Dec. 1st, 2011

Mackenzie Valley Environmental Impact Review Board
Round Two Information Requests
EA 0809-02: Giant Mine Remediation Project

Review Board IR# 1 Climate trends and contingency measures

To: Giant Team

Reference

- DAR s. 6.2.7 Long-term Freeze Maintenance, p. 6-30/31
- DAR, s. 6.2.8.2 Thawing and Climate Change, p. 6-37
- Response to Undertaking No.2 and No.4 (November 15, 2011)

Terms of Reference Section

ToR s.3.1.2

"Consideration should be given to the impact of the environment, such as the impact of extreme weather events or climate change, on the development in each of the sections of 3.2, where applicable."

ToR s.3.3.1

1b. "With the best available information, (provide) a prediction of the amount of active freezing, the amount of passive freezing, power requirements, numbers and general locations of thermosyphons that will be necessary to achieve stability"
1c. "An illustration of the stability of the proposed system for a duration of at least 100 years after converting the active freezing system into a passive system."
10. "An account of how climate change predictions and observations affect the risk level in the long term based on "best estimate" and "high estimate" scenarios, including discussion of risks in light of the current climate predictions as set out in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change"

Preamble

The frozen block design and the assessments of the possible risks associated with failure of active and passive freezing are based on a climate change scenario. In the response to Undertaking No. 2 the developer state:

> *"The climate change scenarios assumed in the various Giant Mine reports were all intended to represent conditions in the year 2100. … For example, the graphs presented in the response to the MVEIRB's Information Request 3 cover a mean annual temperature range from today's values to an increase of 7.9 °C, which exceeds the 3.8 – 6.0 °C range of "worst case" temperature increases predicted by CCCSN's ensemble-mean scenarios"*

The ToR requires an illustration of at least 100 years after converting the active freezing system into a passive system, which will likely be around 2150. Further, the developer has specified that the solution is required to work in perpetuity.

As for projected changes in precipitation and the effect on hydrology, the developer's response to Undertaking No. 2 from the Technical sessions states:

> *"Potential climate change effects were not explicitly incorporated into the design basis for the Baker Creek remediation at the Giant Mine […]. However, the 1:500-year event specified as the current design discharge was increased by approximately 10% (from 22.8 m^3/s to 25.0 m^3/s) from that indicated by the results of a frequency analysis of Baker Creek flood flows. The design also accommodates […] bedfast ice […] as well as […] freeboard, the combination of which provides a conservative design to accommodate flows greatly in excess of the design discharge. The capacity of the channel before reaching the lowest spill point is approximately 58 m^3/s when only the ice accumulation is considered, and approximately 183 m^3/s with an ice-free channel that uses the entire freeboard allocation." (p2)*

> *"The two Canadian climate models discussed here both fail to accurately represent baseline conditions and yield very different results for future projections, in particular when monthly and seasonal precipitation values are considered." (p6)*

Requests

1. Please provide describe on potential long-term climate trends (i.e. more than 100 years from completion of the freeze implementation). Include a discussion of how the identified contingency measures, such as active freezing of the thermosyphons or increasing Baker Creek channel and floodplain capacity, have been incorporated in the risk assessment.
2. Considering the response to the previous point, please describe how the likelihoods for climate change related measures have been selected.

Review Board IR# 2 Risks to the Project from Baker Creek

To: Giant Team

Reference
DAR Section 6.9.2 Method Selection, Alternatives and Preferred Alternative

Terms of Reference Section

ToR s.3.2.5 Accidents and Malfunctions

Preamble

In the Developer's Assessment Report the proponent dismissed the possibility of diverting Baker Creek around the project site because surface water at the site would still need to be collected and discharged to Great Slave Lake. Section 6.9.2 (Page 6-86) states:

> *"The option of rerouting Baker Creek around the mine site entirely was examined as part of the method selection analysis. However, this option was discounted due to the fact that the mine site catchments would continue to drain to the current channel and a creek would continue to exist, albeit with significantly reduced flow."*

