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DEPARTMENT OF JUSTICE
MINISTÈRE DE LA JUSTICE

Our file: 7700-160

July 5, 2002

Mr. Thomas Kudloo
Chairman
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
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Nunavut Water Board

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Dear Mr. Kudloo

Re: <u>License Application & Plan for Reclamation (2002)</u>
<u>Nanisivik Mine - No. NWB1NAN9702</u>

On behalf of the Government of Nunavut, I am pleased to transmit to the Nunavut Water Board a consolidated submission, in preparation for the Public Hearing on a License Application and Plan for Reclamation for the Nanisivik Mine (2002), filed by CanZinco Ltd.

Along with representatives from the Departments of Sustainable Development, and Health, among others, I also intend to be present at the Public Hearing scheduled to begin on July 22nd 2002 in Arctic Bay. We hope our effort to develop a single written submission including all of these Government of Nunavut perspectives, will assist the Board and other participants in the hearing.

Please feel free to contact me personally, concerning any matter related to the closure, the proposed hearing or our enclosed submission.

Sincerely,

Susan Hardy
Legal Counsel
Legal and Constitutional Law Division

Encl.

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PUBLIC HEARING SUBMISSION TO THE

NUNAVUT WATER BOARD

ON THE APPLICATION BY

CANZINCO LTD.

FOR A WATER LICENSE, AND

FOR APPROVAL OF THEIR CLOSURE AND RECLAMATION PLAN

GOVERNMENT OF NUNAVUT

JULY 2002

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Schedules

1. Introduction

This is the first Nunavut Water Board (NWB) proceeding concerning the Nanisivik Mine, in which the Government of Nunavut (GN) has had the privilege to play a role. Given the pre-hearing request for better information about government roles,[1] it is appropriate in our view to preface our formal submissions to the public hearing with some comments clarifying our understanding of,

- the history of mine ownership and operation,
- the government mandates and the interests involved including those of our various Departments, and
- how the GN stands to be impacted by the Board's decision.

Ownership/Operation: CanZinco Ltd., a wholly owned subsidiary of Breakwater Resources Ltd, has owned and operated the Nanisivik Mine since late 1997. Previous owner/operators include:

- Breakwater Resources Ltd, (January 1997 through late 1997);
- Through December 1996, Nanisivik Mines Ltd, a subsidiary of Encana West Ltd; and
- Mineral Resources International Limited (1972 – 4?), now Encana West Ltd.

Productive mining commenced in 1976. This was made possible by a joint-operating agreement, the "*Strathcona Agreement*", signed June 18th 1974, between the federal Crown, and Mineral Resources International Limited. From 1976 through 2000, the mine produced and milled an average 104,753 tonnes of zinc concentrate annually, and a lesser amount of lead and other metals.

In October 2001, CanZinco Ltd. announced the permanent closure of productive operations, to be implemented by September 30th, 2002. Depletion of ore reserves, and declines in the price of zinc were cited as the cause, and have reportedly persisted since the closure announcement. Consequently, this License application relates only to post-closure activities, such as reclamation, generally involving a much-reduced staff at the site.

Core Federal Government Involvement: The federal Crown is the government Party to the *Strathcona Agreement* of 1974. The territorial government is not a Party, and we are aware of no federal-territorial agreements with respect to the mine.

To our understanding, the mine is currently operated pursuant to DIAND land leases, subsurface mineral leases, and the 1997 NWB water license.[2] The current water license

[1] NWB Document, "Community Issues for the Pre-Hearing", June 6, 2002. This document was recorded June 5th, 2002 and read by Phillipe di Pizzo to open the pre-hearing on June 6th, 2002 in Arctic Bay.

[2] We note in addition, s. 25 of the *Strathcona Agreement*, if implemented, guaranteed Canada a minority interest in Nanisivik Mines Ltd., and a place on the mine's Board of Directors, though Canada may not be exercising those rights. Also, Canada obviously has a variety of other federal legislation that could

requires security of $6 million to be in place by September 2002, based on estimates of approximately $9M reclamation expense in the 1996 NWB hearing. It also includes research and reporting requirements, and a variety of pollution control measures, which will be more fully canvassed in the body of this submission.

Canada (Coast Guard) also operates a Public Harbour[3] near Nanisivik and administers landholdings where CanZinco's Zinc and Lead concentrate and other assets are stored in various CanZinco facilities, and shipped out annually.

Core Territorial Government Involvement: Nunavut was established April 1st, 1999 as the result of the *Nunavut Land Claim Agreement (NLCA)*, and federal implementation measures including the *Nunavut Act*. Prior to April 1st 1999, the Northwest Territories was responsible for territorial administration and intergovernmental arrangements respecting the mine. We are assured by DIAND, that one or more bulk land transfers were approved by Order-in-Council during the 1970's, including the residential area occupied by mine operators, and also certain above ground mine infrastructure, and mine-impacted land.

Since the 1970's, the general area of the Mine has been designated a "Development Area" pursuant to the *Area Development Act*. The Nanisivik-Arctic Bay Road, Nanisivik Airport Road, and Nanisivik Dock Road are administered by the GN, under the *Public Highways Act*. [4]

Major mine facilities located on GN-administered land include,

- The mill site,
- The former STOL Port runway,
- The residential area (houses, apartments, carpentry shop, dome…), and
- The mine also holds GN leases for a parcel of land beside the West Twin Lake tailings area, and rights-of-way for tailings pipes.[5]

GN and Departmental Mandates: With respect to closure and clean-up of Mine facilities and sites, generally:

- Since the closure announcement, GN has advocated community consultation and multi-agency cooperation, to ensure coordinated and effective response from the perspective of Nunavummiut, and the residents of Arctic Bay; and

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be brought to bear in appropriate circumstances, including but not limited to the *Fisheries Act* and Regulations, the *Canada Marine Act (Part II)*, and the *Arctic Waters Pollution Prevention Act.*

[3] *Public Harbours Regulations*, (made pursuant to ss. 104 (1) of the *Canada Marine Act*), Schd. III.

[4] *Highway Designation and Classification Regulations* (R - 047-92)

[5] We hope to assist the Board to update certain misstatements about "ownership" in the Closure and Reclamation Plan filed February 2002, by providing some detail regarding our GN understanding with Mine managers respecting their title to or reclamation liability for various assets in **Schedule A.**

- GN is also exploring with the mine and other entities, future uses of the Nanisivik site that may sustain the economic health of Arctic Bay, and improve the long-term legacy that Nanisivik will have contributed to their host community.

