economic ore reserves in 2004 or 2005. However, depressed international base-metal prices necessitated a re-evaluation of the mine production plan, which resulted in a reduction of economic ore reserves such that these reserves were depleted in September 2002. The mine was permanently closed at that time.

An interim mine reclamation plan had been developed and updated on an annual basis by CanZinco in response to terms of the Water Licence. However, the announcement of permanent closure in September 2001 triggered a requirement in the (then) current water licence for submission of a Final Closure and Reclamation Plan. In response to this trigger, CanZinco submitted a Closure and Reclamation Plan in February 2002 that described the approaches and plans for reclamation of the mine site.

Subsequent to a Public Hearing on renewal of the water licence held in the community of Arctic Bay in July 2002 and a technical meeting held in August 2003, the Nunavut Water Board ("NWB") issued Water Licence No. NWB1NAN0208, with an expiry date of May 1, 2008 (the "Water Licence"), which provides for the continuation of on-site environmental protection activities during the development and submission, for approval, of a Reclamation and Closure Plan ("RCP") with all attendant components and support documentation.

The Nanisivik Mine RCP has been developed, per the terms of the Water Licence, as a series of stand alone documents, which each document providing, in detail, information and proposed closure measures for one specific component or topic area. The individual reports that have been developed in this manner are listed under Part G of the Water Licence as summarized in Table 1.

This document is provided in response to the requirements for component report G.8.

Table 1. Summary of Component Closure Plan reports

Water Licence Reference	Report
G3	Final Closure and Reclamation Plan
G4	Reclamation Cover Designs
G5	West Twin Disposal Area Talik Investigation
G6	Borrow Areas Development and Closure Plan
G7	West Twin Disposal Area Surface Cell Spillway Design
G8	Waste Rock Closure Plan
G9	Reclamation and Closure Monitoring Plan
G12	Annual Review of Reports G3 to G9 and Submission, for Approval, of Proposed Modifications
G13	Report on Environmental Site Assessment (ESA) Program
G14	Human Health and Ecological Risk Assessment (HHERA)
G15	West Twin Disposal Area Closure Plan
G16	Underground Mine Solid Waste Disposal Plan
G17	Landfill Closure Plan
G20	Annual Review of Reports G15 to G17 and Submission, for Approval, of Proposed Modifications
G21	Annual Reclamation Liability Cost Update
G22	2007 Terms of Reference for Comprehensive Assessment of Mine Site Remediation

1.2 Specific Requirements for the Rock Piles and Open Pits Closure Plan

The specific requirements for the Rock Piles and Open Pits Closure Plan come from two sources: Part G, Item 8 of the Water Licence and the needs of CanZinco with respect to carrying out the reclamation activities to eliminate the requirements for long term monitoring and maintenance for this site.

Part G, Item 8 of the Water Licence, as excerpted below, provides the following requirements:

8. *The Licencee shall submit to the Board for approval a report assessing all waste rock which shall include but not be limited to:*

   i. *Estimated volumes for recovery and/or remediation;*

   ii. *Plans, sections and estimated volumes of potentially acid generating or metal leachable waste rock at the primary disposal areas;*

iii. *A description of the removal methodology, sequence, rate and disposal locations for material which cannot remain on surface;*

iv. *Assessment in relation to mine soils (waste rock, pit walls) under acidic and alkaline leaching conditions;*

v. *An estimate of the quantity of acid generating or metal leachable waste rock which cannot be practically removed and the scope of compensatory environmental protection measures;*

vi. *A description of areas, slope angles, and relevant topography of waste rock dumps reclaimed or otherwise; and*

vii. *A comparison between complete removal/excavation against leaving in place some of the waste rock adjacent to Twin Lakes Creek including geological mapping and geochemical characterization of residuals.*

CanZinco's specific requirements for the Plan are partially satisfied by those provided in the Water Licence, namely to describe the current status (at mine closure) of the rock piles and the proposed reclamation activities for those areas. However, reclamation of the rock piles is linked with the open pits to such a degree, in CanZinco's opinion, that one common reclamation plan is appropriate that encompasses all rock piles and open pits. These linkages are based on common ARD concerns, common reclamation covering issues and the possibility of applying complementary reclamation measures by utilizing waste rock as backfill to create closure contours for the open pits. Therefore, CanZinco's specific requirements include those listed for rock piles in Part G, Item 8 of the Water Licence as expanded to also include open pits.

