REVIEW OF MEADOWBANK MINING CORP.

WATER LICENSE APPLICATION

FOR THE MEADOWBANK GOLD MINE PROJECT

Prepared By:

Government of Nunavut

Department of Environment

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EXECUTIVE SUMMARY

This review of the Meadowbank Mining Corp. (the applicant; previously Cumberland Resources Ltd.) – Type A water license application for the Meadowbank gold mine project has been conducted by the Government of Nunavut, Department of Environment (GN-DOE). The documents relevant for this review include a water license application and 73 supporting documents.

In reviewing the water license application and its supporting documents, GN-DOE has not identified any substantive issues; however, there are several general and technical comments that should be addressed; these are summarized below for the Nunavut Water Board's consideration. The findings of this review are as comprehensive as possible within the constraints of time available for the review.

One general comment is regarding the organization of this license application and it supporting documents. It appears that the supporting documents relevant for this technical review are inconsistent with the documents outlined by the applicant in a list (namely Doc. 502 dated Dec. 5, 2007). For example, the Bathymetric Surveys (Doc. 309) and the Incineration Waste Management Plan (Doc. 581) submitted for review, are not currently on the list. Additionally, at the beginning of this review, regulators such as GN-DOE received many documents through electronic mail and regular mail delivery, which consumes tremendous amount of time to organize and sort these deliveries. GN-DOE therefore recommends documents relevant for this review should be clarified, and for future reviews, it would be beneficial if a license application and its supporting documents can be organized in binders and sent to reviewers simultaneously prior to the start of the reviews.

Additionally, GN-DOE is uncertain about the scope of this particular water license application. Our review has focused on the mine site itself and not components contained in previously issued water licenses related to the all-season road from Baker Lake, the marshalling area and the temporary construction camp. However, it is our belief that the terms and conditions from these previously issued Type B water licenses (namely 8BC-TEH, 8BC-MEA, and 3BC-TEH respectively), be incorporated into a single enforceable Type A water license that deals with management, mitigation and monitoring of waste and water related issues holistically.

GN-DOE has 11 technical comments on the application related to water quality, waste management, spill contingency planning, and closure and reclamation, which are summarized below.

A. Water Quality

This water license application provides technical analysis to support the conclusions used in project design and management plans, and it generally provides satisfactory mitigation and management procedures for the various waste streams on-site. However, there are still some issues regarding acid rock drainage and metal leaching (ARD/ML), water management and water quality, and waste management that need to be addressed.

An important conclusion made is that adaptive management will be a requirement at this site. The potential for ARD/ML is certain unless mitigative measures are successfully implemented. The applicant has committed to an audit and on-going improvement system during construction, operation and closure; this provides GN-DOE with some confidence that these issues will be appropriately managed.

B. Waste Management

The applicant provides various supporting documents to substantiate how they will manage various waste management facilities. GN-DOE finds the proposed management and mitigation measures for these facilities are generally sound; however, there are some issues regarding the sewage treatment plant, landfills and a landfarm which will need to be addressed. Specifically, contingency measures in the case of sewage plant malfunction, and sewage effluent discharge criteria during construction, will need to be clarified. Additionally, final landfill design drawings, and management procedures for landfilling of asbestos, ozone-depleting substances and fluorescent lamp tubes should be submitted for review. Finally, regarding a landfarm, a final design drawing should be submitted given the project is in licensing stage. Additionally, remediation guidelines for hydrocarbon contaminated soil should be clarified, and remediation methodology for hydrocarbon contaminated water should be re-evaluated.

C. Spill Contingency Planning

Overall, GN-DOE believes that the applicant has done a reasonable job of putting together this spill plan. GN-DOE views this contingency plan as a conceptual outline that will form the basis of a more detailed final plan, which the reviewer recognizes cannot be fully completed until the mine and associated infrastructure is in place and operational. Spill plans are evolving documents that must be updated from time to time to adapt to changing circumstances. The applicant is expected to re-visit and revise their spill contingency plan when the mine becomes operational; subsequent to this, the plan should be re-visited and updated yearly.

D. Closure and Reclamation

The GN-DOE has reviewed the preliminary closure and reclamation plan, and believes the plan is generally acceptable. However, there are some issues summarized below that will need to be addressed. For example, the applicant has not indicated when the final plan will be submitted for review. Additionally, the re-vegetation monitoring period on disturbed sites post-closure is thought to be too short to see the outcome of reclamation effort. GN-DOE therefore recommends the monitoring period be extended to ensure re-vegetation success. Furthermore, GN-DOE is concerned about disturbed wildlife habitat, and strongly advises that waste rock piles be covered with fine grain materials and/or that corridors through the rock piles be provided to ease wildlife passage. Finally, the closure plan for the Tailings Storage Facility and the Portage Rock Storage Facility should be revised once further operational information and management plans are revised. The applicant should also clarify the timing of post-closure monitoring of the tailings facility thermal condition, and commit to monitor thermal conditions for the Rock Storage Facilities.

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REVIEW SCOPE

In undertaking this review GN-DOE has provided comments that are consistent with our legislative responsibilities and national commitments as follows:

Section 5(1) of Nunavut's *Environmental Protection Act* (EPA) states: "subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment." A contaminant is any heat, noise, vibration or substance that endangers the health and/or safety of person, wildlife, plants or the physical environment. There are a number of regulations, guidelines and policies that have been developed and/or enacted under the EPA, these are indicated below:

- *Spill Contingency Planning and Reporting Regulations*
- *Guideline for Dust Suppression*
- *Guideline for the General Management of Hazardous Waste in Nunavut*
- *Guideline for Industrial Waste Discharges in Nunavut*
- *Guideline for Ozone Depleting Substances*
- *Guideline for Contaminated Site Remediation*
- *Guideline for Air Quality - Sulphur Dioxide & Suspended Particulates*
- *Contingency Planning and Spill Reporting in Nunavut: a Guide to the New Regulations*
- *Guideline for the Management of Waste Antifreeze*
- *Guideline for the Management of Waste Asbestos*
- *Guideline for the Management of Waste Batteries*
- *Guideline for the Management of Waste Paint*
- *Guideline for the Management of Waste Solvents*
- *Guideline for the Management of Waste Lead and Lead Paint*
- *Disposal Guidelines for Fluorescent Lamp Tubes*

The Nunavut *Wildlife Act* (WA) assigns GN-DOE responsibility for wildlife management within Nunavut. Management means the regulation of wildlife populations and their habitats for the purpose of sustaining them for human use or enjoyment in perpetuity. This *Act* requires GN-DOE to ensure mitigation and regulation of land-use activities having significant impacts on wildlife and wildlife habitat.