All activities of this nature fall under GN's general public mandate to minimize adverse impacts of many kinds, resulting from this mine closure. Schedule "B" of this submission provides a listing of GN initiatives and studies taken under this general mandate.

For NWB purposes impacts on water are most important. In this narrower area,

- The *Strathcona Agreement*, protects territorial government interests by giving the GN "Commissioner" approval authority concerning proposed reclamation, and certain other closure issues;[6]

- In addition, the approval of specific GN Departments is required for certain activities or conditions, including a number which overlap with NWB's jurisdiction concerning mine impacts on water, as shown below.

Agency	Authority Exercised
Community Government and Transportation	Approval required for reclamation as required in connection with GN Leases, Quarry Permits, etc....
Sustainable Development - Environmental Protection & Wildlife	To avoid prosecution, abandonment and reclamation measures on Commissioner's Land, which are not authorized by the Water License, must satisfy the requirements of the Nunavut *Environmental Protection Act*. An approval is also required concerning adverse effects on wildlife as the result of the mine's operation and closure: *Nunavut Wildlife Act.*
Health & Social Services	Approval is required to ensure public health and safety: *Public Health Act* and regulations, including the Sanitation Regulations and Water Supply Regulations.

[6] Ss. 24 (2) reads: *In the event of the permanent closure of the mine it shall be the responsibility of the Company:*

(a) to dispose of materials, equipment and buildings, including housing, under its ownership or title, within a time period, and in a manner, satisfactory to the Minister and the Commissioner,

(b) to submit to the appropriate government agencies plans and schedules for the abandonment, clean-up and restoration of the site. The abandonment, clean up and restoration shall be undertaken in a manner socially, aesthetically and environmentally acceptable to the government agencies concerned ...

(d) to retire fully any outstanding portions of loans, outstanding user-charges and other debts payable to Her Majesty and chargeable to the project.

Anticipated Impacts of the Board's Decision and License: As outlined, GN's administrative mandate meets or overlaps with the Board's authority, and particularly its authority relating to reclamation, in a number of areas. GN regulators hope to avoid, through effective participation in this hearing, the potential for future differences between federal and territorial reclamation requirements, from the perspective of the Applicant.

In addition, the Board must assess and determine an appropriate response concerning the financial responsibility of the Applicant.[7] This is of the utmost significance to Arctic Bay and Nunavut as a whole. As more fully canvassed in Section 3. ii) b) of this submission, perhaps the most significant GN concern in this area, is that our inherited legislation does not authorize territorial reclamation security in these listed areas.

There is no doubt that a failure of proposed reclamation measures, even through insolvency or default, could cause inestimable harm. Given that the majority of land in the area local to the mine is alleged to be Commissioners' Land, the GN has a core interest and duty to Nunavummiut to contribute with all means at our disposal in the interest of an NWB hearing that is thorough, and that ensures the Board issues its decision and license conditions only after being satisfied that an acceptable environmental quality will be achieved, and that the Applicant's financial responsibility is fully assured.

Our submission follows. In many technical areas, GN's internal review of the Closure and Reclamation Plan was supplemented by an analysis from EBA Engineering Consultants Ltd., of Yellowknife, NWT. We understand that DIAND will be formally submitting the EBA Report.

2. GN Review of Closure and Reclamation Plan

i) General Comments

The burden of proof in this hearing rests with CanZinco, with respect to two issues: i) whether and with what specific measures the Applicant can restore an acceptable level of environmental quality, and ii) whether there are terms and conditions available to the Board, which are sufficient to ensure the Applicant's financial responsibility for the proposed reclamation. This part of our submission addresses the first issue, and whether the Applicant can restore an acceptable level of environmental quality, based on the Closure and Reclamation Plan presented to the Nunavut Water Board in February 2002, (the " Reclamation Plan").

The Reclamation Plan does canvass the majority of the areas impacted by mine operations over the years; however, the lack of detailed information about proposed measures to clean up or contain mine waste and contamination, or their likelihood of success, makes this Reclamation Plan non-compliant with Part H of the current water license, and generally inadequate as a basis to provide or withhold required GN approval or commentary. In our view, the Reclamation

[7] *Nunavut Waters and Surface Rights Tribunal Act*, ss. 57.

Plan as it stands now is also insufficient to ensure that an acceptable environmental quality will be restored or maintained by the Applicant.

In our submission, it is important at this final stage in the life of the mine that the NWB impose specific requirements for a Remediation Plan with specific end-points, time lines, criteria, monitoring to confirm compliance with those criteria, and corrective action where non-compliance is detected.

To achieve this level of detail, a number of studies must be completed, including the environmental site assessment, the health risk assessment, and the soil quality remediation objectives. As outlined in our specific comments, there is also a need for additional information about several proposed reclamation measures.

Because the Reclamation Plan is not yet capable of evaluation, GN must reserve the right to comment or provide required approvals either at the hearing, or such later time as the necessary information is provided for our review. GN also reserves the right to seek additional advice or expertise concerning any new studies, information, or proposals presented to the Board.

ii) Specific Comments

GN has listed a number of concerns below, generally by geographic location or "facility" affected. Without addressing these concerns we do not believe this Reclamation Plan can satisfy a reasonable person that an acceptable environmental quality will, with certainty, be achieved.

1. WEST TWIN LAKE DISPOSAL AREA

Tailings Cover & Containment

The West Twin Lake disposal area is located adjacent to a Commissioners Land Lease, and tailings disposal by the Applicant appears to have run over onto territorial land well before CanZinco or the GN arrived on the scene. In this tailings disposal area generally, the Reclamation Plan proposes to cap the surface cell and test cell with a cover of 1.0m of shale and 0.25m of sand and gravel.[8] The shale portion of the cover is intended to provide thermal insulation and confirmed to be acid consuming[9], but of poor durability.[10] The sand and gravel cover offers the cap an increased durability and a preferable albedo, (meaning light colour to reflect the sun).[3,11]

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[8] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 32 (6.2.7)
[9] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 17 (5.2.5)
[10] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 34 (7.1)
[11] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 13

The Reclamation Plan maintains that this cover will allow permafrost to aggregate and encapsulate the tailings provided the active layer is never deeper than 0.9m beneath the grounds surface.[12]

The adequacy of this proposed depth of cover seems insufficient. To avoid a risk of pollution through their accidental release into the environment, tailings should be maintained in a frozen state. If not, their long-term chemical stability and confinement is not assured.