2. Approach to Closure of Rock Piles and Open Pits

2.1 Overview

In order to achieve the requirements for this Plan and for preparation of this document, the following steps were completed:

1. review and compilation of relevant existing information;
2. collection of new information; and
3. preparation of the Plan.

The relevant existing information included ARD assessments reported on by Lorax Environmental, the Phase 2 and 3 Environmental Site Assessments that were reported on by Gartner Lee Limited ("Gartner Lee") and annual waste rock relocation updates prepared by CanZinco. The new information that was collected included a survey of the East Adit and West Adit areas, discussions with CanZinco site personnel, mine closure information developed by BGC Engineering Inc. regarding local geothermal monitoring and closure cover designs and a summary review of geothermal conditions and performance of the Area 14 shale cover over waste rock.

2.2 Progressive Reclamation Prior to Mine Closure

2.2.1 Rock Piles

Progressive reclamation of the surface rock piles has been undertaken since 1992. Waste rock and rejects from the dense media separation ("DMS") plant have been relocated from surface into, primarily, the underground mine and, since approximately 2000, into the East and Oceanview open pits. This work was linked, in part, to both mine operations as some of the waste rock was placed strategically to benefit the mining methods and to undertake progressive reclamation of the open pits as the placement of waste rock contributed to backfilling of the pits. During this period, some relatively minor volumes of waste rock were also hauled and temporarily stored on surface as part of the normal mining procedures.

This work was conducted according to the reclamation concepts that were filed with the NWB through the annual updates to the Interim Abandonment Plan as required by the Water Licence. The work conducted for progressive reclamation of the rock piles was reported annually to the NWB as required by the Water Licence and the volumes moved into and out of various rock piles were reported as listed in Table 2.

Table 2. Progressive Reclamation of Rock Piles

Year	Location	Destination	Volume Relocated (m^3)
1992 to 1996	East Adit (39S)	Underground	23,000
	West Adit (02S and 09S)	Underground	11,500
	5-Year Total		**34,500**
1997	East Adit (39S)	Underground	1,400
	West Adit (02S and 09S)	Underground	5,000
	Annual Total		**6,400**
1998	East Adit (39S)	Underground	5,000
	West Adit (02S and 09S)	Underground	1,500
	Annual Total		**6,500**
1999	East Adit (39S)	Underground	4,700
	West Adit (02S and 09S)	Underground	6,000
	Oceanview	Underground	1,279
	Annual Total		**11,979**
2000	East Adit (39S)	Underground	13,600
	West Adit (02S and 09S)	Underground	3,300
	Annual Total		**16,900**
2001	East Adit (39S)	Underground / East Open Pit	12,192
	09 South	Underground	3,731
	Annual Total		**15,923**
2002	East Adit (39N/S)	Underground / East Open Pit	26,710
	West Adit (02S)	Underground	310
	09 South	Underground	17,290
	Oceanview	Oceanview Pit	10,030
	Annual Total		**86,186**
2003	Oceanview	Oceanview Pit /East Open Pit	350
	Annual Total		**350**
1992 to 2003	**12-Year Total**		**178,738**

Notes: All volumes taken from Annual Water Reports.

Prior to 2001, volumes reported for "West Adit" included both "09 South" and "02 South" rock piles.

Where necessary, volumes were calculated from tonnage using a specific gravity of 2.61.