Additionally, the GN is signatory to the *1998 Canada Wide Accord on Environmental Harmonization* and the *Canada-wide Environmental Standards sub-agreement*, to provide for the continual development, improvement, and attainment of priority Canada-wide Standards (CWS's) for environmental quality and human health across Canada, consistent with the vision and principles of the Accord. The following CWS's are relevant to this project:

- *Canada-Wide Standards for Dioxins and Furans*
- *Canada-Wide Standards for Mercury Emissions*
- *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil*

ACRONYM	MEANING
AP	Acid Potential
ARD	Acid Rock Drainage
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CaNP	Carbonate Neutralization Potential
CCME	Canadian Council of Ministers of the Environment
CCME FWAL	Canadian Water Quality Guidelines for the Protection of Aquatic life
CWS	Canada-Wide Standards
DEIS	Draft Environmental Impact Statement
DOE	Department of Environment
EA	Environmental Assessment
EC	Environment Canada
EIS	Environmental Impact Statement
EPS	Environmental Protection Act
FEIS	Final Environmental Impact Statement
GHG	Greenhouse Gas
GN	Government of Nunavut
GNWT	Government of the Northwest Territories
HC	Health Canada
HC DW	Health Canada Guidelines for Canadian Drinking Water Quality
MMER	Metal Mining Effluent Regulations
ML	Metal Leaching
NAG	Net Acid Generation
NPAG	Non Potentially Acid Generating
NIRB	Nunavut Impact Review Board
NP	Neutralization Potential
NPR	Net Potential Ratio
NWB	Nunavut Water Board
PAG	Potentially Acid Generating
PCB	Polychlorinated Biphenyl
RBC	Rotating Biological Contacting
RSF	Rock Storage Facility
TEMP	Terrestrial Ecosystem Management Plan
TPH	Total Petroleum Hydrocarbons
TSF	Tailings Storage Facility
VPH	Volatile Petroleum Hydrocarbons
WA	Wildlife Act

TECHNICAL ISSUES

A. WATER QUALITY

Issue # 1: Acid Rock Drainage & Metal Leaching

Reference

- Type A Water Licence Application (Doc. 485) - section 2.3.5
- Operational ARD/ML Sampling and Testing Plan (Doc. 425)
- Mine Waste and Water Management (Doc. 500)

Concern

Through previous sampling and analysis, the applicant has classified waste rock and tailings material as either Potentially Acid Generating (PAG) or Non Potentially Acid Generating (NPAG) based on the screening criteria (pg 9, Doc. 425):

NPR < 1	Likely acid-generating (PAG)
1 < NPR < 2	Uncertain
2 < NPR	Not potentially acid-generating (NPAG)

It is acknowledged that the Net Potential Ratios (NPR) are a screening tool rather than a definitive indicator of the potential for acidification and that site specific factors play a role in determining geochemical characterization and management. While the applicant is confident that the risks of acid rock drainage/metal leaching (ARD/ML) are limited due to mitigation and management, the NIRB Project Certificate conditions (#15) include re-evaluation of ARD/ML potential within two years of its issuance.

The applicant is proposing that on-site analysis of total sulphur and total carbon dioxide (i.e., Carbonate Neutralization Potential or CaNP test) be used as a surrogate in order to have a timely response to analysis and management response to PAG and NPAG material. The applicant is also committed to on-going testing using on-site and laboratory based analysis to assess other surrogate measurements (e.g., Net Acid Generation or NAG test, and CaNP Mineralogy) to classify materials of ARD potential. These commitments are encouraging and will improve the understanding of geochemistry and waste management for the Project

It is noted, however, that analysis for neutralization potential (NP) has been reported as Sobek methodology and that the CaNP, based on CO_2 analysis, are comparable (pg 10, Fig 3-4, Doc 425). Although these values are similar, in reviewing the geochemistry data presented to date some samples currently classified as NPAG because of NPR>2, may now be classified as PAG because the NPR<2 if using the CO_2 determination for NP. The applicant should clarify how this change in NP determination affects material classification and waste volume calculations. For example, Table 4.3, pg 14, Doc 425, indicates that the cumulative NPR for the Vault Rock Storage Facility is 2.5 and revising NPR determinations using CaNP may affect the current understanding of the RSF. In re-evaluating the ARD/ML potential over the next two years, the applicant should also revisit the existing database and confirm that waste volume calculations are still valid. These revisions should also be reflected in revised water quality predictions.

The applicant suggests that segregation of PAG and NPAG IV may be difficult operationally (pg, 54, Doc 485) and that if it cannot be done then all the material will be managed to minimize ARD potential. The applicant presents management of material, based on either PAG or NPAG classification, and it should be clarified how IV material will be managed if it cannot be segregated and when this decision point will be made.