The Review Board notes the following:

- During the Technical sessions, the developer stated that "one of the greatest site risks at Giant Mine is Baker Creek" (Day 2, p207), and confirmed that the developer would "be willing to pursue relocating it if the creek were to pose an unacceptable long-term risk to arsenic containment" (Day2, p208)
- In the technical session, the Board's technical advisor on risk assessment noted 1) that the project's design tolerances mean there was a five percent probability of failure to contain Baker Creek during the first 25 years; and 2) this was characterized as a "staggering" risk considering the implications of failure during that period. (Day 4, p262).
- In response, the developer stated that it acknowledges the risk, that is not comfortable with the risk, and that is why the Giant Team has started looking at the north diversion of Baker Creek as a contingency (Day 4, p262).

Because of the risks associated with Baker Creek, it is important that the Review Board understand the options and trade-offs as they relate to project design and implementation.

Requests

1) Please describe the channel design criteria that are required to reduce the risks associated with Baker Creek to acceptable levels.
2) Please describe the effects that the above design criteria would have on the proposed mine remediation plans such as channel location, surface water drainage, schedule, accommodation of fish habitat, and any other relevant considerations.
3) What does the Giant Team consider to be the most significant constraints, limiting the diversion of Baker Creek around Giant mine site (e.g. costs, engineering, permitting process, etc.)?

Review Board IR# 3 Fish Habitat

To: Giant Team

Reference
DAR 7.4.3- Aquatic Environment, Site Study Area

Terms of Reference Section

ToR s.3.5.2 Fish and Aquatic Habitat

2."(Provide) A description of potential impacts to fish and fish habitat, including predicted habitat losses or gains from the proposed development"

Preamble

During Day 2 of the Technical Session, the developer identified the possibility of re-routing Baker Creek to avoid the mine site. Historical observations indicate that fish continued to use Baker Creek during mine operation and that fish use of the creek increased as water quality improved following the cessation of ore processing in 1998. Physical habitat was also heavily affected during the operation of the Giant Mine and little of the original channel remains. The DAR describes that impacts are expected to persist until the remediation and rehabilitation activities in Baker Creek are completed in project year seven.

With one exception (the Reach 4 re-alignment in 2006), there has been to description of consideration given to providing fish habitat in the re-aligned sections. The Reach 4 re-alignment was constructed before the remediation plans had been developed and before a risk analysis of the creek to the project. The Review Board notes that the majority of Baker Creek at the project site is a human-constructed diversion channel, and that it is likely that any remediation and rehabilitation works will result in a human-constructed diversion channel with engineered habitat features.

Request

1. Can habitat similar to that which exists in Baker Creek be constructed in a diversion channel?
2. Taking into consideration the possibility of connecting and therefore augmenting habitat productivity in natural water bodies in the diversion plan, please provide a comparison of the habitat accounting for a) maintaining Baker Creek at site constructed to the design criteria that reduce to acceptable levels the risks that the creek poses to the project; and b) a preferred diversion channel design. Please include the effect of schedule lag between completion of the remediation and rehabilitation activities and the construction of a diversion channel.

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Review Board IR# 4 Surface water and project design

To: Giant Team

Reference

DAR 6.9- Remediation Project Description- Baker Creek
Developer's June 17, 2011 response to Review Board Round One IR#12
Technical Session, Oct. 18 2011
Technical session undertaking #2

Terms of Reference
ToR s.3.2.5 Accidents and Malfunctions

Preamble

In the developer's presentation on water management during the Technical Sessions and in its response to undertaking No 2 indicated the hydrologic design criteria for Baker Creek are "conservative". However, there is no clear indication of how the term conservative is defined in the context of the design basis. This lack of clarity of definition makes it difficult to understand which criteria are considered conservative in an absolute sense and which are conservative only in a relative sense.