As a result of the 12-year progressive reclamation of rock piles, a large potion (approximately 70%) of the total volume of waste rock has already been relocated into the underground mine or one of the open pits. The current estimated volumes of waste rock remaining in the various rock piles as of the end of 2003 are listed in Table 3.

Table 3. Current Volumes of Waste Rock Piles

Rock Pile	Current Volume (m^3)
East Adit (39S)	36,180
West Adit (02 South)	15,590
09 South	7,571
Oceanview	"remnant"
K-Baseline	"remnant"
Area 14	10,300
Total Volume	**69,641 + remnants**

Notes: All volumes taken from Annual Water Reports.
Where necessary, volumes were calculated from tonnage using a specific gravity of 2.61.

The Environmental Site Assessment conducted by Gartner Lee in 2002 and 2003 identified the presence of residual mineralized material in the area of a previous ore stockpile at the Oceanview portal site. An estimated 5,000 m^3 of material is present covering an area of approximately 0.5 ha.

2.2.2 Open Pits

CanZinco undertook some progressive reclamation of open pits beginning in approximately 2000. This work was conducted according to the reclamation concepts that were filed with the NWB through the annual updates to the Interim Abandonment Plan as required by the Water Licence.

At the East Open Pit and Oceanview open pit, waste rock from surface rock piles has been placed into the bottom of the pits as a means of backfilling the pit to create the desired surface contours providing for positive drainage from the pit. At the East Open pit, the brow over the 39N adit was blasted down to create a safe and physically stable environment. A large portion of the backfilling requirement at the East Open Pit and Oceanview Pit was completed during the progressive reclamation program, as is further described in Section 3.

3. Characterization of Facilities

3.1 Rock Types

3.1.1 Geology

The Nanisivik sulphide deposits are hosted in carbonate rocks within a Proterozoic sedimentary sequence. This sequence developed as a Neohelikian intracratonic basin, the Borden Basin, on a peneplaned gneiss complex of Archean-Aphebian age.

The present Borden Basin sequence consists of generally shallow water clastic and carbonate sediments up to 6,100 m thick, called the Bylot Supergroup. The Supergroup is divided into three Groups, a lower clastic group (the Eqalulik Group), a middle carbonate group (the Uluksan Group) and an upper clastic group (the Nunatsiaq Group).

The Uluksan Group is made up of the lower Society Cliffs Formation and the upper Victor Bay Formation. The Society Cliffs Formation varies in thickness from 260 m at Arctic Bay to 856 m at Tremblay Sound. West of Tremblay Sound, it was deposited in a subtidal to intertidal environment. The Society Cliffs Formation is conformably overlain by the Victor Bay Formation, which consists of shales, siltstones, dolostones and coarse carbonate clastics and varies in thickness from 156 m to 735 m. The Victor Bay Formation is considered to have acted as a cap rock to mineralization in part of the mine area. All of the economic mineralization at the Nanisivik mine lies within the upper member of the Society Cliffs Formation.

The Nanisivik mine property is up to 7 km wide and up to 15 km long. Rocks cropping out on the property include small exposures of quartzite of the Adams Sound Formation on the southern edge of the lease area. The unit immediately below the Society Cliffs Formation, the Arctic Bay Formation, crops out in the area but is not exposed on the property. The main units exposed are the Society Cliffs Formation and the overlying Victor Bay Formation, together with Paleozoic sandstones of the Gallery Formation.

In the mine area, dips are usually quite shallow and the main structure is faulting. Major structures that are recognized in the mine include the South Boundary Fault, which marks the southern margin of sulphide mineralization, and the Keystone Graben Fault, which defines the southern margin of the Main Ore Zone horst.

The various massive sulphide deposits contain more than 50 million tonnes of which barren massive pyrite bodies occupy most of the area and contain the largest sulphide tonnages. Zones containing sphalerite are present within the massive pyrite bodies, but are confined to a restricted vertical interval. All of the known significant sphalerite deposits are in horsts adjacent to the Keystone Graben.