We tentatively recommend an increased cover thickness, to provide greater assurance against unacceptable risk. The effectiveness of the proposed containment method relies on the ability to ensure the stability of the permafrost. The following concerns have lead to this recommendation:

- Based on the Mine's own surface cell testing and modelling, under the assumption of a 5.5 ^{O}C temperature increase due to **climate change** over the next 100 years, anticipated the active layer to migrate to a depth of 1.25m.[13]

- **Annual seasonal variation** would also warrant a thicker cap to account for occaisional warm years. The thickness should also consider variations related to cover material, tailings properties, and surface properties.[14]

- The Reclamation Plan also raises the **chemical stability** of the tailings as an issue of concern. We are independently advised that a heat-producing oxidation reaction could occur because of high level of sulfides (Pyrite) in the tailings. The Reclamation Plan indicates that this heat will likely dissipate quickly with respect to the energy required to melt the pore ice.[15,16] The current quantitative examination of heat dissipation and the energy generation through oxidation required to melt the pore ice would confirm these assumptions.[17] Study results confirming this assumption must be reviewed before the necessary cover thickness can be fully and finally assessed.

- Another issue that relates to **pore water chemistry** and the potential impact on the proposed thickness of the tailings is the potential for freezing point depression. Freezing point depression occurs as the result of increased conductivity, when there is an elevated level of ionization in water. (e.g. the use of salt in the winter to thaw ice from the roads). EBA indicates that pore water that is associated with high levels of sulfur, like that in these tailings, could be expected to have elevated conductivities. If this occurs then the active layer would be extended deeper, beyond the proposed zone

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[12] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell*. p. 31 (6.2.5)
[13] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell*. p. 32 (6.2.6)
[14] EBA Engineering Consultants Ltd. (2002) *Review of Nanisivik (CanZinco) Abandonment and Restoration Plan*. p.8.
[15] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 41 (6.1.1)
[16] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell*. p. 17 (5.2.5)
[17] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 55 (8.5)

where temperatures read at or above 0 ^{O}C. Study results evaluating whether elevated ionization levels occur, or are sufficient to impact the integrity of the permafrost must be reviewed before the necessary cover thickness can be fully and finally assessed.

- **Frost heaving** may warrant an increase in the proposed thickness of the cover. The Reclamation Plan provides information on the environmental baseline for the site. One such study mentions that dry ridge ground cover dominates the mine area, stating:

  "the ground surface commonly showed evidence of frost heaving".[18]

  In the Reclamation Plan another report, this time from BGC on the spillway, states:

  "The review of the soils within the WT dike area and their relative susceptibility to frost heaving revealed that the susceptibility was higher for the lake bed sediments, moderate to high for the tailings and low for the shale rock fill."[19]

  These two reports mention that there is the potential for frost heaving to occur at the mine site with material that could be comparable to that proposed as guard material. In light of those findings, the impact of frost heaving is of obvious concern as it could compromise the effectiveness of cover material. Study results evaluating the impact of frost heaving must be reviewed before the necessary cover thickness can be fully and finally assessed.

- **Drainage and erosion impacts** were considered in the Reclamation Plan for the cover, and spillway. The Reclamation Plan proposes an armoring layer in the cover to minimize mitigate these effects; however, the topography appears to concentrate flow along several linear features, and the flat grade of the structure may cause shallow water ponds that could compromise the permafrost. The potential for adverse impacts from erosion and pooling must be addressed and considered in the design of the cover, and may require additional further study.

- **Potential impacts from human activity** should also be considered. Residents of Arctic Bay who have used the Nanisivik area since before the Mine was established will likely visit the site.[20] It does not appear that the cover was designed to prevent this kind of impacts, (e.g. ATV and skidoo traffic, camp activities, etc.) The potential for adverse impacts from human activity must be addressed, and may require additional further study if cover-design responses are proposed.

- The fact that **the Reclamation Plan relies entirely on the neutralizing potential of shale cover to prevent the release of heavy metal seepage** is of concern. The shale will help mitigate the impact of seepage through capping material, but there is a lack of evidence provided in the Reclamation Plan to show that this protection will be adequate, without some other additional barrier. The EBA study notes that gypsum is forming on the exterior of the dyke, confirming the occurrence and neutralization of seepage

[18] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan.* v.1 p.3-9
[19] BGC Engineering Inc. (2002) *Preliminary Design of The West Twin Dike Spillway.* p.6
[20] Nunavut Water Board (June 5, 2002) *Nanisivik Pre-Hearing Conference-Minutes.* (Draft) p. 3

through the dyke. The sufficiency of shale cover as the sole response to seepage requires additional study, and possibly a back-up plan.

Ensuring the stability of the permafrost will not only reduce oxygen availability and favorable conditions for reduced reactivity, but the stability of the permafrost is also critical to ensuring the stability of the dyke.[21] For all of these listed reasons we would like CanZinco Ltd. to reappraise the adequacy of the proposed cover.

Overall, it seems that the standard to which mine reclamation must adhere, at least as a baseline, is found in the newly released *Metal Mining Effluent Regulations*, P.C. 2002 – 987. Section 73 of the *Nunavut Water and Surface Rights Tribunal Act* states that conditions relating to the deposit of waste in water must be "at least as stringent" as the conditions prescribed in new regulations.

Dyke Stability

The West Twin Dyke is a frozen core dyke that has been constructed through annual upstream lifts of ~2m with a current height of 18m.[22] The toe of the dyke has been reinforced to ensure long-term stability and an ongoing monitoring program is used to assess this stability. Analysis of the dyke's stability was conducted in 2000. These included: "rigid-block" sliding along the base of the dyke, slope stability analyses, and creep failure.

A 2002 assessment of the seismic stability of the dyke, mentioned that dyke has not been evaluated to withstand ground motions associated with the Maximum Design Earthquake (MDE) without release to the reservoir. This is a requirement of the Canadian Dam Safety Standards[23]. In addition additional studies are required to confirm long-term stability. These include

- the unknown potential of seismic induced liquefaction and associated risks, and
- assessment of the friction angle of the tailings and shale to confirm the assumption made in the stability analysis.

