Attachment # 3

Submission to Nunavut Water Board by Environment Canada

By Lawrence Ignace, dated October 26, 2001

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RE: Review of Polaris Decommissioning and Reclamation plan.

Environment Canada has reviewed Cominco's Decommissioning and Reclamation Plan for Polaris Mine site and offer the following comments and recommendations for your consideration.

Cominco has conducted an extensive evaluation of surface contamination and assessment of disposal options for all installations and facilities of its Polaris mine site. In general EC has not identified any major concerns with the Plan with the exception of the approached proposed for Garrow Lake.

Garrow Lake

Final bathymetrics of the lake should be provided to indicate the bottom profile that exists following the removal of the tailings pipeline.

TeckCominco Response

- *Final bathymetrics will be conducted after the disposal of tailings into the lake has been completed to ensure there is a complete record of the bottom profile.*

The lowering of Garrow Lake to its natural levels has been occurring over the last two years with its final release planned for 2002. This will lower the lake level by approximately 2.5 meters which results in a approximately 30% reduction to the thickness for the mixolimnion layer (surface layer). This will also expose a new wetted shoreline of Garrow Lake which could lead to the introduction of sediments to the surface waters. This could impact the water quality of Garrow Lake for future release.

TeckCominco Response

- *Lowering of Garrow Lake to pre-impoundment levels will re-expose a previously exposed shoreline. The original shoreline has been exposed to long term surface wind and wave erosion. The potential for increased turbidity associated with wave action was greater during the period of impoundment where increasing the elevation of the lake submerged new shoreline that had never been previously exposed to wave action.*

- *As the shoreline is being gradually re-exposed, time for the draining and re-establishment of the shoreline is occurring. This change in water level is being monitored regularly by on-site Polaris mine staff. In 2001 the lake was not lowered beyond the minimum elevation obtained in 2000. As a result there will be an extra year to lower the lake to its original elevation relative to the schedule proposed in the Closure Plan. This will also ensure that the shoreline of Garrow Lake is gradually being re-established to allow for stability (e.g. re-introduction of permafrost) and continual monitoring during this initial phase of the Closure Plan (e.g. 2002-2004).*
- *Our monitoring plan (Attachment #8) has been revised to include the measurement of TSS of the surface layer of the lake to document on-going turbidity during and after lowering of the lake. The monitoring program also includes visual observations for stability of the lakeshore.*

It is also assumed in this plan that discharge from Garrow Lake will conform to the existing licence limits. Environment Canada recommends that, once "natural" discharge is allowed from Garrow Lake, the water quality should reflect, as near as possible, the natural background levels that existed before mining.

TeckCominco Response

- *In summary, within nine years it is predicted that the surface water quality of Garrow Lake will return to < 0.1 ppm Zn.*
  Paul Erickson of AXYS Environmental Consulting Ltd. has been modeling the behaviour of Garrow Lake as a tailings facility throughout the life of the Polaris Mine (e.g. 20 years of data). On an annual basis, the Surveillance Network Program ('SNP') data has been forwarded to Mr. Erickson and he has reviewed the data in relation to the model.
- *Included in the Closure Plan are graphs forecasting the water quality changes (Volume 2, Report # 3) through to 2005. In response to the reviewer's question, TeckCominco requested that Paul Erickson review this issue in more detail and extend the model's forecast through until 2010. In support of this, Polaris staff forwarded Paul the most recent SNP data collected in 2001. Paul's response to the issue of discharge water quality considers the latest data and his comments are included as Attachment #9.*
- *There is extensive data collected over the past 20 years of operating Garrow Lake as a tailings impoundment area supporting the conclusions of Mr. Erickson. TeckCominco feels that this provides adequate comfort and is reasonable for the prediction of water quality objectives that are part of the Closure Plan.*

The Garrow Lake report (volume 2 supporting documentation), used a model to predict the stability of the halocline and expected metal concentrations in the mixoliminion (surface layer). This model used data up to and including 1999, however it must be recognized that Garrow Lake is undergoing some immediate and large changes due to draw down (since 2000). Since this model is being used to predict into the future, these changes must be taken into consideration. In addition, if the Garrow lake dam is taken apart before these predictions can be verified, it poses a concern for long term water quality and downstream impacts.