The applicant also proposes that over the project life that total metal analysis will be assessed as a tool to indicate metal leaching. It has not been possible to make this correlation to date (pg 10, footnote, Doc 425), however, with on-going work on understanding geochemistry the applicant may be able to establish some useful correlations. The metals that have a potential to be leached include arsenic from UM and Vault IV, and arsenic, copper, nickel and zinc from IF and Portage IV samples. These units are classified as NPAG and are intended to be used as construction and/or capping material. In re-evaluating the ARD/ML potential over the next two years, the applicant should include the assessment for establishing correlations between total metal content and metal leaching potential. The applicant should also consider including some PAG material in these programs. Although the intent is to encapsulate the PAG material in order to mitigate leaching potential, the inclusion of these samples in the program may improve correlations by providing additional information with respect to maximum rates possible from material on-site.

The applicant has also committed to using NPAG material in road construction (Table 2.1, Doc. 500). Clarification of what ARD/ML analysis and screening criteria will be used for material used to construct site roads and for exposed outcrop along the road that may be subject to cutting, should be included in the waste and water management plan. Given that work will continue on-site to improve geochemistry understanding this work should be expanded to include access routes as well.

<u>Recommendation</u>

- The applicant should clarify how changing NP determination using on-site analysis (i.e., CaNP test) affects material classification and waste volume calculations. In re-evaluating the ARD/ML potential over the next two years, the applicant should also revisit the existing database and confirm that waste volume calculations are still valid. These revisions should also be reflected in revised water quality predictions.

- The applicant should clarify when the decision point will be made to segregate NPAG and PAG IV material. If the material cannot affectively be separated, it should all be managed as PAG.

- In re-evaluating the ARD/ML potential over the next two years, the applicant should include an analysis establishing correlations between metal concentration and leach rates for NPAG material. They should also consider including some PAG material in these programs. Although the intent is to encapsulate the PAG material in order to mitigate leaching potential, the inclusion of these samples in the program may improve correlations by providing additional information with respect to maximum rates possible from material on-site.

- Clarification of what ARD/ML screening criteria will be used for material used to construct site roads, and for exposed outcrop along the road that may be subject to cutting, should be included in the waste and water management plan. Given that work will continue on-site to improve geochemistry this work should be expanded to include access routes as well.

Issue # 2: Water Management & Water Quality

Reference

- Type A Water Licence application (Doc. 485) - section 2.3.5
- Mine Waste and Water Management (Doc. 500)
- Water Quality Predictions (Doc. 516)
- Waste Quality and Flow Monitoring Plan (Doc. 450)
- Proposed Water treatment Methods (Doc. 467)

Concern

Water management focuses on maximizing non-contact water and minimizing contact water. Integral to the management is a series of dikes. The applicant is proposing to construct the dikes primarily from materials mined on-site with the designs including a downstream rockfill, a filter zone and an upstream impermeable element (pg. 62, Doc. 485). The proposed design includes either a geomembrane liner or compacted till as the impermeable element will depend on the availability of till at the time of construction and the construction costs at that time. Water management also includes a network of ditches and sumps to facilitate site management of contact and non-contact water. The applicant has not provided detailed design or maintenance procedures for these structures, however, they do state commitments to ensure that the challenges presented by ice-rich ground will be considered (pg 65, Doc. 485). The applicant should provide information with respect to: a) using the liner or till for the dike; and b) design details for the ditch and sump construction before work proceeds.

Water quality predictions completed characterizing the "expected probable" case, the "possible poor-end" case, and the "hypothetical" case of water quality from the mine site over mine life. The water balance calculations and water quality predictions are completed by a computer-based program (GoldSim) that includes inputs on material characteristics, site conditions and management plans to be put into place specific to the Meadowbank Project. The significant difference between the three scenarios is the metal leach rates used in the calculations. The "probable" case assumes the field based test results and appropriate explosives management, and the "possible poor end" case assumes the field based test results however with the assumption of worst-case possibility within the probable natural variance. The "hypothetical" case uses the higher laboratory based test results and assumes ARD/ML establishment in localized areas; this situation is unrealistic and not discussed in details in the application. The applicant is depending on the long term stability of waste material to occur with the establishment of frozen, permafrost conditions within the PAG material before ARD and/or metal leaching becomes significant. The three scenarios model water quality for all mine components.

The applicant acknowledges that there are limitations to the model (pg 35, section 4.9, Doc. 516). The level of precision and accuracy of the predictions is determined by the accuracy/precision of the input parameters and assumptions based on engineering design. Given that the engineering is at the feasibility stage of design, the applicant has assumed that these predictions represent order-of-magnitude estimates. The applicant has proposed water management systems that would control and minimize discharge to the environment of water in contact with mine site components, has proposed adaptive monitoring and management systems, and has committed to treatment, as required. The applicant further acknowledges that as the project evolves, continued data will be required to verify and/or refine the model input and output. GN-DOE acknowledges that even the best models can not compare with the evaluation of operational monitoring data that allow for refined predictions and management plans.

In order to assess the predicted water quality, the model results were compared to the following existing water quality criteria (pg 37, Doc 516):

- Canadian *Metal Mining Effluent Regulations* (MMER)
- Health Canada *Guidelines for Canadian Drinking Water Quality* (HC DW)
- CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* – for Fresh Water Aquatic Life (CCME FWAL)

GN-DOE would clarify that there are no current Nunavut drinking water quality criteria; current acceptable practice is the application of CCME drinking water criteria. To avoid confusion, GN-DOE will refer to the drinking water criteria in the Doc. 516 as CCME DW.

The applicant indicates that the MMER represents the minimum requirement for discharge of untreated effluent. Non-compliance with MMER for drainage discharged to the environment (in this case drainage from the attenuation ponds to Wally and Third Portage Lakes) will trigger treatment requirements. GN-DOE recognizes that other regulators have the mandate to address the application of these criteria and enforce any terms identified in the NWB water licence to be potentially issued. GN-DOE is committed to ensuring environmental protection within the territory and ultimately looks to the consideration of CCME FWAL for water quality for the project.