Study results confirming the long-term stability of the dyke must be reviewed and approved in light of the core significance of dyke stability in this Reclamation Plan.

Spillway

The spillway is a channel for surface water, intended to protect the dyke from erosion due to seasonal runoff or severe storms, by conveying water safely around the dyke.[24,25] This

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[21] BGC Engineering Inc. (2002) *Pseudostatic Analysis for Seismic Stability of West Twin Lake Dyke (Project Memorandum)*. p.3

[22] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 9 (3.5)

[23] Canadian Dam Safety Guidelines, (January 1999).

[24] BGC Engineering Inc. (2002) Preiliminary Design of the West Twin Dike Spillway for Closure. p. 6.(2.5).

Reclamation Plan proposes the construction of a 450 - 600m long trench that is 6m wide and as much as 10m deep.[26,27] The construction will involve excavation into permafrost and solid rock, which will likely require maintenance over subsequent years. In reviewing the available information EBA has estimated that stabilization could take as long as five years. Studies, monitoring or other mechanisms must be added to the Reclamation Plan to deal with any issues or defects that appear during the stabilization period, including a need for ongoing upkeep. The Reclamation Plan should also include studies assessing whether the spillway will at some point be able to function on its own without ongoing maintenance.

Test Cell

The Reclamation Plan proposes to leave a breach in the test cell to facilitate drainage and minimize the potential for water to pool on the surface of the cover.[28,29] The Reclamation Plan needs further development of the reclamation proposed for the test cell. This should include but is not limited to the proposed thickness of cover material, the specific composition of the cover, the 4m high (tailing/shale dyke), and the monitoring of these measures, which will be required to ensure that containment is successful.

Reservoir

The Reclamation Plan indicates that the reservoir will remain after the site has been decommissioned, and proposes to maintain the stability of the sub-aqueous tailing with of a constant 1m water cover intended to prevent the tailings from contact with oxygen.[30] Maintaining tailings under water is a common practice, however, it is important to ensure that the water is deep enough to limit oxygen availability. Based on EBA's analysis, there is a risk of resuspension of the tailings, and exposure to oxygen, due to high wind and waves.[31] GN must recommend a deeper water cover, or in the alternative that studies be carried out to asses whether 1m of water cover, or some deeper level of water cover, will be effective in containing the tailings. Further, the potential subsurface flow between the WTDA and East Twin Lake should be assessed in the evaluation of an appropriate depth for the water cover.[32] In this case the GN's recommendations are considered crucial for reasons of public health, as well as water or environmental quality.

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[25] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1 p.6-2
[26] Golder Associates. (2002) *Hydrological study Nansivik Spillway Design*. p. 14
[27] EBA Engineering Consultants Ltd. (2002) *Review of Nanisivik (CanZinco) Abandonment and Restoration Plan*. p.14
[28] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 10 (3.5)
[29] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1 p.6-2
[30] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1 p.6-2
[31] EBA Engineering Consultants Ltd. (2002) *Review of Nanisivik (CanZinco) Abandonment and Restoration Plan*. p.10.
[32] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 9 (3.5)

Control Structure, Polishing Pond, & Decant Structure

These structures will regulate the flow of water from the reservoir into Twin Lakes Creek. The Reclamation Plan proposes to remove the culvert and stop logs that presently regulate the flow of water from the reservoir to the polishing pond, to excavate the sediment from the polishing pond and place it in the surface cell, and to remove the decant structure.[33] The Reclamation Plan should provide more detail indicating how the water level will be maintained at the required depth following the removal of the decant structure. We are particularly interested to know

- Is there a need for additional armoring or an engineered structure to minimize erosion?
- Where will CanZinco put the structures or material that will be removed?
- What is the present state of the sediment from the polishing pond prior to incorporation of the material in the surface cell, and does it require treatment of any kind?

2. PIPELINES

The legal right-of-way for tailings pipelines operated by the Applicant, was established by and is subject to a Commissioners Land Lease. Two West Twin Pipelines are involved: one transfers water and tailings from the mill to the tailings disposal area, and the other transfers reclaim water from the reservoir to the mill. The reclaim water pipeline is 3150 metres in length and the tailings pipeline can be up to 4000 metres long, depending where the tailings are placed. A four metre wide, gravel right of way was constructed as a base, along the complete length of these pipelines.

The Reclamation Plan proposes to remove everything to do with the pipelines. Items not sold, or removed off site, will be disposed in the underground workings. The built up portion of the roadway will be scarified (i.e. broken and loosened up) and contoured, or breached to return to natural drainage patterns.

The tailings disposal system includes two dump ponds, one below the mill and another east of the town site, along the roadway. These ponds were used to drain sections of the tailings pipeline during emergency shutdowns and maintenance operations. Each pond is approximately 10 metres by 30 metres in area, surrounded by gravel berms about 1.5 to 2 metres high and lined with impermeable Hypolon liners. For closure, the pond liners and any accumulated sediment (contaminated soils) will be disposed of in the underground workings and the gravel berms then graded and contoured to prevent water pooling.

More detail is needed concerning the condition, volume, and destination of equipment anticipated to remain aboveground, and volumes of material and equipment expected to be disposed underground. This is discussed further under section titled "Mined Areas".

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[33] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1 p.6-2,3

It is anticipated that areas along the pipeline right of way have been subjected to tailings spills on occasion over the mine life. Given the potential for Acid Rock Drainage (ARD), it is necessary to assess the potential for ARD along the pipeline right of way, including the dump pond areas, and where the potential is high, the Reclamation Plan should include an estimation of volume and appropriate disposal methods for the contaminated material.

3. LAND FILL

Cover and Contents

The proposed use of 1.25m of shale as the cover material at the landfill has raised a number of concerns as it has a relatively low level of durability, the highest susceptibility to erosion of evaluated cover material, and an unfavorable albedo.[34,35] These factors that need to be taken into account in designing the landfill cover as had been for the design of the tailings cover.

