



# Dominion Diamond Ekati Corporation Jay Project Water Licence W2013L2-002

Yellowknife, NT

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Government of  
Northwest Territories

# Presentation Overview

- Introduction
- Management Plans
- Geotechnical Considerations
- Construction
- Operations
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- Reclamation Security



# Introduction

- DDEC has proposed to construct Jay Pipe within Lac du Sauvage.
- ENR has attended technical sessions and participated in regulatory process to date.
- The following outlines ENR's concerns and includes recommendations to the WLWB.



# Management Plans

- DDEC included several plans for which they requested Board approval.
- ENR notes that a WL must be issued before a plan can be approved.
- ENR is supportive of an expedited review process following water licence issuance.
- ENR refers the Board to our Intervention for specific comments/recommendations.



# Dike Design

- DDEC is requesting approval of the Jay Dike and North Dike Detailed Design Report.
- Measure 4-4 of the Report of EA required the establishment of a dike review panel.
- It is noted that the dike panel review process may result in additional recommendations to revise/update the design and operation of the dike.



# Dike Design

- **ENR recommends that the water licence include a term and condition requiring DDEC to notify the Board regarding how they will address the panel's recommendations in regards to dike design and associated operational plans. It is recommended that DDEC submit this information to the WLWB within 30 days of completion of the panel recommendations.**
- **ENR recommends that the Board review process for the dike design coincide with the dike design review panel's process. This should provide an efficient review process and ensure the Board has the necessary information to make a sound decision on the document.**



# Dike Design

- Hydraulic Gradient: The difference between the upstream and downstream water levels over the flow path length within the dike foundation.
- During dike design and operation, it is necessary to mitigate against the erosion of the foundation soils by setting the hydraulic gradient design value lower than the critical hydraulic gradient.
- It is concerning that only a limited number of hydraulic conductivity tests have been completed to assess the critical hydraulic gradient.



# Dike Design

- A depressurization system (e.g., wells or toe drain) may be required to control the hydraulic gradient within the foundation of the dikes.
- No established trigger to denote the need for installation and operation of a depressurization system.
- Maintaining the hydraulic gradient below the design values is a critical element of dike stability.



# Dike Design

- **ENR recommends that dike design documentation include additional information to describe the timing and locations for installation of monitoring instrumentation to assess the foundation pore-water pressure.**
- **ENR recommends that a trigger or threshold be established to identify when a depressurization system is required as this relates to dike stability.**
- **ENR recommends that the response actions to install a dewatering system be included in the dike design documentation or other suitable dike construction plan.**



# Dike Design

- **ENR recommends that all lakebed sediment hydraulic conductivity results be provided. The information could be included in an updated Table 4-5 of the factual report (Golder, 2016a). Based on the time to test the sample, it is likely that this data could be available mid to late November.**
- **ENR recommends that the dike design engineer utilize the laboratory testing completed on the lakebed sediments to evaluate the selection of the critical hydraulic gradient used in the design. This information could be included in an updated dike design report and/or an addendum to the dike design report.**
- **ENR recommends that DDEC indicate whether additional sediment hydraulic conductivity testing will be completed to assess and evaluate the critical hydraulic gradient. If not, rationale should be provided.**



# Dike Design

- Operation, Maintenance and Surveillance Plan for the operation period of the dike have not been completed to date.
- DDEC has proposed that this plan would be developed and implemented prior to the dewatering, anticipated in 2020.



# Dike Design

- **ENR recommends that the water licence require an Operation, Maintenance and Surveillance Plan for the dikes be developed for review and approval six months prior to dewatering.**
- **ENR recommends that the water licence require the submission of the Jay and North Dike detailed design drawings. These drawings should be:**
  - Submitted 30 days prior to construction
  - Signed and stamped by an engineer
  - Labeled “issued for-construction” or equivalent
- **ENR recommends that the updated drawings be accompanied with an itemized list of revisions.**



# Dike Design

- Local esker material used for road.
- Potential for degradation of permafrost.
- Limited information regarding mitigation measures.



# Dike Design

- **ENR recommends that the water licence, under an appropriate management plan, require details regarding inspection of mine infrastructure, roads and eskers.**
- **ENR recommends that the management plan also outline mitigation measures and contingencies to address permafrost degradation or slumping that may occur from excavating material from local eskers.**



# Construction

- Dike construction early 2018 to 2020.
- Double turbidity curtain will be applied to mitigate TSS impacts to water quality of Lac du Sauvage.
- DDEC has also submitted a CEMP which outlines TSS limits, triggers and mitigation measures.