The South Boundary Zone is wedge-shaped and consists of massive pyrite. It is controlled by the South Boundary Fault. The Main Ore Zone is an elongated, sinuous, lenticular body, hosted in carbonate, with a nearly horizontal upper contact. A number of bodies are irregular subvertical veins, while some other bodies underlie gently dipping shale contacts. These variations in structural style occur both in the massive pyrite and in the sphalerite zones.

Each of the sphalerite-rich ore bodies is confined to a restricted vertical interval that varies in thickness and elevation from zone to zone. Flat sulphide contacts cut at low angles across dolostone bedding and sulphides rarely follow the beds.

The Main Zone deposit is about 3 km long. It is oriented east-west, although it is sinuous in plan. The deposit is broadly 'T' shaped, with a flat-topped upper section that is typically about 100 m wide and 20 m high. A remarkable feature of this deposit is the constant elevation of the top of the deposit over its entire length. The keel section of the deposit extends to about 80 metres below the upper section. While it is subvertical, no obvious controlling structures have been recognized to date. In places, flat-lying "wings" of sulphides extend out laterally from the keel zone.

Internal structures in the ore zones tend to be complex, and range from massive and banded to chaotic or brecciated. Banding tends to be subhorizontal in both the upper section of the Main Zone and the keel section of the deposit, but it may be parallel to dipping dolostone contacts in some areas. As well, the ore is porous in places and large irregular zones of ice are present in some faces underground.

The accepted geological model is that the Nanisivik deposits are Mississippi-Valley Type ("MVT"). By definition, these are post-depositional, carbonate hosted deposits. Typically, they are coarse-grained and mineralogically simple. They tend to be sphalerite-rich, may be very large and may contain high base metal grades. However, MVT deposits include quite diverse deposits, different in shape, grade and mineralogy. This diversity appears to result from source fluid chemistry, rocks through which the fluids pass prior to deposition, source fluid temperature and the nature of the depositional environment.

3.1.2 Rock Piles and Open Pits

These rock piles were created and utilized during the development of various ore zones. After the initial development of an ore zone, subsequently generated waste rock would be utilized in a variety of ways within the underground mine including the backfilling of the many cut and fill stopes. The rock types represented in the surface rock piles is a mixture of the various rock types encountered in the underground and open pit mines. This mixture would include a range of rock types from the host carbonaceous rock types to massive sulphide waste containing predominantly pyrite (iron sulphide) mineralization.

The open pits contain exposures of massive and disseminated sulphides (predominantly represented by pyrite mineralization) in the walls and floors. These exposures are largely discreet zones within the carbonaceous host rocks that generally form the bulk of the exposed rock.

3.2 Acid Rock Drainage Potential

3.2.1 Summary of Information

The Acid Rock Drainage ("ARD") potential of various rock types were reported on by Lorax Environmental in their report titled "Acid Generation Potential of Soil, Waste Rock and Shale" dated April 2001 (Lorax 2001). In addition to samples of tailings, shale and till that are not of direct relevance to this Plan, a total of 85 samples of waste rock from various rock piles and 18 samples of pit walls from the East and West open pits were reported on that are of direct relevance to this Plan.

All of the samples underwent acid base accounting (ABA) analysis and the summary results are listed in Table 4. In addition to the results listed in Table 4, Lorax 2001 reports specific sulphur species and carbonate-specific neutralization potential analyses that are not repeated herein.

The data listed in Table 4 is specific to the time of sampling and it is recognized that the configurations, sizes and content of the rock piles and pit wall exposures has changed since that time. However, given that the rock types mined did not change, it is considered reasonable to assume that the results, as listed, are representative of the rock piles in general even as they may have been modified over time.