Discharge to the environment is planned to be from the attenuation pond through a diffuser into Wally Lake in the Vault area throughout operations. In the Portage area discharge to the environment is from the attenuation pond into Third Portage Lake during years 1 to 5, and from the reclaim pond to the open pit from year 5 to closure. Modelling indicates that the discharge complies with MMER at the diffuser discharge point, except during year 6 to closure in the Portage area; there are possible exceedances of cyanide and copper. In reviewing the provided information, GN-DOE notes that at the diffuser, the effluent quality has several parameters that exceed HC DW and CCME FWAL, and the applicant notes that these criteria will potentially be approached within a 30 m radius from the diffuser (pg 70, Doc. 485). GN-DOE acknowledges that effluent plume modelling from the diffuser must account for effluent discharge, water quality and flow, however, the applicant should clarify at what distance the CCME FWAL criteria are met if it is outside the 30m boundary. As a minimum, the applicant should ensure the effluent

discharge to the receiving environment meets the CCME FWAL criteria within a 30 m radius from the Third Portage Lake diffuser.

The applicant has developed sampling and management plans for PAG materials to mitigate the potential for ARD/ML including separation and encapsulation of PAG waste rock to promote internal freezing conditions, subaqueous disposal of tailings and flooding of pits. Additionally, the applicant has developed a Water Quality and Flow Monitoring Plan (Doc. 450) to track changes in drainage chemistry. This plan incorporates compliance points (CM), where drainage is discharged to the environment and must meet MMER, and internal monitoring locations (IM) to monitor contact water across the site for operational purposes. The proposed monitoring plan, and its associated triggers and response mechanisms are sufficient to address water quality issues over the mine life. However, GN-DOE suggests that the applicant confirms the data presented in Appendix C: Table C-1 in the Doc. 450 and clarify if these are the triggers for action for IM locations (i.e., are these 10x predicted "possible poor end"? pg 18, Doc. 450). Further, there is a commitment from the applicant that some locations will meet the HC DW criteria such as the pit lakes and adaptive management may need to reflect a change in applying MMER criteria to HC DW criteria over mine life. This consideration should be reviewed annually with the monitoring program.

Proposed waste and water management measures are intended to ensure that drainage from the attenuation ponds being released to the environment meet MMER requirements. While the applicant is confident that the risks of water quality impact are limited due to mitigation and management, the NIRB Project Certificate conditions (#9) include providing water treatment details for process and attenuation pond water. Proposed treatment methods are presented (Doc. 467) to address concentration of TSS, metals and cyanide species. GN-DOE acknowledges that water treatment would be implemented on an "as needed" basis during operation to ensure MMER compliance and implemented at closure to ensure flooded pit water meets HC DW prior to dike breach. A metal that seems to be of concern is arsenic and proposed treatment includes the addition of iron to the drainage prior to pH adjustment with lime (pg 11, Doc. 467). Current water quality predictions indicate that iron concentrations may be above the HC DW and CCME FWAL criteria under the "expected probable" case. Additional treatment for arsenic may introduce additional iron into the drainage, and for iron exceedances, treatment will be implemented by adding lime to precipitate the iron. GN-DOE acknowledges that even the best models cannot compare with the evaluation of operational monitoring data that allow for refined predictions and management plans. GN-DOE therefore recommends that the applicant refines water quality predictions and management plans (i.e., treatment needs) based on updated monitoring data during operation.

<u>Recommendation</u>

- The applicant should provide information with respect to: a) using the liner or till for the dike; and b) design details for the ditch and sump construction before work proceeds.

- The applicant should ensure the discharge from the Third Portage Lake diffuser meets the CCME FWAL criteria within a 30 m radius from the diffuser.

- The applicant confirms the data presented in Appendix C, Table C-1 in the Water Quality and Flow Monitoring Plan (Doc. 450), and clarify if these are the triggers for action for IM locations. Water quality monitoring and water management plans may need to reflect a change in applying MMER criteria to HC DW criteria for pit lake water over mine life.

- The applicant should refine water quality predictions and management plans (i.e., treatment needs) based on updated monitoring data during operation.

Issue # 3: Waste Management & Water Quality

Reference
- Type A Water Licence application (Doc. 485) - section 3.3.6
- Mine Waste and Water Management Report (Doc. 500)

Concern
GN-DOE has reviewed the applicant's proposed waste management plans and is generally satisfied that wastes will be managed in an environmentally responsible manner and that the plans are robust enough to allow adaptive management. GN-DOE acknowledges and appreciates that the applicant has considered comments made to date and committed to annual reviews and updates of management plans.

The Mine Waste and Water Management Plan (Doc. 500) indicates that dust-control water (pg 10-5) will be drawn from Portage attenuation pond for use in the Portage Mine Area and drawn from Phaser Lake for use in areas outside the Vault and Portage catchment areas. GN-DOE recognizes that dust suppression will be necessary to minimize contamination of soil and vegetation and will ensure visibility on the road and safe passage for mine traffic. It is anticipated that the road corridors will be part of the site water management system with ditches and sumps directing impacted drainage toward the attenuation ponds. However, there may be areas that fall outside the proposed water management network (e.g., Vault haul road) and GN-DOE recommends that water from the noted areas be used, unless on-going monitoring indicates that it exceeds MMER and will require treatment prior to discharge to the environment. If other dust suppressants are to be used, the applicant is to refer to GN-DOE *Guideline for Dust Suppression* issued under the *Environmental Protection Act*.

Recommendation
- The applicant should use water from Phaser Lake and Portage Attenuation Pond for dust suppression, unless on-going monitoring indicates that it exceeds MMER and will require treatment prior to discharge to the environment.