TeckCominco Response

- *TeckCominco disagrees with the statement that the lake is undergoing 'large' changes due to draw down. The surface layer of the lake is being gradually returned to its original elevation. With the cessation of tailings deposition in the lake in 2002, the physical and chemical conditions of the surface layer of the lake will gradually change through natural processes to reflect* ***pre-mining conditions.*** *The behaviour modeling described above has been verified through an on site SNP. The modeling and sampling conducted over the past 20 years clearly demonstrated that the long term stability of Garrow Lake will not be impacted by the lowering of water level.*
  Environment Canada has not provided a scientific basis for their concern. Providing this would allow the TeckCominco an opportunity to respond more specifically to this concern.
- *The reviewer states that as the model is being used to predict into the future, the current changes must be taken into account. On an annual basis, Mr. Erickson receives updated data and reviews the performance of the lake relative to the forecasted performance from the model. The water quality*

forecast provided by Paul Erickson of AXYS Environmental Consulting Ltd. in Attachment #9 has been updated to include the 2001 SNP data to ensure the latest data is considered as part of this response.

EC recommends that the dam remain in place and that Cominco be allowed to discharge (via siphons) from Garrow Lake in order to reach and maintain the original lake level. A new water licence could be established with set licence limits to reflect that mining has stopped and no effluent is being placed in the lake. In addition to this, an appropriate monitoring program must be established to verify the predictions of the model, as well as, the overall water quality within the lake in all layers. At a minimum, this program should operate for 5 years after the lake has returned to natural lake levels with an evaluation occurring each year, preferably during the open water season. A winter evaluation could be added to the monitoring program to allow for a better understanding of the dynamics of the lake. Following each year and at the end of the five years of monitoring, an assessment should be conducted to verify the lake's stability and whether or not it is conforming to the model predictions. The next steps for Garrow Lake would depend on this five year assessment.

TeckCominco Response

- *TeckCominco strongly disagrees with the comment that the dam should remain in place for a 5 year period following returning the lake to its original elevation. The reviewer has not identified a technical rational for the concern, yet the consequences of the Water Board agreeing to the reviewer's recommendations are costly and logistically impractical for TeckCominco. The basis for TeckCominco's comments are as follows:*
  - *a) TeckCominco has already been sampling the water quality of Garrow Lake for 20 years and has invested in a comprehensive model that has been regularly updated. This provides TeckCominco with a high degree of certainty in regards to predictions in terms of water quality objectives and the behaviour of Garrow Lake upon closure of the Polaris Mine. The environmental risk associated with the mixing of Garrow Lake due to storm events during the potential open water seasons is extremely low (see below). It appears that Environment Canada has not considered this with the above comments.*
  - *b) The only mechanism that can physically cause the Zn levels in the surface layer of Garrow Lake to increase after disposal of tailing ceases in 2002 is a major wind storm event that occurs during the short period of time when the lake may be ice free. As discussed in the report titled 'Garrow Lake Dam, Effect of Removal on Lake Stability and Outflow Water Quality' (Report #3, Volume 2 of 4 of the Polaris Decommissioning and Reclamation Plan), it would take a wind speed of 105 km for 2.5 hours to cause mixing of the upper 1 meter of the halocline with the surface layer. Wind speed in Resolute from 1961-1990 has never reached this velocity for more than 1 hour (Note – the report in the Closure Plan has an error in Figure 4. The vertical axis labeled 'Duration' should be in days, not hours). If the top metre of the halocline were to mix with the surface layer, then the 'new' surface layer would be thicker by1 metre and, subsequent wind events would have to be even more severe to cause any additional mixing of the surface layer with the now deeper halocline.*
  - *c) In addition to the information included in the Closure Plan, TeckCominco requested that Paul Erickson of AXYS Environmental Consulting Ltd. update the information in the Garrow Lake water quality model and comment further on the water quality issues (Attachment #9).*
    - *In order to assess the effects of this unlikely event (105 km/hr wind for 2.5 hours), Paul Erickson calculated that if the top metre of the halocline did mix with the surface water in 2004, the resulting concentration of Zn in the surface layer would increase by 0.015 ppm. This would result in the surface layer of Garrow Lake having a Zn concentration of 0.26 ppm. This is approximately 50% of the current licence limit for Zn (0.5 ppm). If this mixing occurred subsequent to 2004, then the resulting Zn concentrations in the surface layer would be even lower (i.e. 2004 represents the worst case).*
    - *In 2004, if there was mixing of the top two metres of the halocline with the surface layer (would require a wind for 8 hours constantly sustained at 105 km/hr), the resulting Zn concentrations in the surface layer would increase by 0.07 ppm to 0.31 ppm. This is still*