For the GN, a most compelling concern involves the material in the landfill, as it could be at least as important as the tailings or even of greater concern given the uncertainty of its contents. The Government of Nunavut is intensely concerned about the specific contents of the landfill, accumulated since the 1970's and how it may best be remediated consistent with territorial environmental and public health legislation and required approvals.[36] An estimated 2000 drums of waste oil are on record as having been buried there, and there may be other unknown materials.[37] The Reclamation Plan currently proposes to cover the landfill and add an additional 1.25m of shale, to induce permafrost freezing within the waste and the base cover material. The cover will be contoured to prevent erosion.[38] "Run off diversion ditches around the landfill area will be upgraded such that the diversion of the water around the landfill area will be maximized."[39]

It is impossible to say whether the proposed containment is adequate, until we know what materials are likely in the landfill, and where. EBA advises us that a gradiometer geophysical survey with some excavation and thermal modeling of the site would assist regulators to determine whether the proposed method of reclamation is adequate. The gradiometer geophysical survey would indicate the edges of the landfill and potential locations of waste oil drums. Excavation would assess the condition of the drums, and soil samples would evaluate potential soil contamination levels. The thermal modeling of the site would provide better information about the permafrost conditions at the landfill in light of its present contents, which will assist in the design of an appropriate cover.

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[34] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 11 (5.1.1)
[35] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell.* p. 34 (7.1)
[36] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p. 12 (3.8)
[37] UMA Engineering Ltd. (1998) *GNWT – RWED Nanisvik Mine Operations Literature Review.* p.4-15
[38] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan.* v.1 p.6-4
[39] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p. 44 (6.4)

Further, efforts could be made to assess the potential contents of the landfill through a detailed breakdown of the waste stream. Additional information related to the prior location of incinerators, if any, at the landfill would also be of value. EBA advises us that the identification and collection of surface water and leachate samples (if present) would be of assistance. From our perspective the assessment should address the broad range of potential contaminants that might be contained in the landfill. (e.g. hydrocarbons, heavy metals, polychlorinated biphenyls, glycol, etc.)[40]

The Phase 2 assessment has not given appropriate weight to these issues, in our view. GN sees the development of an effective knowledge base, containment of contamination, and follow-up measures at the landfill as a critical aspect of the overall Reclamation Plan, warranting a level of concern and remediation response at least equal to that being received by contamination from tailings.[41]

The Reclamation Plan should use the information derived from these studies to assess the risks and benefits associated with the containment of unknown quantities of unknown substances under an engineered cover against at least one other alternative: the excavation and removal of hazardous materials from the landfill.

Land Farm

The land farm contains hydrocarbon-contaminated soil from a diesel spill at the carpenter shop in 2000. The land farm consists of an earthen cell (presumably shale) that was fitted with a geotextile liner to contain the contaminated soil.[42] The Reclamation Plan proposes to dispose of this soil underground.

The Reclamation Plan has not completely addressed reclamation requirements at the land farm. Required details from an environmental and public health perspective include the location of the hydrocarbon contaminated soil within the mine, any special measures to be taken in its storage, the proposal for disposition of the geotextile liner, and sampling should be undertaken to assess potential contamination of the cell material. If the cell material is contaminated the Reclamation Plan should address its contouring, remediation, or disposition in detail.

4. MINED AREAS

In addition to the Main underground mine, several satellite areas (Ocean View, K-Baseline and Area 14) have operated during the life of the mine. In the Main Ore Body there are eight (8) openings to the underground workings. There are also portals to the Ocean View, K-Baseline

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[40] EBA Engineering Consultants Ltd. (2002) *Review of Nanisivik (CanZinco) Abandonment and Restoration Plan*. p.12

[41] EBA Engineering Consultants Ltd. (2002) *Review of Nanisivik (CanZinco) Abandonment and Restoration Plan*. p.13

[42] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 12 (3.8)

and Area 14 workings and a ventilation raise at Ocean View.[43,44] The GN agrees with the NWB's requirement for better descriptions and mapping of these areas to assist parties reviewing or implementing the Reclamation Plan.

The Reclamation Plan includes removal of support culverts in three of the portals and then all portals would be buried with an inert cover and contoured to the local topography. Raises will be sealed. The Reclamation Plan includes disposal of waste material and equipment in the underground workings prior to the mine entrance being permanently closed.

The Reclamation Plan relies heavily on the use of mine workings as a permanent disposal site for a wide variety of waste material and equipment. This is based on the concept that the underground permafrost conditions are suitable for permanent disposal for contaminated soil, sediment from lime treatment process, demolition debris, equipment and other non-hazardous material. However, there is no detail outlining the volume of material to be disposed of underground or that sufficient storage space is available.

In conjunction with the volumes of waste material is the type of material to be disposed underground. The proposed Reclamation Plan includes disposal of decontaminated, non-hazardous solid waste material (mill and mine equipment, mobile equipment and building materials), infrastructure demolition debris, and soils containing residual hydrocarbons.

Given the reliance on the permanent disposal of material underground, a critical component will be a Reclamation Plan, or strategy, that outlines the volume and type of material to be permanently disposed of underground, and demonstrates that the required storage space is available.[45] The Reclamation Plan may also benefit by including more detailed disposal and/or segregation proposals for certain waste materials or equipment that require special handling and containment, even underground.

The final design and contour of the closed portals and sealed raises also require clarification. It is proposed that the opening will be plugged with waste rock, however, there is no details on the volume, placement, or stability of this material. Additional information on the condition of the underground openings and an evaluation of their stability is required before the GN can comment on this closure method.

Finally, as the Board also noted, the Reclamation Plan has not addressed whether there is a need for long-term monitoring of stability, ground subsidence, other monitoring measures that could provide better assurance that the Reclamation Plan will result in a stable and acceptable environmental quality.

5. OPEN PITS AND TREATMENT FACILITY

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[43] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p. 13 (3.10)

[44] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan.* v.1 p.6-4

[45] EBA Engineering Consultants Ltd. (2002) Review of Nanisivik (CanZinco)Abandonment and Restoration Plan, p. 5

There are three open pits on-site: West Open Pit, East Open Pit and Ocean View Open Pit. Associated with the East Open Pit is the East Adit Lime Treatment Facility, used to treat runoff in the area, as required, through the summer season during freshet or a rainfall.

The Reclamation Plan proposes that the open pits be filled with potentially acid generating material, covered, and the surface contoured to prevent pooling and conform to local topography[46]. This information is inadequate and raises several issues of concern:

- First, the slope **stability** of the pit walls and the stability of the proposed fill and contour plan. Detailed designs of pit in-fill and cover are needed to identify the volume and type of material to be placed in the pit and how it will be placed.