For example, the 1:500 year flow estimate was initially derived from a shorter period of flow records. When the estimate was recalculated using a longer period of flow records, the value decreased by approximately 10%. Nevertheless the higher flow value has been carried forward in the design basis and this is referred to as being conservative. However, this approach does not take into consideration the overall uncertainty associated with either estimate, and consequently it is not possible to assess the overall conservatism of the design basis for Baker Creek.

The 1:500 year design flow is an estimate by extrapolation. As is the case with all estimates there is associated uncertainty that is typically referred to as the confidence limits of the estimate. The estimate can have a high probability of occurring within the confidence limits (e.g., 95% is a commonly used probability) but the probability of the stated design flow value actually occurring is lower, and often considerably lower. Freeboard allowances need to take this uncertainty into consideration but there is no indication in the documentation provided to date what the uncertainty of the design flow is (i.e., the width of the confidence limits) and consequently how the design basis is conservative in consideration of this uncertainty.

Request

1. What are the confidence limits surrounding the 1:500 year design flow for Baker Creek? Does the channel design as presented in the DAR accommodate the upper 95% confidence limit for this design flow? If not, how would the design change in order to accommodate the upper confidence limit, at what additional cost, and what implications would this design change have for potential fish habitat compensation works?
2. The development of anchor ice in the Baker Creek channel is a relatively recent occurrence but in recent years appears to occur with some consistency. Given the recently common occurrence of anchor ice, how is the inclusion of an allowance for anchor ice in the design basis in any way conservative and not just representative of current conditions?

Review Board IR# 5 Climate change and design of Baker Creek

To: Giant Team

Reference
DAR 9.2.2.2 Potential Climate Change Effects
Technical Session Undertaking #2

Terms of Reference

ToR s.3.1.2

"Consideration should be given to the impact of the environment, such as the impact of extreme weather events or climate change, on the development in each of the sections of 3.2, where applicable."

ToR s.3.3.10
"An account of how climate change predictions and observations affect the risk level in the long term based on "best estimate" and "high estimate" scenarios, including discussion of risks in light of the current climate predictions as set out in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change".

Preamble

The developer's response to Undertaking #2 from the October technical sessions indicated there was no explicit incorporation of climate change into the design basis for the Baker Creek remediation. The justification for this decision was detailed in Attachment 1 of the response to Undertaking #2 filed by the developer. This response makes reference to the continuing uncertainty regarding the location-specific effects on climate parameters, such as precipitation, that may accompany the more-generally agreed-upon location-specific increases in temperature that are expected to result from climate change. Predictions of future (2071-2100) precipitation in the project area are presented for two different climate models and these indicate that 13 to 27% higher annual precipitation in comparison to the 1971-2000 period.

The predicted increases in precipitation have not been incorporated into the project design because of concerns regarding the applicability of these models to adequately predict the 1971-2000 baseline conditions, with one model under-estimating annual precipitation by 4% and the other model over-estimating annual precipitation by 18%. Variances were greater when considered on a monthly basis. These results are considered to be a limitation of the large spatial scale of the models which provides poor spatial resolution. Other concerns are indicated as well leading to the decision to not explicitly incorporate predicted increases in precipitation into the project design at this time despite the generally accepted wetter conditions that will occur with the warmer temperatures as a result of the greater moisture holding capacity of warmer air.

Evapotranspiration is expected to increase as well, with both precipitation and evapotranspiration affecting watershed runoff and stream flows. Notably, the evapotranspiration predictions were not examined as critically as the precipitation predictions yet, in the absence of critical review, these losses were considered to likely cancel out any increase in precipitation that may occur.

One factor that was not examined in the analysis of climate change effects at all is the potential effect of the expected warmer conditions on the Probable Maximum Precipitation (PMP) event. The water holding capacity of air increases with temperature, as does the PMP with the result of larger storm-based rainfall events, the consequences of which are not significantly attenuated by increased evapotranspiration.

Request

1. Given the stated incorporation of conservatism into the design basis for the Baker Creek remediation, and notwithstanding the questionable level of conservatism associated with the stated design considerations, please clarify how the decision to not incorporate any explicit consideration of climate change into the design basis is consistent with a conservative project design that effectively manages the project risks associated with flooding from an overtopping of the Baker Creek channel.