B. WASTE MANAGEMENT

Issue # 4: Sewage Treatment & Management

Reference
- Type A Water License Application (Doc. 485)

- Sewage Treatment System to be Use at Meadowbank Gold Project (Doc. 355)
- 112607 Letter to NWB re Sewage Treatment Plant
- Big John Operation Manual
- General Arrangement of L250 to L500 Rotordisk in Full Steel Tank

Concern

In the submitted documents, the applicant indicates that during mine construction treated sewage will be discharged to a fishless lake, namely Tear Drop Lake; however, it is unclear what the impact will be on the water quality in the lake. Page 10 and 11 of Doc. 355 indicates that a Rotating Biological Contacting (RBC) sewage treatment system will be able to meet a range of effluent quality (i.e., 4 to 40 mg/L for Biochemical Oxygen Demand and Total Suspended Solids). However, there is no further discussion on specific effluent discharge criteria that the applicant intends to meet. To ensure water quality of the Lake is not compromised, GN-DOE recommends as a minimum that the applicant meets *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories*, and that monitoring at the lake be conducted to ensure the lake water complies with the *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Finally, the applicant should discuss contingency measures in the case of RBC malfunction, and indicate how and where the raw sewage will be handled and placed. This information has also not been submitted for review.

Recommendation

- The applicant should ensure that treated sewage discharge to the Tear Drop Lake occurs only during construction, that the effluent meets the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories*, and that monitoring at the lake be conducted to ensure the lake water quality complies with the *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.

- The applicant should submit information for review detailing contingency measures in the case of sewage treatment plant malfunction.

Issue # 5: Landfill Design Drawings & Management Procedures

Reference

- Type A Water License Application (Doc. 485)
- Landfill Design and Management Plan (Doc. 458)
- Landfill Design and Management Plan Supplementary Information (Doc. 562)

Concern

The applicant has provided preliminary design drawings for two proposed landfills. However, given that the project is in licensing stage and construction can be started once a water license is granted, the applicant should have the final design drawings available for review.

Page 11 of Doc. 458 provides a list of materials to be landfilled including asbestos, white goods (i.e., refrigerators), and light bulbs (items of concerns are fluorescent lamp tubes); however, the applicant has not provided detailed landfilling procedures for these items of concern. The applicant is to refer to DOE's *Guideline for the Management of Waste Asbestos, Guideline for*

Ozone Depleting Substances, and policy for disposal of fluorescent lamp tubes. Waste asbestos as defined in the guideline is a hazardous waste. To dispose of this waste by landfilling, it needs to be buried immediately, covered with 0.5 meters of material such as soil and refuse, and measures taken to ensure the landfill site will not be disturbed in the future. Additionally, the applicant is required to contract a registered waste management company to handle this landfilling procedure.

Regarding landfillling of white goods, the GN-DOE's guideline states that any equipment such as refrigerators containing ozone depleting substances (i.e., chlorofluorocarbons) should have these substances removed by a certified technician prior to disposal. Finally, page 11 of the Doc. 458 discusses landfilling of waste light bulbs; however, it is not clear if fluorescent lamp tubes are included as part of the light bulbs designated for landfilling. If the fluorescent tubes are to be landfilled, the applicant should be aware of the fluorescent tubes in excess of 0.2 mg/liter (parts per million) based on leachate quality tests, are prohibited from landfilling, according to the GN-DOE policy.

Recommendation

- The applicant should submit for review, final design drawings for the two proposed landfills.

- The applicant is to refer to GN-DOE guidelines and policy documents regarding landfilling of asbestos, equipment containing ozone depleting substances, and fluorescent lamp tubes.

Issue # 6: Landfarm Design Drawing & Management Procedures

Reference

- Type A Water License Application (Doc. 485)
- Landfarm Option Analysis (Doc. 498)
- Landfarm Design and Management Plan (Doc. 564)

Concern

The applicant has provided a preliminary design drawing for the proposed landfarm. However, given the project is in the licensing stage and construction can be started once a water license is granted, the applicant should have the final design drawings available for review.

Additionally, page 5 of the Doc. 564 states "if the soil and snow/ice cells do not have sufficient capacity to accommodate a large spill, a temporary stockpile area could be set up adjacent to the landfarm." However, the applicant has not provided any further details on management and design of this temporary storage area. For example, how will this area be managed to ensure contaminants do not enter the surrounding environment? Will a liner be installed? What is the capacity of this temporary storage area?

Recommendation

- The applicant should provide a final design drawing for the proposed landfarm.

- The applicant should provide further design and management details regarding the temporary emergency stockpile area for hydrocarbon contaminated soil.

Issue # 7: Remediation Guidelines for Hydrocarbon Contaminated Soil

Reference
- Type A Water License Application (Doc. 485)
- Landfarm Option Analysis (Doc. 498)
- Landfarm Design and Management Plan (Doc. 564)

Concern
It is unclear which remediation guidelines the applicant intends to use, and what parameter will be measured, for remediation of hydrocarbon contaminated soil.

Page 2 of the Doc. 564 indicates that the applicant intends to use the most stringent guidelines such as the Canadian Council of Ministers of the Environment (CCME) *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil*, to which the Government of Nunavut is a signatory. The standards describe guidelines for four different kinds (fractions) of hydrocarbons based on the number of carbons in their chemical formula; however, BTEX (benzene, toluene, ethylbenzene and xylene) has been excluded from this guidance document. The applicant then further describes that 2500 mg/kg would be the anticipated guideline within the water license to be issued; this is based on their assumption that diesel contamination will be the dominant contaminant of concern. However, as there will be other hydrocarbon based fuels commonly used such as gasoline and aviation fuel, a more appropriate approach would be to test for different kinds (fractions) of hydrocarbons depending on the kinds of hydrocarbon spills that have occurred on site. Additionally, it is incorrectly stated on page 2 of the Doc. 564 that the remediation guideline for coarse grained diesel contaminated soil is 2500 mg/kg. GN-DOE would like to point out that commonly used diesel should belong to the Fraction 2 category not the Fraction 3 of the Canada-Wide Standards (CWS) guidance document dated April 30 – May 1, 2001. The correct guideline value should therefore be 760 mg/kg.