- **Water Drainage** should also be assessed to ensure no pooling of surface water, however, there is no information provided on drainage around or into the pit, through the in-filled material. Detailed designs should be proposed, incorporating an outline of the potential drainage in the area of the closed pits.

- The Reclamation Plan suggests that backfill material will include adjacent borrow, demolition debris from the industrial site, and waste rock. There is no explanation about the volume of each material, or how it will be placed in the open pits. The **placement of acid generating material** in the pit, or its exposure on a pit wall, could lead to Acid Rock Drainage at the pit sites. A revised plan, with a follow-up sampling and monitoring program is recommended, to ensure no acid generating conditions.

From GN's perspective as a land administrator adjacent to these sites, containment measures and the reduction of risks due to escaping contaminants are of serious concern.

The Reclamation Plan also proposes to dispose of sludge generated by the East Adit Treatment Facility underground in the mine. It is not clear whether or not the sludge will require physical or chemical stabilization before disposal. This should also be addressed in greater detail.

6. WASTE ROCK STORAGE AREAS

Waste rock generated by historic mine activities has been stored on surface in piles located at 02 South Portal, 09 South Portal, 39 North Portal, Area 14, K-Baseline and Ocean View. Currently, all waste rock produced is utilized as pillar support and backfill.

The general concept of the Reclamation Plan is to recover and use waste rock in the piles to support current underground backfill practices. Waste rock not used underground will either be used in the reclamation of the open pits or left in place and covered.

The Reclamation Plan relies heavily on the use of mine workings as a permanent disposal site for a wide variety of waste material and equipment, including waste rock. Gartner Lee recommended estimating the volume and schedule for waste rock disposal in order that

[46] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1, p. 6-5

sufficient space underground is available and a haul plan is in place[47]. We suggest that the geochemistry of the waste rock piles be considered in the haul schedule in order that the piles with a higher potential for acidic drainage are given priority for underground disposal.

In conjunction with this haul and disposal plan, there will also be the need for a map of areas left on surface that will either require capping and covering or use in the open pit reclamation. No detail is provided on the design of the caps, although it is proposed that shale be used to cap the waste rock piles and permafrost conditions will develop. As stated in previous sections, use of the shale and thickness of the permafrost active layer is an issue that will require clarification.

It is further recommended that a monitoring program for surface waste rock material be implemented to ensure that ARD potential predictions are correct (i.e. waste classified as non acid generating becoming acid generating over time due to internal geochemical reactions). This program would also ensure the successful design and construction of the caps and covers.

Stock Pads

The ore stockpile pads are adjacent to the portals at Area 14, K-Baseline and Ocean View and was used to store ore, during the mining of these satellite areas, until it was hauled by truck to the underground crushing facilities.

The Reclamation Plan proposes that any sulphidic material remaining on the stockpile pad will be removed and disposed underground. It is recommended that a monitoring program be implemented to ensure that all of this material is disposed of properly.

Roadbeds

Within the Reclamation Plan, service roads that are identified as the responsibility of the mine include the road from the mill to the East Adit, K-Baseline, Ocean View and Area 14. Portions of the road near 02 South, 09 South and the East Open Pit were constructed with mine waste.[48] Additional work by Lorax (2001) identified a variable geochemistry in the roadbeds that results in variable acid-generating potential. Although most of the samples were classified as non-acid generating, there were some samples that exhibited a potential for ARD.

The Reclamation Plan includes continued sampling of the roadbed areas and those areas noted as contaminated would be excavated and disposed of underground. Elsewhere, the roadbeds would be contoured and breeched to ensure natural drainage. All culverts removed.

It is unclear at this time what roadbeds, culverts, and pipelines are included under this proposed sampling and closure activity and this will need to be clarified. It is also necessary to outline the program that will in place during closure of the roadways to ensure the contaminated areas are completed removed and disposed of.

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[47] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p. 55 (8.3)

[48] Gartner lee report, p.6-8

It is anticipated that areas along the road right of way have been subjected to spills on occasion over the mine life. It is important to clarify what is meant by contaminant in this section; for example, it may include hydrocarbon products, ore, waste rock material, reagents. Each of these contaminants requires special handling and disposal methods. It is suggested that the road right of way be assessed for potential contaminated sites, volumes estimated and disposal method presented.

Of other concern is the material the road is constructed from, namely waste rock that may have a potential for ARD on a local scale. Given this concern, it is necessary to assess the potential of ARD along the right of way, and where the potential is high, the Reclamation Plan should include an estimation of volume and appropriate disposal methods for this identified material. If capping of the roadbed is proposed, it is important to provide detail on the design of the cap and cover.

7. STOLPORT

The land where mine operators once operated a STOLPort facility, are subject to a Commissioners Land Lease. Reclamation requirements of the lease have not been confirmed discharged, nor has there been any termination. The Reclamation Plan proposes to reclaim the stolport by removing the lights from the runway.[49] The mine should extend the scope of the proposed phase II environmental site assessment to include sampling of the STOLPort area, to determine the need for further reclamation of potential spills related to the storage and use of fuel. There might also be a need for a general clean up of debris that the Reclamation Plan should address.

8. MINING FACILITIES & RELATED INFRASTRUCTURE

The Mill and a large yard area extending on both sides of the Nanisivik Dock road, some of the most heavily trafficked areas of high industrial activity proposed for reclamation, are subject to a Commissioners Land Lease. The Reclamation Plan proposes to reclaim the mining facilities and related infrastructure by salvaging equipment for use elsewhere or for sale. The remaining facilities and infrastructure will be demolished and placement underground. The foundations of these building are to be covered by overburdern/soil.[50]

The proposed method of reclaiming these facilities appears reasonable, providing sufficient volume exists in the in the mine.[51] The Reclamation Plan identifies the west open pit as an area that might be utilized used as a repository for debris from the industrial complex.[52] If the west

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[49] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*. v.1, p. 6-13
[50] REFERENCE
[51] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p. 55 (8.3)
[52] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 6-5 (6.3.2)

open pit is to function in this capacity then the Reclamation Plan should detail issues related to such as the location of debris, compaction of material, alternative measures to mitigate the effects of voids in the back fill, and the cover design.

Contaminated soils, identified in the phase II environmental site assessment, will be remediated either by disposal underground or through the application of a fresh layer of covering material atop the existing contaminated soil.[53] The mine should provide clear parameter related to the application of the respective remediation measures proposed in the Reclamation Plan.