# Construction

- DDEC's proposed sampling locations:

## Winter

- CEMP monitoring will occur 100 m from the toe of the rockfill placement front.
- SNP locations will be approximately 200-250 m from the dike edge.

## Open Water

- CEMP monitoring will be established at the outer turbidity barriers in the main basin of Lac du Sauvage.
- In response to Second Round IR16, DDEC has proposed that SNP sampling will now occur 50 m from the outer turbidity barrier.



# Construction

- Currently, both CEMP and SNP appear to be in close proximity outside the outer curtain.
- CEMP stations are intended to be “early-warning”.
- SNP stations should be similar to other operations in the area.



# Construction

- ENR recommends that the CEMP monitoring stations during the winter construction season be located 100 m from the centreline of the dike.
- ENR recommends that the SNP monitoring stations during the winter construction season be located 200 m from the centreline of the dike.
- ENR recommends that the CEMP monitoring stations during open-water construction season be located halfway between the inner and outer curtain.
- ENR recommends that the SNP monitoring stations during the open-water construction season be located 50 m from the outer curtain.
- ENR recommends that the locations for the silt curtains during the open-water construction season be moved closer to the dike such that the outer curtain is 150 m from the centreline of the dike.



# Construction

- DDEC has proposed the following TSS limits for the compliance point:
  - Daily Maximum TSS Concentration: 200 mg/L
  - Maximum 30-day Average TSS Concentration: 25 mg/L



# Construction

- **ENR recommends the following TSS limits for the Jay dike construction:**
  - **A maximum daily TSS limit of 50 mg/L (max grab).**
  - **A 7-day moving average TSS limit of 25 mg/L (max avg.).**
  - **A 30-day moving average TSS limit of 11 mg/L (long term avg.).**



# Construction

- DDEC has now proposed SNP sites 50 m outside the outer turbidity curtain, making it unclear where the CEMP early warning sampling would occur.
- CEMP stations should be located to provide early warning.



# Construction

**ENR recommends that following triggers and monitoring locations be established as part of the CEMP during dike construction:**

## **Winter:**

- **A short term daily CEMP trigger concentrations value should be set at half (25 mg/L) of ENR's proposed maximum daily limit (50 mg/L) 100 m from the centreline of the dike.**
- **A longer term 7-day average CEMP trigger concentration be set at 15 mg/L 100 m from the centerline of the dike.**
- **A longer term 30-day average CEMP trigger concentration be set at 5 mg/L 100 m from the centerline of the dike.**



# Construction

## Summer:

- A short term daily CEMP trigger concentrations be set at half (25 mg/L) of ENR's proposed maximum daily limit (50 mg/L) halfway between the inner and outer curtain as close to 100 m from the centerline of the dike as possible.
- A longer term 7-day average CEMP trigger concentration be set at 15 mg/L halfway between the inner and outer curtain as close to 100 m from the centerline of the dike as possible.
- No 30-day average CEMP trigger concentration as there is a second curtain between the CEMP sample location and the proposed SNP station.



# Toxicity Modifying Factors

- DDEC proposes using anthropogenically derived water hardness to increase their discharge limits, by adjusting their SSWQO and EQC to reflect the hardness attenuating effect of higher hardness waters.
- ENR does not agree with this approach.



# Toxicity Modifying Factors

- The discharge of waste should be limited to the extent reasonably possible.
- The use of known toxicity modifying factor relationships should not be used to increase contaminant loads by taking advantage of “ameliorative” molecules coincidentally found in an effluent stream.
- Toxicity modifying factors should reflect the natural or pre-disturbance receiving environment.



# Toxicity Modifying Factors

- Concentrations of COPCs in the effluent could increase the zone of influence of an applicant over time.
- If ameliorative properties were found adjacent to other downstream users, they could seek to increase their releases of contaminants in their effluent stream.



# Toxicity Modifying Factors

- **ENR recommends that SSWQO for the Jay project should be established using baseline hardness concentrations for parameters where toxicity is affected by hardness.**
- **ENR recommends that EQC for the Jay project should be re-calculated using SSWQO based on baseline hardness concentrations.**



# Waste Discharge – Jay Project and Downstream Users

- During the technical sessions, there was discussion of potential impacts to DDMI from the release of effluent from the Jay Project.
- DDEC undertook additional modelling, to assess impacts to DDMI at as close to East Island and DDMI's mixing zone as possible. DDEC also did waste load allocation calculations for Ekati site discharge, DDMI's discharge and the flow through the narrows.