Note that page 2 of the Doc. 564 makes reference to GN-DOE's *Guideline for Contaminated Site Remediation*. These guidelines provide remediation standards for contaminants of concern such as total petroleum hydrocarbons (TPH), BTEX, lead, and polychlorinated biphenyl (PCB). However, on page 12 and 13 of the Doc. 564, the applicant states that they will test the treated soil for TPH, BTEX, volatile petroleum hydrocarbons (VPH) as well as total metals, and oil and grease. As the CWS does not specify guidelines for TPH, BTEX, VPH, metal and oil/grease, it is unclear whether the applicant still intends to use the CWS as described on page 2 of Doc. 565 or the applicant intends to use a combination of guidelines such as CWS, GN-DOE guidelines and others that are appropriate. As a minimum, GN-DOE recommends the applicant samples the treated soil for hydrocarbon Fraction 1 and Fraction 2, TPH, BTEX, prior to eventual disposal of the soil.

Recommendation
- The applicant should clarify the remediation guidelines that will be used for hydrocarbon contaminated soil, how the guidelines will be used, and what parameters will be measured.

Issue # 8: Treatment and Monitoring of Hydrocarbon Contaminated Water

Reference
- Type A Water License Application (Doc. 485)
- Landfarm Option Analysis (Doc. 498)
- Landfarm Design and Management Plan (Doc. 564)

Concern
P 13 and 18 of the Doc. 564 states that leachate and melted snow from a landfarm will be collected in sumps and then treated by an oil-water separator. Subsequently, the treated water will be either reused in a process plant on site or be discharged to the Reclaim Pond within the Tailings Storage Facility. Prior to the discharge to the Reclaim Pond, the treated water will be monitored for metals, benzene, toluene, ethyl benzene, oil & grease, and pH to certain standards. In the event of non-compliance with the standards, appropriate remedial actions will be implemented.

GN-DOE is satisfied that the applicant commits to monitor the treated water prior to discharge and to ensure the treated water complies with appropriate standards. However, the applicant should be made aware of that when treating contaminated water by the oil-water separator, it is generally advised to include an additional filtration treatment step such as the use of an activated carbon filter. Further guidance on this can be found in the Government of the Northwest Territories *Generic Plans and Operating Procedures of a Remediation Facility for Hydrocarbon Contaminated Materials in the NWT*. The applicant is therefore recommended to re-consider their treatment methodology.

Recommendation
- The applicant should consider additional treatment beyond the use of an oil-water separator for treatment of hydrocarbon contaminated water.

C. SPILL CONTINGENCY PLANNING

Issue # 9: Spill Contingency Planning

Reference
- Spill Contingency Plan (Doc. 483)

Concern
GN-DOE believes the Spill Contingency Plan is generally satisfactory; however, we have provided specific comments below for further improvement. Additionally, GN-DOE recognizes the plan cannot be fully completed until the mine and associated infrastructure is in place and operational. Spill plans are evolving documents that must be updated from time to time to adapt to changing circumstances. *The applicant is expected to re-visit and revise their spill contingency plan when the mine becomes operational*; subsequent to this, the plan should be re-visited and updated yearly.

It should be clearly understood that GN-DOE's review and/or acceptance of this spill contingency plan does not release the applicant from their responsibilities pertaining to the proper management of the hazardous materials under their control.

Specific comments for the applicant's consideration are as follows:

Section 4 - General

$ Once the personnel are in place, this section should include a list of names and contact coordinates.

$ The 24 hour contact person's name and phone number should be front and centre on the cover page in large bold lettering.

Section 4.3 Emergency Response Team

$ Once the personnel are in place, the names of the team members should be listed; it would be useful to provide an indicator beside each name to determine if they are able to respond to spills of all materials on site or specific materials.

Section 5, Table 5.1

$ When available, provide names and contact phone numbers so that these individuals can be contacted by outside (regulatory) agencies.

Section 5, Table 5.2

$ The correct phone number for GN-DOE, Manager of Pollution Control, Robert Eno is 975-7748. Fax: 975-7739

Section 6, Table 6.1, Consumable Chemical Materials on Site

$ Wherever practical, the table should include, for quick reference, the actual quantities of each hazardous material as well as an additional column indicating the TDGR hazard class (1 through 9) for each.

Section 6.1 Explosive Materials

In addition to the obvious hazards associated with explosives storage, there is also an environmental hazard relating to runoff from nitrogen-based explosives, which is toxic to plants and aquatic life. These materials should therefore be protected from the elements – particularly rain – so as to avoid possible toxic runoff from the storage sites.

Section 6.6 Infectious Substances

$ At the last meeting of the Spills Working Group, it was agreed that for purposes of spills, sewage is considered to be a Class 6.2 infectious substance and as such, all quantities are reportable. Given that exposure to raw sewage is primarily a human health hazard, it is recommended that, in addition to normal spill response procedures, the applicant immediately

consults their own on-site health professionals for advice in the event of a sewage spill.

Section 6.8 Disposal Methods

$ The applicant should expand this section providing additional details on the methods proposed for disposing of spilled materials.

Section 9.2 Training

$ The applicant should provide a detailed description of the proposed spill response training that will be provided to their response team including a course outline, list of topics to be covered, schedule and the qualifications of the instructors.

Appendices, General Comment

$ The appendices should be tabbed and where necessary, as in Appendix I, sub-tabbed and fully indexed for ease of reference.

Appendix A - Site Maps

In addition to identifying the general infrastructure, these maps should also include the following information:

$ likely pathways of contaminant flow (as in spills)

$ environmentally sensitive areas

If these details cannot be properly depicted on the existing (3) maps provided, it is suggested that a series of smaller maps which cover specific sectors of the camp and mine site be included. It should also be kept in mind that it may be necessary to refer to these maps under less-than-ideal conditions, such as outdoors in inclement weather; therefore, they should be easy to manipulate.

Recommendation

- Pending the correction of the deficiencies identified above, GN-DOE recommends that the plan be accepted.

- The applicant is expected to re-visit and revise their spill contingency plan when the mine becomes operational; subsequent to this, the plan should be re-visited and updated yearly.