approximately 38% below the current licence limit for Zn. If this were to occur subsequent to 2004, then the Zn concentrations would be even lower.

- *In both of the above cases, the resulting water quality remains within current licence limits, within the current Metal Mining Liquid Effluent Regulations and within proposed updated Metal Mining Effluent regulations.*

d) *The cost of leaving the dam in is substantial. It is also impractical from a logistics perspective. Leaving the dam in place after the island is abandoned would require personnel returning to the island each discharge season, establishing a camp and remaining on the island to operate the siphon system. This would be required on an annual basis until the decision is made to remove the dam. At that time, substantial heavy earth moving equipment, crews, a large camp and fuel storage facilities would need to be re-established on the island. Roads would either need to left intact after mine closure or need to be re-activated to transport fill removed from the dam to the designated disposal area in Little Red Dog quarry.*

e) *The Closure Plan proposes that Garrow Lake dam be decommissioned by partially removing the dam. This in itself is a contingency. If conditions were to occur that required containment of the lake surface waters, it would be possible to reconstruct the dam, as approximately 70% of the material would still remain in place.*

- *If monitoring results identify a significant departure from the predicted water quality over two successive sampling periods, TeckCominco will discuss with the Water Board and through it, to other regulatory agencies, the course of action that may be necessary. If there is concern for the water quality exceeding the applicable standards, then one of the options that will be considered is the re-construction of the dam for the purpose of temporarily preventing discharge while a solution is implemented.*
- *The reviewer proposes a winter component to the monitoring program to 'better understand the dynamics of the lake'. As identified above TeckCominco has invested considerable resources to develop a model and to collect data (including winter) over the past 20 years. TeckCominco believes that there is a good understanding of the lake dynamics after this extensive period of monitoring.*
- *The reviewer recommends that 5 years of monitoring occur after the lake has been returned to its original level. A comprehensive monitoring program is proposed in the Closure Plan for Garrow Lake prior to and after it has been returned to its original level in 2004. Monitoring is proposed until 2011. Details of the parameters to be sampled, sample locations and timing of the monitoring program are detailed in Attachment #8. The Closure Plan proposes regular reporting of the results. In 2011, a final review of the data collected will be done and a determination made whether the site (including Garrow Lake) is stable and performing as predicted.*
- *After the site has been abandoned in 2004, the monitoring plan (Phase 2) proposes sampling of the lake during the spring while the ice is still safe to work on. During the summer it is often not possible to access the lake monitoring station due to ice flows. The monitoring plan does propose to monitor wind speeds during the potential open water season. If a wind event occurs that has sufficient energy to potentially mix the upper metre of the halocline, then additional sampling of the lake will be attempted before it freezes up.*

No definitive information was provided within Polaris's Decommissioning plan that demonstrated the current health of the aquatic biota within the lake. EC recommends that an assessment/status of the biota for Garrow Lake specifically within the mixolimnion (surface layer) be carried out. Special attention should be paid to the *Myoxocephalus quadricornis* (Four Horned Sculpin) a listed species of concern with the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