Details related to the proposed reclamation of building and equipment foundations should be incorporated into the Reclamation Plan. These details should provide a clear indication of the proposed design of the cover and an inventory of buildings that have foundation.

9. RESIDENTIAL AREA OR "TOWNSITE"

Residential Infrastructure

The proposed method for the reclamation of the residential area involves the salvage of all economically viable material and the demolition of the remaining facilities. All non-hazardous materials will be taken underground (mine) while hazardous material will be will be disposed of off site. The demolition and reclamation of government owned facilities within the town would be included in the project on behalf of the GN.

As indicated in **Schedule B**, GN is working with the mine and other Agencies to determine whether there would be beneficial alternative uses for some of this infrastructure. If no such arrangement is achieved; however, then complete reclamation of the residential infrastructure is the only alternative.

The proposed method of reclaiming these facilities appears reasonable, providing sufficient volume exists in the in the mine.[54] Should CanZinco wish to pursue other avenues such as alternative disposal sites, then the Reclamation Plan identifies the west open pit as an area that might be filled with debris from the industrial complex.[55] If the open pits are to function as repositories for demolition debris then the Reclamation Plan should detail the resulting potential for contamination, including the location of debris in the pit, compaction of material, alternative measures to mitigate the effects of voids in the back fill, and the cover design.

The Reclamation Plan should also indicate buildings in the residential area that currently rest on a foundation that will have to be covered with overburden. Details on the proposed thickness, material and contouring intended for use in reclamation of these foundations should also be included.

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[53] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p.8 (3.4)
[54] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p. 55 (8.3)
[55] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 6-5 (6.3.2)

Carpenter Shop

The carpenter shop warrants special mention due to a diesel fuel spill that occurred in 2000.[56] This was the result of a failure with the valve housing when the settling of the tank placed an increased load on the valve.[57] The site is to be assessed to during reclamation to determine the hydrocarbon content of soils beneath the buildings foundation. The Reclamation Plan should provide more information on potential avenues related to the potential outcomes of the assessment. These potions should address the need for additional testing, the disposal of contaminated soil, and remediation of the foundation.

10. AMBIENT ENVIRONMENTAL CONDITIONS (WIND BLOWN TAILINGS)

The area alleged to be Commissioners' Land, is in the zone most likely to be impacted by wind-blown tailings, past and future. The Reclamation Plan mentions the fact that there were wind blown tailings on site and that the Phase II Environmental Site Assessment (ESA) is intended to assess the extent of this contamination in the surface soil, According to the Reclamation Plan these factors will be assessed and appropriately remediated[58]; however, it needs to be more fully developed so that the adequacy of both the ESA and any proposed remediation measures can be assessed.

In order for the Reclamation Plan to effectively address the issue of wind blown tailings it must delineate the distribution and range of the windblown tailings in addition to any related high metal concentrations as the result of tailings, in the surface soil and groundwater.

We recommend that the mine be required to conduct a geotechnical assessment comparable in both method and scope to that conducted by the Nanisivik Mine in 1985. A comparison of the two studies will provide an indication of the extent of potential wind blown tailings contamination at and around the mine site. As the study was conducted prior to the sub aerial containment of the tailings the previous study should provide a base line that would allow for the distribution of wind blown tailing to be delineated.[59]

The Reclamation Plan should also provide a map of areas identified by the phase 2 site assessment and particularly those areas that have having elevated levels of Zinc, Lead, and Cadmium needs to be incorporated. This map should also identify the areas of the site that will have to be reclaimed as per established and approved soil quality remediation objectives (SQRO). (See comments on *Human Health & Ecological Risk Assessment*, and *SQROs*)

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[56] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 6-13 (6.8.2)
[57] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p.43 (6.3)
[58] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 6-14 (6.8.4)
[59] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 3-10 (3.4.3)

11. MINE FACILITIES AT THE DOCK

In addition to a federally operated dock, the mine-owned infrastructure in the dock area includes the tank farm, reagent storage and lay down area, a concentrate storage shed, and the conveyor.[60] As with the residential area, GN is interested in a cooperative arrangement that could avoid adverse impacts or the loss of services to Arctic Bay and surrounding communities, by allowing the Dock and possibly other related facilities to operate after the mine closes.

Unfortunately the Government of Nunavut has no involvement or authority to administer or determine outcomes regarding, the harbour, the dock, the surrounding land, or the activities that presently occur in that area. Further, GN cannot become involved, unless any liabilities associated with past contamination are minimized or eliminated by a responsible party.

Federal Fisheries, Transport and/or the Coast Guard must ultimately take or approve the decisions that will determine the fate of the dock area, and whether or to what extent it continues to operate and/or is reclaimed. However, given the possibility of an ongoing GN interest in this site, and/or the thorough reclamation of part or all of it in the event of adjacent uses, we have the following comments.

Tank Farm

The Reclamation Plan proposes four options for the reclamation of the tank farm. Once again we agree with NWB's comments about proposed reclamation options for the tank farm, of June 20th, 2002. The Reclamation Plan should include much more detailed information for the disposal of the tank farm based on the fourth option presented and contemplate the applicability of a comparable arrangement to that of the residential infrastructure. This option involves the decontamination of the tanks and placement underground, the removal of geotextile line and the contouring of the berm to facilitate drainage.[61] The Reclamation Plan should also make an effort to assess the berm and related area for hydrocarbon contamination, given that there has been damage to the geotextile liner.[62] Finally, a detailed proposal on the disposal of waste material deposited in the waste tank should be provided, and the specific location where material will be place underground would assist regulators to assess the proposed reclamation.

Chemical Storage & Lay Down Area

Contaminated soils, identified in the phase II environmental site assessment, will be remediated either by disposal underground or through the application of a fresh layer of covering material atop the existing contaminated soil.[63] The mine should provide parameter related to the application of the respective remediation measures proposed in the Reclamation Plan.

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[60] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p.8 (3.4)
[61] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 6-11 (6.6.4)
[62] Acres International Limited. (2001) *Notes of Site Visit* (Nanisivik Mine, Baffin Island, Nunavut). p.10 (3.3.1)
[63] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p.8 (3.4)

The proposed assessment of the dock site will involve the development of 10 sampling test pits with approximately 4 samples taken from each, in the dock yard area.[64] This might be a little lean for the scope of potential contamination on the dock site which includes wind dispersion of concentrate (prior to 1982), the potential of hydrocarbon contamination at the land farm, and the potential contamination of soil in the yard area from storage of milling and mining reagent in an exposed area.