# Waste Discharge – Jay Project and Downstream Users

- ENR accepts the modeling results as provided by DDEC.
- Under the “Maximum Average EQC Scenario” in later years of extended discharge from DDMI (Yr. 6 & Yr. 8) cadmium, chromium and nitrate may exceed DDMI’s water quality benchmarks. However, the modeling also suggests that even under the “No Jay Scenario” that these same parameters do not meet benchmarks.



# Effluent Quality Criteria

- ENR notes that the predictions regarding water quality and effluent discharge have evolved from the EA and reflect a revised water balance and updates to analyte concentration predictions in the Misery Pit.
- Expected salinity concentrations in the Misery Pit at closure have decreased since the EA.



# Effluent Quality Criteria

- Changes to the Mine Plan since the environmental assessment include changes to the pumping rate from the Misery Pit to Lac du Sauvage.
- Pumping rate is now constant but is continuous throughout the year.
- Mine plan increased from 10 to 13 years and a change in the Jay Pit capacity.



# Effluent Quality Criteria

- ENR is concerned that EQC established now may be higher than necessary, particularly if unduly conservative assumptions are used.
- ENR believes that it is not appropriate to base regulatory limits on predictions subject to improvement.
- Given the length of time that is available before the discharge of effluent from Misery Pit, there is an opportunity to adjust EQC, prior to discharge, as additional information becomes available.



# Effluent Quality Criteria

- **ENR recommends that EQCs adopted in the water licence should not be based on overly conservative predictions of minewater. The quality of minewater and the resulting effluent have been improving over time as additional monitoring, assessment and modelling is conducted by DDEC.**



# Effluent Quality Criteria

- **ENR recommends that the EQCs adopted in the water licence align with the Pollution Prevention principle and Objective 2 of the MVLWB Water and Effluent Quality Management Policy (MVLWB, 2011).**
- **ENR recommends that the Board include a provision in the licence to review the EQCs and revise as additional information and operational data becomes available prior to discharge of effluent to Lac du Sauvage**



# Chloride EQC

- DDEC is proposing that the maximum chloride EQC would be 928 mg/L which is dependent upon hardness in the receiving water.
- ENR does not agree with using an anthropogenically increased hardness to modify a water quality objective and also notes that the CCME does not currently support a hardness dependent chloride guideline.



# Chloride EQC

- It appears based on mixing assessments presented by DDEC that Chloride concentrations should reduce within tens of meters from the diffuser and the degree of chronic toxicity will reduce with distance.
- However, the buffering capacity of hardness is of concern to ENR as the overall reduction of water hardness as opposed to the reduction of Chloride concentrations is unclear.
- Additionally, there are no operation data or modeling of dilution rates of Chloride in the mixing zone available at this time.



# Chloride EQC

- The degree of chronic toxicity of effluent with chloride concentrations up to 928 mg/L is still uncertain.
- Acute toxicity with chloride can occur as low as 649 mg/L, ENR notes that the more recent modeling suggests that chloride concentrations will be much lower than assessed in the EA.
- To address this uncertainty, ENR proposes that acute end-of-pipe toxicity testing and chronic toxicity testing at the edge of the mixing zone be required.



# Chloride EQC

- **ENR recommends that the baseline hardness adjusted maximum grab Chloride EQC be set on an interim basis. Following the collection of operational data, modeling and assessment, the Chloride EQC should be revisited by the Board**
- **ENR recommends that acute toxicity testing be conducted at end-of-pipe and chronic toxicity be conducted at the edge of the mixing zone as part of the effluent management program (i.e. SNP).**



# Chloride EQC

- To ensure that appropriate contingencies are in place if Chloride becomes acutely toxic to aquatic life later in the mine plan (Year 12-13), a contingency plan should be developed by DDEC to manage Misery Pit water.
- **ENR recommends that DDEC proactively develop an adaptive management response plan for acutely toxic effluent to be activated in the event that the discharge from the Misery Pit is determined to cause acute toxicity.**



# Total N Eutrophication Limit

- DDEC disagrees with ENR's recommendation that a total Nitrogen eutrophication limit be used to manage nitrogen (N) inputs to Lac du Sauvage. DDEC is proposing to monitor total phosphorus concentrations.
- ENR notes that the use of total nitrogen as an eutrophication limit/trigger would follow recent initiatives in other jurisdictions.
- CCME (2016) endorses the use of nutrient concentrations as opposed to response variables such as chlorophyll *a* for managing nutrients.