Some observations and conclusions from the data listed in Table 4 that are relevant to this Plan are as follows:

1. All of the samples from all rock types and pit walls have a strong neutralizing potential (NP), which is attributed to the nature of the host rocks and which has a relatively narrow range from 215 to 893 kg $CaCO_3$/t (pH 7.0);
2. The maximum acid potential (MAP) varies widely both between sampling locations and between samples from each individual location from 6 to 1175 kg $CaCO_3$/t;
3. The net neutralization potential (NNP) and the NP:MAP ratio also vary widely, due primarily to the highly variable MAP from -960 to +762 kg $CaCO_3$/t and from 0.2 to 129.3, respectively;
4. Two of the nine sample locations (K-Baseline rock pile and 09 South rock pile) have an average NP:MAP ratio < 1 and a negative average NNP such that they would be classified as an ARD risk;
5. Two of the nine sample locations have an average NP:MAP ratio of between 1 and 3 and a weak average NP such that classification according to ARD risk is uncertain; however, each of these areas contains individual samples that would be classified as an ARD risk; and

6. Five of the nine sample locations have an average NP:MAP > 3 and a strong average NNP suggestive of an overall non-ARD risk; however, some of these sample sets contain individual samples that would be classified as an ARD risk.

Table 4. Summary Acid Base Accounting Results for Rock Piles and Open Pits

Source	No. samples	AP	NP (pH 7.0)	NNP (pH 7.0)	NP:AP
Rock Piles					
K-Baseline	8	568 (459 to 709)	442 (386 to 524)	-127 (-323 to 51)	0.8 (0.5 to 1.1)
09 South	20	502 (195 to 1175)	354 (215 to 504)	-147 (-960 to 309)	0.9 (0.2 to 2.6)
02 South	8	340 (152 to 578)	362 (276 to 438)	21 (-303 to 286)	1.4 (0.5 to 2.9)
East Adit	20	201 (7 to 497)	586 (363 to 893)	385 (-19 to 742)	6.1 (1.0 to 50.5)
West Adit Access Road	12	138 (6 to 527)	612 (435 to 768)	474 (39 to 762)	20.4 (1.1 to 129.3)
Oceanview	8	156 (58 to 265)	657 (628 to 684)	502 (365 to 626)	5.2 (2.4 to 11.7)
Area 14	9	278 (119 to 575)	608 (398 to 829)	330 (-177 to 704)	3.3 (0.7 to 6.6)
Open Pits					
East Open Pit	10	533 (341 to 962)	538 (332 to 640)	5 (-630 to 299)	1.2 (0.4 to 1.9)
West Open Pit	10	152 (55 to 292)	484 (454 to 431)	332 (188 to 475)	4.2 (1.6 to 9.6)

Notes: All units kg $CaCO_3$/t.

3.2.2 Implications for Remediation of Rock Piles

The ARD characterization data summarized above have the following implications for remediation of rock piles:

1. Two of the seven rock piles (K-Baseline and 09 South) have overall average negative NNP and NP:AP < 1 and are demonstrated as representing an ARD risk that requires mitigation for closure. These two rock piles could be considered to be of highest risk, relative to the other rock piles and pits sampled.

2. One of the seven rock piles (West Adit/02 South) has an overall average weakly positive NNP and NP:AP between 1 and 3, which are generally considered to be marginal results that fall into the area of uncertainty regarding ARD risk. Further, there are individual samples within the data set that possess a strong acid generation potential. The implications of these observations are that the West Adit/02 South rock pile is considered to represent an ARD risk that requires mitigation for closure. This rock pile could be considered to be of moderately high risk, relative to the other rock piles and pits sampled.

3. Two of the seven rock piles (East Adit and Area 14) have overall average strongly positive NNP and NP:AP >3, which is generally interpreted as non-acid generating and not requiring the implementation of ARD mitigation measures. However, these data sets each contain one or more individual samples with acid generation potential. These observations are as anticipated given the carbonaceous nature of the host rocks as mixed with mineralized waste rock from the ore zones of the various mining areas. The implication of these observations is that the East Adit and Area 14 rock piles are considered to represent an ARD risk that requires mitigation for closure. These two rock piles could be considered to be of moderate risk, relative to the other rock piles and pits and pits sampled.