- Further general comments on the spill plan are included in the Appendix A of this document.

D. CLOSURE & RECLAMATION

Issue # 10: Closure & Reclamation

Reference

- Type A Water License Application (Doc. 485)
- Preliminary Closure & Reclamation Plan (Doc. 511)

Concern

The applicant has submitted a *Preliminary Closure & Reclamation Plan* (Doc. 511) describing how the project site will be restored after closure, and further indicated in page IV of Doc. 511 that a final version of the plan will be submitted. However, the timeline of this submission is unclear, and whether the applicant will seek consultation with relevant regulators such as GN-DOE on the final plan.

Additionally, GN-DOE is concerned about the proposed timeline for monitoring re-vegetation success at disturbed project sites post-closure. Page 5-1 to 5-3 of the Doc. 511 indicates re-vegetation will be taking place and refers to the Terrestrial Ecosystem Management Plan, 2005 (TEMP) for details. Note that this TEMP plan is not part of the document list relevant for this license review although this has been submitted to the Nunavut Impact Review Board (NIRB) during the NIRB environmental assessment phase for this project. Furthermore, this TEMP was updated in December 2006 and submitted to the NIRB as a requirement under the Meadowbank project certificate. Consequently, GN-DOE reviewed the 2006 TEMP rather than the 2005 one, and reiterates the following comments provided previously to NIRB

> "It is noted in the Terrestrial Ecosystem Management Plan that Cumberland plans to monitor revegetation until year 11 post closure. However, DOE believes that revegetation will not occur until many years after closure of this mine. The likelihood that vegetation monitoring will yield useful data is thus low unless a long term commitment (several decades) is made to this activity. It would be a significant contribution to environmental management in the north if a long-term (several decades) commitment were made to conduct vegetation studies at this site, albeit at widely spaced intervals rather than annually. Only by collecting these long-term data can the true impacts and cumulative effects of mining on habitat be assessed."

Finally, GN-DOE is concerned about the proposed methodology to restore disturbed wildlife habitat sites. The applicant indicates on page 11-2 of the Doc. 511 that they will cover the Tailings Storage Facility and Rock Storage Facilities with a layer of coarse grained waste rock, with potential to add another layer of fine till. It is important that the applicant restores the disturbed sites to ease wildlife passage, and a final layer of finer grain materials would be beneficial for this purpose. Alternatively, corridors through disturbed areas or rock piles can be provided to ease wildlife passage.

Recommendation

- The applicant should clarify when the final closure and reclamation plan will be submitted, and should commit to submit this final plan to relevant regulators such as GN-DOE for review.

- The applicant is recommended to extend monitoring proposals for re-vegetation post-closure to ensure the success of re-vegetation, and to provide further to the body of research addressing challenges to re-vegetation in the north.

- The applicant is recommended to cover waste rock piles with finer grain materials and/or to provide corridors through the rock piles to ease wildlife passage.

Issue # 11: Water Quality & Closure

Reference

- Type A Water Licence application (Doc. 485) - section 4.9
- Mine Waste and Water Management Report (Doc. 500)
- Water Quality Predictions (Doc. 450)
- Preliminary Closure and Reclamation Plan (Doc. 511)

Concern

The applicant is proposing that at closure, efforts to refill the open pits will ensure a relatively quick refill rate without compromising the water quantity of the adjacent lakes. GN-DOE sees this plan as an appropriate measure as submerging potentially acid generating pit walls and waste rock materials will limit ARD and ML reactions. Preliminary water quality changes as the pits refill are outlined in the prediction model, however, there is a commitment to continue updating the prediction over mine life and to monitor and treat as required the in-pit water.

The closure plan incorporates the use of a cover of NPAG material to ensure geochemical stability on the Portage Rock Storage Facility (RSF) and the Tailings Storage Facility (TSF); however, it is proposed that the Vault RSF will not require a cover. It is presented that the decision to cap one but not the other is based on current geochemical understanding and the predicted water quality. The long term geochemical stability of the RSFs and TSF is dependent on assumptions that the establishment and maintenance of frozen conditions will occur, that the proposed classification of waste rock is correct, and that management plans will be appropriately implemented and mitigation measures are successful. There are underlying field realities that may affect these assumptions, however, GN-DOE acknowledges that this information and assessment can only occur during mine operation to fully understand site conditions and resultant water quality.

Management of the facility includes measures to promote freezing conditions during tailings deposition, and monitoring plans to monitor thermal conditions over the mine life. GN-DOE appreciates the commitment by the applicant to proactively monitor thermal conditions within the tailings facility and implementing passive or active treatments to encourage freezing conditions if it is realized during operation that predicted conditions are inaccurate (pg. 6-4, Doc. 500). The Mine Waste and Water management plan (Doc. 500) suggests that freezing conditions will not be established until 10 to 15 years after operations cease and it is unclear the post-closure monitoring period (pg 14-2, Doc. 511) or if it incorporates thermal monitoring. GN-DOE therefore requests clarification on the timing of post-closure monitoring of the tailings facility thermal conditions.

GN-DOE also recommends a stronger commitment to monitoring thermal conditions within both Vault and Portage RSF areas to ensure predicted thermal conditions are being met. If predicted

thermal response is not realized during operations, waste management plans will need to be adapted to incorporate measures that facilitate the establishment of freezing conditions.

The applicant proposes that water quality in the flooded pits will be monitored and predictions indicate that the chemical constituents will comply with MMER criteria and CCME FWAL criteria except for arsenic, cadmium, chromium and manganese. It is noted that "…water quality within the flooded pits will be managed and monitored until the water is of acceptable quality to be allowed to mix freely with the surrounding lake water" (pg 7-3, Doc. 511). To ensure local water quality is not compromised, GN-DOE recommends that the water quality of the flooded pits meets the CCME FWAL criteria for parameters of concerns (i.e., metals) prior to dike breaching.