TeckCominco Response

- *With respect to the request for a post-decommissioning assessment of the presence of aquatic biota in the surface layers of Garrow Lake, TeckCominco does not agree that this should be required for the following reasons:*
  - *Garrow Lake was designated as a 'Tailings Impoundment Area' pursuant to Subsection 5(2) of The Metal Mining Liquid Effluent Regulations' under the Fisheries Act by the Minister of Fisheries and Oceans in 1981.*

- *During the application period for the current Water Licence, DFO had requested studies to relate the relevance of data on metal concentrations in the water to those concentrations in fish and macro-invertebrates. The Water Licence granted did not require these studies either to support the application or as a condition of the Licence.*
- *New Metal Mining Effluent Regulations have been gazetted and it is expected that they will come into effect in 2002. Under the proposed legislation, Garrow Lake is specifically named as a tailings impoundment area. It is one of 5 lakes in Canada with this designation. Under the proposed regulations, which will be administered by Environment Canada, there will be the requirement to conduct Environmental Effects Monitoring ('EEM'). It is important to note that under the regulations, the required location for the EEM is downstream of the discharge point of Garrow Lake and not within the lake itself.*

– *If Environment Canada or DFO wishes to conduct an assessment program of aquatic biota within Garrow Lake, TeckCominco would be prepared to provide logistical support for the work while there are facilities on the island.*

Further Comments:

Contaminated Soils

The disposal option for the underground storage of contaminated soils is an acceptable approach. However a detailed account of volumes, types of contaminated material, exact location/s and details regarding the geology of the placement area should be provided. The portals and other accesses to the mine will be sealed but there was no mention in the plan where the contaminated soils will be placed. EC recommends that the contaminated soils be sealed into place to further encapsulate the contaminated material. This would ensure that if, for any reason there is a change, such as climate change causing the loss of permafrost to this depth, the material would not have a direct route to the surface.

TeckCominco Response

- *To confirm and refine the volumes of contaminated soils, Gartner Lee Ltd. developed contour plans complete with cross sections utilizing sampling data. This was done in the area of the barge/product storage and dock areas, as these were the most complex areas containing the majority of the contaminated soils. If soils contain both hydrocarbons and metals, the material is categorized as hydrocarbon contaminated for the purpose of selecting the disposal location within the mine. There are 29,200 cu.m. of hydrocarbon containing soils to be removed and encapsulated in the mine workings. There is an additional 61,750 cu.m. of metals contaminated soils identified for removal and burial in the mine.*
- *The staff at Polaris have reviewed the volumes of materials to be stored underground and identified the storage locations in the mine for these materials. A memorandum complete with two drawings identifying the locations are attached (Attachment #10).*
- *The hydrocarbon-contaminated soils will be sealed into a remote location in the mine. Through Gartner Lee Ltd. TeckCominco requested comment from an additional technical expert on the subject. As a result, Dr. Chris Burn was requested to respond to the question of storage of hydrocarbon contaminated soils in the mine. Dr. Burn's curriculum vitea and response is attached (Attachment #6).*
  - *Dr. Burn recommends that the stopes where the hydrocarbon contaminated soils are placed, have the floor wetted to ensure any voids in the rock are sealed by ice. This will be done.*
  - *It is important to note that the hydrocarbon contamination that is to be stored underground **is not in the free fluid phase**. It is attached to fine soil particles and as such will not mobilize in the underground environment. Complete freezing of the contaminated soil in conjunction with an impermeable boundary of ice (as outlined above) will ensure containment. The papers referred to in Mr. Burn's response deal with free flowing hydrocarbon contamination.*
  - *The review by Dr. Burn also clearly shows that there is no issue of permafrost degradation at the depths that the contaminated soil will be stored in the mine.*

It is important to note that the hydrocarbons are encapsulated in a location remote from other mine workings. Access to the area is limited and as an additional measure of protection, the access tunnel will have a wetted earthen plug installed and allowed to freeze.