2. Please describe how climate change is expected to affect the probable maximum precipitation for the project site.

3. Please describe how the Baker Creek channel, as designed, will handle the current and potential future probable maximum precipitation flow.

Review Board IR# 6 Future Review

To: Giant Team

Reference
Technical sessions Oct. 20, p 213 and 247

Terms of Reference
N.A.

Preamble

At the Technical Session, parties expressed concern over the idea of transferring impacts and responsibilities to an unlimited number of future generations. The Developer has committed to an independent examination of relevant emerging technology every ten years, and has committed to reviewing the project after one hundred years to determine whether it is doing what it is supposed to, and whether it is the correct approach to continue. The developer indicated that this may involve other stakeholders.

The Review Board does not require a high level of detail about these future processes, but would like a better general understanding of what these entail.

Request

1. Please clarify how the independent reviews of emerging technology every ten years will be conducted over the long term.
2. Please clarify if and how the hundred-year review will include other stakeholders, and, in general terms, the mechanisms that will ensure an objective review.

Review Board IR# 7 Perpetual Care

To: Giant Team

Reference
Perpetual Care Workshop, Sept. 26, 2011
Technical sessions Oct. 21, p 183

Terms of Reference
N.A.

Preamble

The site will require active management, including water treatment and regular replacement of various important components, for perpetuity. The developer has indicated it would study other perpetual care sites for lessons that are applicable to the Giant Mine Remediation Project. The report of the Perpetual Care workshop identifies several other perpetual care case studies with lessons for the Giant project.

At the Technical Session, parties discussed ways to communicate risks about the site and responsibilities to people in the distant future about the site, and challenges of communicating with people 5000 or more years from present considering changes in languages and culture over such timescales. The Perpetual Care workshop examined how this communication issue is being dealt with at other perpetual care sites elsewhere.

Request

1. Please describe how the Giant Team has examined other perpetual care projects, what lessons have been learned, and how they will be applied to the project.
2. Please describe any approaches being considered for communication with future generations over the very long term.

Review Board IR# 8 Fish habitat, creek diversion and risk management trade-offs

To: Department of Fisheries and Oceans

Reference
Technical Session Oct. 18 p235

Terms of Reference Section
ToR s.3.2.5 Accidents and Malfunctions

ToR s.3.5.2(2) Fish and Aquatic Habitat

"A description of potential impacts to fish and fish habitat, including predicted habitat losses or gains from the proposed development"

Preamble

The DAR indicates that the majority of Baker Creek at the project site was constructed to convey surface water across the project site. Much of Baker Creek on the mine site appears to be a human-constructed diversion channel. At the completion of the remediation and rehabilitation works Baker Creek will remain a human-constructed diversion channel but with the addition of engineered habitat features.

Fisheries and Oceans Canada made a number of statements at the technical sessions (October 18, 2011, p235-237) about Baker Creek regarding the possible importance of Baker Creek to Arctic graying in the region and the uncertainty of Arctic grayling productivity/habitat availability in other streams in the region, such as the Yellowknife River. Fisheries and Oceans Canada also stated "in terms of population information, we don't know the importance of Baker Creek to the overall grayling populations in Yellowknife Bay. There hasn't been that study done".

The Review Board is interested in the views of Fisheries and Oceans Canada in reconciling the habitat value of Baker Creek against the risks to the project from creek flooding or overtopping, and related contingencies regarding the diversion of Baker Creek.

Request

1. Has Fisheries and Oceans Canada conducted any studies using defensible methods that support its statements regarding the regional importance of fish habitat in Baker Creek and the availability of habitat in other water bodies such as Yellowknife River?
2. Taking into consideration the risk analyses in the first round of information responses and the discussions at the Technical Session, in DFO's opinion, what level of risk to the project from Baker Creek would be enough to justify diverting it?