Concentrate Storage Shed & Conveyor

The Reclamation Plan proposes to dismantle and dispose of this infrastructure in underground in the mine with the foundation of the concentrate shed being reclaimed with a cover of overburden/soil.[65] The Reclamation Plan should provide information on the reclamation of this infrastructure. Specific detail related to the cover of the shed's foundation, the availability space in the underground workings of the mine, and the prospective location underground would be of value in assessing the adequacy of the proposed method for reclamation of this infrastructure.

12. FUEL STORAGE (DAY TANKS, FUELLING STATION AND END USER TANKS)

The Intermediate Day Tanks consist of two, 105000 litre diesel tanks and one 47000 litre gasoline tank, located in a dyked and lined enclosure adjacent to the industrial building. There are numerous End User Tanks located around the mine site for a variety of purposes, including refueling stations for mine equipment, heating of buildings, and delivery of jet fuel. All of these End user Tanks of more than 1000 litre capacity have secondary containment.

The proposed closure of these fuel storage facilities includes either removing off site or decontamination and disposal in the underground workings.

A feature missing from the current closure Reclamation Plan is the location of all of these facilities, particularly the End User Tanks. It is anticipated that over the mine life, spills of fuels have occurred in the area of the storage and transfer facilities. It is necessary that the fuel storage areas be assessed for potential contaminated soils, volumes estimated and appropriate disposal method.

13. HAZARDOUS MATERIALS

In the Reclamation Plan, many hazardous materials are identified, however, the volumes, types and storage location are not fully detailed. A comprehensive list of hazardous materials should

[64] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p.50 (7.3.1)
[65] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA.* p.8 (3.4)

be provided indicating annual consumption, anticipated surplus if any, storage location and any spill location. These materials include, but are not limited to:

- *reagents used in mill process*
- *petroleum products*
- *Calcium Chloride and Ammonium Nitrate*
- *Analytical Chemicals*
- *Polychlorinated biphenyls (PCBs)*
- *Asbestos*

Appropriate disposal methods, including neutralization, incineration, disposal underground, or removal from site, should also be incorporated with the inventory.

For planning purposes it is suggested that a copy of the mines asbestos survey be included in the Reclamation Plan.

Other assessment needs include the ANFO (explosives) and Dock storage facilities to identify areas and volumes where calcium chloride and ammonium nitrate have been spilled. A possible impact of these spills is freezing point depression associated with any ionization of pore water (discussed under "Tailings Cover & Containment"). The depression of the freezing point may result in a change in the underlying permafrost conditions.

14. SOIL QUALITY REMEDIATION OBJECTIVES (HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT)

Gartner Lee (2001) recommended that a human health and ecological risk assessment be completed to determine site-specific soil quality remediation objectives, and the overlap with public health concerns is obvious.[66] It is paramount that this work be completed and the objectives be developed as this will provide the overall regulatory criteria relating to closure activities. Without the establishment of these objectives, any reclamation plan will remain as an interim plan and will essentially be incomplete.[67]

15. MONITORING PROGRAM

The Reclamation Plan addresses monitoring of the site during reclamation and closure, and we generally agree with the Board's comments in this area. The Reclamation Plan involves monitoring by personnel at the mine site during the course of the proposed reclamation activities. Following reclamation of the site, monitoring will be conducted for a proposed five-year period to ensure the effectiveness of the reclamation measures. Monitoring over the five-year closure period will be conducted through a series of on site visits. Data from these

[66] Gartner Lee, page 55 (recommendation 2)
[67] EBA Engineering Consultants Ltd, page 20.

monitoring regimes will be made available in the month following its collection with an interpretation provided in an annual report.[68]

The scope of the current monitoring concept should be specifically revised to reflect the potential risk associated with the unknown contents of the landfill. We would like to see the incorporation of more rigorous monitoring program, which reflects the potential risks associated with the proposed permafrost encapsulation of the landfill. This should include the sampling of any leachate identified during the proposed annual site inspections.[69] The current monitoring regime for areas affected by wind blown tailings may also require revision upon completion of the Phase II Environmental Site Assessment, which should determine the extent to which the site has been impacted by sub aerial confinement of the tailings.[70]

Another issue related to the proposed monitoring concept is the adequacy of the five-year duration of monitoring during the closure period of the mine site. As mentioned in the Reclamation Plan permafrost encapsulation has two effects that make it effective as a containment option for the tailing. These are the reduced oxygen availability, and a decrease in kinetic energy that slow the rate of any reaction. While this reduced rate is beneficial in minimizing any oxidation from occurring, it is potential detrimental from a monitoring perspective as it will take longer for warning signs, related to improper reclamation, to become evident. Another factor that would also delay the appearance of these warning signs is the buffering nature of the shale used in the cover, which will mitigate impacts of improper reclamation until consumed which could take longer then the five-year monitoring period.[71] Based on this and comments provided by EBA the proposed concept should extend the length of closure monitoring by an additional five years, for a total of ten years of closure monitoring. If the monitoring regime of the site is intended assess the adequacy of the reclamation activities then this additional monitoring time must be required.

The Reclamation Plan indicates a firm commitment to maintenance and repair work that may be required to ensure that this reclamation is a long-term success: however, there is no indication what measures of correction or Reclamation Plan revision will be implemented if the monitoring results are unacceptable.[72] The Reclamation Plan or License should address any corrective follow-up, and corrective modifications to the Reclamation Plan, which are required based on monitoring results received after the Reclamation Plan otherwise has general approval. In addition, we recommend that the Applicant be required to develop a Phase II Environmental Site Assessment following the monitoring period, ensuring that the site has been reclaimed to an acceptable standard prior to termination.

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[68] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 8-1 (8.1)
[69] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 p. 8-4 (8.3)
[70] Gartner Lee. (2001) *Nanisivik Mine, Environmental Site Assessment and Proposal for Phase 2 ESA*. p.49 (7.3.1)
[71] Gartner Lee. (2002) *Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell*. p. 17 (5.2.5)
[72] Gartner Lee. (2002) *Nanisivik Mine Closure and Reclamation Plan*, v.1 – p.8-4 (8.3).