Recommendation

- The applicant should revise closure plans regarding the TSF and the RSFs as operational information and management plans are revised.

- The applicant should clarify the timing of post-closure monitoring of the TSF thermal conditions; the Mine Waste and Water Management Report (Doc. 500) suggests that freezing conditions will not be established until 10 to 15 years after operations cease and it is unclear the post-closure monitoring period.

- The applicant should commit to monitor thermal conditions within the Vault and the Portage RSF areas with mitigative measures implemented if predicted thermal response is not realized.

- The applicant should ensure the water quality of the flooded pits meets the CCME FWAL criteria prior to dike breaching.

APPENDIX A

General Spill Plan Recommendations

Spill Prevention:

A concerted effort should be devoted to spill prevention and the methods that the applicant would employ toward that end. Under prevention, the following should be considered:

$ All fuel tanks, connectors and associated plumbing should be installed in a manner that meets current acceptable codes for the installation of such appliances. Individual fuel tanks, such as heating fuel tanks, should be situated on solid platforms, on a stable base, and should be inspected on a regular basis, for leaks and movement (shifting). The applicant is referred to a newly-released GN-DOE document, *"Illustrated Homeowner's Guide to Heating Oil Tank Inspections"*. An electronic copy is available from GN-DOE, upon request.

$ Caches of drummed fuel and chemicals are particularly subject to spillage because they often become buried in snowdrifts and are thus susceptible to damage from heavy equipment: most commonly, front end loaders. Furthermore, once buried, leaking containers cannot be detected until after the snow melts, by which time, most, if not all, of the spilled material has escaped off site with the spring runoff. Drum cache locations should be clearly defined and marked so that they are visible even during the winter season.

$ To prevent spreading in the event of a spill, fuel/chemicals stored in drums should be located a minimum distance of 30 metres from all streams, preferably in an area of low permeability.

$ All fuel and chemical storage drums should be situated in a manner that allows for easy access and inspection during all seasons.

$ Large caches, in excess of 20 drums, should be inspected daily. The applicant is advised to keep a written log of the inspections.

$ For long term storage (> 6 months), it is recommended that drummed fuel/chemicals be stored on pallets or on a well-drained site to prevent the bottoms from rusting out.

Third Party Response

$ Third party spill response firms are frequently based out of major centres and are therefore not immediately available to respond to spills at remote sites. What is the expected response time? This is especially important for operations which are located beyond the road system and where the response contractor may have to fly men and equipment to the spill site. It is not enough to have a firm on standby: the response must be timely, effective and efficient. These are the fundamental principles which govern a successful spill response operation.

$ How will the men and equipment be deployed to the site?

$ Describe the qualifications and experience of a response team. The applicant would be expected to provide an overall description of the firm's experience and track record, including references.

$ A description of the equipment available to the response team and which will be mobilized to the spill site.

Catastrophic Failure of Containment Dams

While GN-DOE believes that a catastrophic failure of the tailings facility is highly unlikely, we also believe that it is not unreasonable to suggest that the applicant considers what action would be taken in such an event. This may require a table-top exercise involving mine management, heavy equipment operators, engineers, first responders and any other personnel that are likely to be called upon to assist. The applicant should consider, but not restrict themselves to, the following:

$ Describe the probable extent of the downstream innundation.

$ Describe the local impacts of a sudden release of tailings.

$ Is human health and safety at risk?

$ What immediate steps would the applicant takes to minimize/mitigate possible environmental damage?

$ Notification of downstream users and communities.

$ Chemical and physical characterization of the released tailings.

$ Describe the follow-up sampling program that would be employed to determine the extent of the contamination.

$ How would the applicant go about assessing the damage to fish and wildlife habitat?

$ Is there likely to be any wildlife (including fish and birds) fatalities as a result of an accidental tailings release?

$ How would the applicant go about effecting the clean up and remediation of the impacted areas?

Winter/All Weather Road Operations

$ Speed on winter and all weather roads should not exceed: 30 km/hr for fully loaded vehicles; 50 km/hour for empty vehicles.

$ Trucks should carry at least 10 square metres of polyethylene material (for lining a trench or depression), a spark-proof shovel & oil absorbent blankets or squares.

$ Trucks should carry reliable radio and/or satellite phone communications.

$ Trucks should carry sufficient response equipment for the safe removal of fuel from an overturned tanker (such as hatch cone covers, hoses etc).

$ In general, the applicant should be fully prepared to deal with spills resulting from vehicle accidents along the road, in a timely and efficient manner.

Hazardous Waste Management

$ The applicant is advised that they will have to obtain a hazardous waste generator number from GN-DOE in order to ship hazardous waste out-of-territory.

$ The applicant is advised that if they intend to store hazardous waste on site for 180 days or more, they will be required to register with GN-DOE as a hazardous waste storage facility. Registration is free but requires the applicant to fill out a questionnaire/form.

Spill Report Forms

The NWT-Nunavut spill report form has been updated and is available as an interactive electronic form. Within a few months, it is anticipated that the spill line will be able to receive e-mailed spill reports. Until further notice, however, the form is to be filled out and be faxed to the spill line as before.

The interactive electronic spill report form comes in two formats: Adobe PDF and Word. It should be noted that for the Adobe PDF version, in order to be able to fill out the form electronically and save it to disk for eventual transmission via e-mail, one must have the full (read-write) version of Adobe Acrobat. If one has Adobe Reader only, one can fill out the form but cannot save it to a disk. For this reason, GN-DOE developed a Word version of the spill form, which, although slightly inferior, works reasonably well.

Both versions are available on the GN-DOE's website at:

http://www.gov.nu.ca/env/

Click on "Applications and Forms".

Contact Information at GN-DOE

For any questions, clarifications and/or registration related to spill contingency planning, the applicant is advised to contact our Manager of Pollution Control, Robert Eno at (867) 975-7748 or reno@gov.nu.ca.