4. Two of the seven rock piles (West Adit access road and Oceanview) have overall average strongly positive NNP and NP:AP >3, which is generally interpreted as non-acid generating and not requiring the implementation of ARD mitigation measures. These data sets each contain one or more samples that have marginal ARD test results (weakly positive NNP and NP:AP between 1 and 3) that fall into an area of uncertainty regarding ARD risk. It is unlikely that these piles represent a risk of acid rock drainage and mitigation measures may not be required. Nonetheless, special measures are proposed for these two rock piles that are described in Section 4. These two rock piles could be considered to be of lowest risk, relative to the other rock piles and pits and pits sampled.

3.2.3 Implications for Remediation of Open Pits

The ARD characterization data summarized above have the following implications for remediation of the open pits that were sampled:

1. The data set for the East Open Pit has a weakly positive overall average NNP and a marginal average NP:AP ratio between 1 and 3. Further, there are individual samples within the data set that possess a strong acid generation potential. The implication of these observations is that the East Open Pit is considered to represent an ARD risk that requires mitigation for closure. The East Open Pit could be considered to be of moderately high risk, relative to the other rock piles and pits sampled.

2. The data set for the West Open Pit has a strongly positive overall average NNP and an average NP:AP ratio >3. Further, there were no individual samples within the data set that presented results

that were either indicative of an ARD risk or fell within the area of uncertainty (i.e., all samples had a strong positive NNP and NP:AP > 3). This suggests that the West Open Pit does not represent an ARD risk. However, it is known that some mineralized rock is exposed in the walls of the West Open Pit and, therefore, that there may be individual areas within the West Open Pit that could represent an ARD risk. The implication of these observations is that acid rock drainage mitigation is required for discreet locations of mineralized materials. The West Open Pit could be considered to be of low risk, relative to the other rock piles and pits sampled.

3.3 Description of Rock Piles

3.3.1 K-Baseline

The K-baseline rock pile was located at the K-Baseline adit, which was used for underground mining access from 1987 to 1990. Subsequent to the completion of mining in this area, all but a "remnant" quantity of the waste rock was relocated underground such that a rock pile no longer exists. Some residual mineralized material was identified in the ESA program on surface in a previous ore stockpile area.

Run off from the K-Baseline rock pile is intermittent (i.e., there are no permanent streams in the immediate rock pile area). Runoff from this area enters Chris Creek, which is monitored for water quality prior to entry into Strathcona Sound.

The ARD test data summarized in section 3.2 demonstrates that the remnant K-Baseline rock pile is considered to be an ARD risk.

3.3.2 09 South

The 09 South rock pile is located generally outside of and adjacent to the 09 Adit to the southeast of the West Adit. The 09 adit was used for ventilation purposes and to access the main ore zone. The 09 rock pile was in use from approximately 1977 to 1980 for the storage of waste rock from proximal mining areas. From 1995 to 2002, a large portion of the waste rock that had been stored in this rock pile was relocated back into the underground mine as summarized in Table 3. The residual volume of waste rock remaining in 2003 is estimated at 7,571 m^3.

Run off from the 09 South rock pile is intermittent (i.e., there are no permanent streams in the immediate rock pile area). Runoff from this area enters Twin Lakes Creek, which is monitored for water quality prior to entry into Strathcona Sound.

The ARD test data summarized in section 3.2 demonstrates that the 09 South rock pile is considered to be an ARD risk.

3.3.3 West Adit/02 South

The West Adit/02 South rock pile is located generally outside of and adjacent to the West Open Pit at the West Adit site. The West Adit was used as the primary mine entrance throughout the life of the mine. The West Adit/02 rock pile was in use from approximately 1976 to 1979 for the storage of waste rock excavated during the initial development of the ore body. From 1995 to 2002, a large portion of the waste rock that had been stored in this rock pile was relocated back into the underground mine as summarized in Table 3. The residual volume of waste rock remaining in 2003 is estimated at 15,590 m^3.