Fuel Tanks

For the incineration of tank sludges, waste oil and maybe glycol, no details were provided on the type of incinerator to be used. An approved two stage incinerator should be used.

TeckCominco Response

- *The decommissioning work at the site is currently out for tender. Proposals from contractors include different methods for dealing with tank sludges, waste oil and glycol. It is premature to determine which methods will be used, but all of the methods described below are acceptable under current regulations and practices:*
  - *Place the recovered hydrocarbon sludge and/or glycol into approved shipping containment and transfer the materials to southern Canada where they will be either recycled and/or disposed of through a certified disposal company.*
  - *Incinerate hydrocarbon waste sludges. There are no territorial regulations or guidelines governing the approval or operation of incinerators in Nunavut. There are also no Federal regulations or guidelines for the operation of small incinerators for non-hazardous materials. If incineration is selected as the preferred disposal method, a two-stage incinerator (as recommended by the reviewer) would be used to ensure thorough combustion of the products being incinerated.*

Landfills

EC has no significant concerns with the design or cover materials chosen. However, as indicated in Polaris Landfill Closure Plan it is recommended that further durability tests should be undertaken to evaluate "shale" as a cover material. EC concurs that further durability tests should be conducted in order to ensure long term stability of the cover materials from freeze/thaw degradation.

TeckCominco Response

- *Originally when the Closure Plan was developed, it was anticipated that the material to construct the landfill covers would consist of either gravel located adjacent to the Operational Landfill or shale from the New Quarry. Both materials are available for use at the site. As the gravel is closer to the Operational Landfill, it is the preferred material for that location.*
- *Shales are commonly known to be subject to slaking and it is assumed that this is the basis of the question raised by the reviewer. However, the calcareous shales that are typical of the area around the Polaris Mine are relatively competent. In practical terms, durability tests only simulate the active layer processes. This is an over-estimation as diurnal freeze-thaw cycles at this latitude are limited. In the event that the use of shale is selected for cover material, samples will be taken and submitted for standard ASTM freeze-thaw and mechanical breakdown testing prior to being used.*

Marine Study

There were indications of contamination of the marine environment surrounding the current works at Polaris mine, however, no recommendations were provided as to how this might be addressed. Understanding that the remediation of contamination in the marine environment may cause more problems than it solves, EC recommends that further monitoring should occur to determine if there is continued contamination into the future. For example, the site in front of the operational landfill should be monitored.

TeckCominco Response

- *Pre-mining sampling of ocean sediments conducted by DFO indicates the presence of metals above the CCME probable effects level (PEL) in some areas near the Polaris Mine site.*
- *In the area of Garrow Bay, no pre-mine data is available. Sampling conducted in 1999 by Gartner Lee Ltd. indicates that in Garrow Bay, adjacent to the Operational Landfill, some sediment contain metals concentrations above the CCME probable effects levels. While there is no information to suggest or to dismiss that the metals levels in the sediments are related to the effects of the adjacent Landfill, the Closure Plan proposes isolation of the Landfill in a manner that eliminates the potential for migration of metals contamination into the marine sediments.*
- *The proponent agrees with the reviewer's comment that in the marine environment attempts to remediate metals concentrations in sediments would cause more problems than it solves.*
- *The proponent agrees to monitor metals concentrations in sediments as recommended by the reviewer. Refer to Attachment #8 for revisions to the proposed post-closure sampling plan. The sampling plan includes sediment sampling at three locations upon the completion of remedial activities at the site in 2004 and again at the end of the proposed monitoring program in 2011.*

Monitoring

Post Closure Monitoring Phase I and II provides a general understanding of what will be done. However, there is need to develop a more detailed monitoring plan including the location of stations, a list of parameters to be measured and frequency of sampling/observations for each station. This is important when confirmatory testing of remediated soils is being conducted during Phase I of the post closure monitoring program.

TeckCominco Response

- *Refer to Attachment #8 for a detailed description of the post-closure monitoring plans.*

If you have any question or concerns please contact me at (867) 975 4639 or Email lawrence.ignace@ec.gc.ca

Sincerely

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