Run off from the West Adit/02 South rock pile is intermittent (i.e., there are no permanent streams in the immediate rock pile area). Runoff from this area enters Twin Lakes Creek, which is monitored for water quality prior to entry into Strathcona Sound.

The ARD test data summarized in section 3.2 demonstrates that the West Adit/02 South rock pile is considered to be an ARD risk. It is not considered to be practical to recover all of the waste rock at this location, however due to the steepness of the slope from the West Open Pit to Twin Lakes Creek, as illustrated on Figures 3 and 4. While it would be physically possible to construct access ramps by cutting and blasting into the slope, this would have a substantial impact on the land contours and, likely, on water quality in Twin Lakes Creek via increased sediment and probable metal loads, as described further in Section 4.

The fundamental reclamation work proposed for the West Adit/02 South rock pile is relocation of waste rock into the West Open Pit for covering such that the waste rock will freeze into permafrost. However, the impracticalities, possible environmental impacts and lasting land disturbances of ensuring that the rock pile is completely reclaimed suggest that some waste rock will remain on the steep slope overlooking Twin Lakes Creek. The volume of waste rock that remains in this area after the reclamation program has recovered as much waste rock as possible into the West Open Pit is anticipated to be in the order of 1,500 m^3.

Given that the quantity of residual rock will be relatively small and likely of mixed rock type (i.e., carbonaceous host rock as well as some mineralized material), an observational approach is proposed for this residual waste rock wherein water quality in Twin Lakes Creek will be monitored and assessed for identification of any observable impacts from the residual waste rock. In this way, if the residual rock is observed to be having an impact on Twin Lakes Creek, then further remediation, including possible trail building on the steep slope and possible in-creek access, can be considered.

3.3.4 East Adit

The East Adit rock pile has also been referred to as "39N" and "39S" and is located outside of (north) of the East Open pit. "39N" is the portion of the rock dump located on the north side of the mine access road and "39S" is the portion located on the south side of the same road.

The East Adit was initially developed by a company known then as Texas Gulf Sulphur in the late 1960's and predates all other underground activity. The stockpile was created at this time but additional material was added to it a decade later, when it was decided to enlarge the old East end workings and tunnel towards the main underground mine. This connection created an alternate mine exit and facilitated the development of the Eastern portion of the main ore zone. The East Adit rock pile was in use from approximately 1967 to 1968 and again from 1979 to 1980 for the storage of waste rock excavated during development of the Eastern ore zone. From 1995 to 2002, a large portion of the waste rock that had been stored in this rock pile was relocated back into the underground mine and the East Open Pit as summarized in Table 3. The residual volume of waste rock remaining in 2003 is estimated to be 36,180 m^3.

Run off from the East Adit rock pile is intermittent (i.e., there are no permanent streams in the immediate rock pile area). Runoff from this area flows to the East Adit treatment facility where, during mine operations, the water combined from several source areas was treated with lime on an as-required basis for metals removal prior to release to Chris Creek. The treatment facility is proposed to be operated on an as-required, contingency basis through the mine reclamation period also. Water quality at the inflow and outflow from the treatment facility will be monitored.

The ARD test data summarized in section 3.2 demonstrates that the East Adit rock pile has an overall average strongly positive NNP and NP:AP >3, which is generally interpreted as non-acid generating and not requiring the implementation of ARD mitigation measures. However, the data set contains one or more individual samples with acid generation potential the rock pile is considered to represent an ARD risk that does require mitigation.

3.3.5 West Adit Access Road

The West Adit Access Road, from the Industrial Complex to the 09 adit was constructed of a mixture of rock types including shale and waste rock. The volume of rock in this road is estimated to be 30,000 m^3.

Run off from the West Adit Access Road is intermittent (i.e., there are no permanent streams in the immediate rock pile area). Runoff from this area enters Twin Lakes Creek, which is monitored for water quality prior to entry into Strathcona Sound.