# Total N Eutrophication Limit

- ENR has presented in our Intervention a literature review suggesting that N and N-P co-limitation can occur.
- **ENR recommends that a total N based eutrophication objective should be included for the Jay project. A total N loading limit should also be considered to ensure no adverse downstream effects.**



# Mixing Zones

- DDEC provided a mixing zone assessment to analyze additional mixing zone sizes for COPCs to assess achievable EQCs for Misery Pit water discharge based on 150m & 100m mixing zones.
- DDEC's basis for the selection of a larger mixing zone (i.e. 200 m) is based off their interpretation of the draft guidance document for establishing regulated mixing zones in the Mackenzie Valley (MVLWB 2016).



# Mixing Zones

- ENR interprets the guidelines to be that the mixing zone should be 100 m and that a smaller mixing zone will be considered by the Board.



# Mixing Zones

- DDEC notes that some parameters in a smaller mixing zone did not result in a significant change in EQCs, particularly adjusted EQCs, with the exception of nitrate and cadmium during later years of operations.
- These non-achievable EQC's are similar to what DDEC is currently predicting with a 200 m mixing zone (not achievable at the 95th percentile).



# Mixing Zones

- DDEC has no current plan to make adjustments in response to existing 95<sup>th</sup> percentile cadmium or nitrate exceedences with a 200 m mixing zone area.
- **ENR recommends the Board set the regulated mixing zone area at 100 metres.**



# Meromixis and Monitoring

- Compared to the EA, the predicted groundwater inflows (quantity and quality) to the Jay pit are lower in the most recent analysis.
- During the EA DDEC committed to updating the water monitoring plans and response framework with the “final details on groundwater monitoring programs that will include the recommendations on measurement frequencies, reporting requirements and action levels”.
- ENR notes that this information has not been presented by DDEC in the water licence application materials.



# Meromixis and Monitoring

- **ENR recommends that the Water Quality Model that informs the Water Management Plan be updated based on operational data at a frequency of every 3 years at a minimum. The Water Quality Model shall include any updates to the surface water and groundwater components, as well as a re-evaluation of the stability of the meromixis.**



# Meromixis and Monitoring

- **ENR recommends that the groundwater monitoring and reporting program for the open pits during operation and closure phases be specified in the appropriate management plan (e.g., Water Management Plan or other) and the results documented in the Water Licence Annual Report.**



# Waste Rock Management

- DDEC has committed to completing additional field reconnaissance of the Jay WRSA to confirm assumptions in the geotechnical design.
- It is understood that waste rock could be placed within the WRSA as early as 2018, commencing with lakebed sediments and/or overburden soils.



# Waste Rock Management

- ENR recommends that the geotechnical field reconnaissance of the Jay WRSA be completed prior to any placement of materials within the WRSA.
- ENR recommends that the results of the geotechnical investigation be submitted to the WLWB along with an opinion regarding the implications of the work on the Jay WRSA design and routing for surface runoff and seepage.
- ENR recommends that the WLWB approval process for the Jay WRSA design consider the requirement to confirm the foundation characteristics of the WRSA and therefore the results of the geotechnical investigation.



# Waste Rock Seepage

- ENR notes that some rock within the WRSA will be potentially acid generating (PAG).
- There is currently no down gradient water quality seepage monitoring locations (SNP) or seepage management/collection systems proposed by DDEC.
- Contact water from the Jay WRSA should be monitored at seep locations as it is considered a waste under the *Waters Act*.



# Waste Rock Seepage

- **ENR recommends that seepage collection ponds or systems be designed and implemented as part of the Jay WRSA design.**
- **ENR recommends that the Board consider placing a condition in the water licence indicating that seepage water is to be collected and managed in accordance with an approved Water Management Plan for the Jay Project.**



# PAG Rock Segregation

- DDEC is proposing to co-place PAG rock with Non-PAG rock to achieve a bulk neutralization potential in the Jay WRSA.
- ENR notes that the primary method of geochemical management of PAG waste rock in the approved EKATI ICRP is by encapsulating those materials within permafrost.
- DDEC has placed less emphasis on permafrost encapsulation as the primary method for the Jay WRSA.



# PAG Rock Segregation

- **ENR recommends that encapsulating reactive materials within permafrost should be an objective for geochemical management of PAG waste rock.**
- The south side of the Jay WRSA may also have the greatest depth of active layer and infiltration, due to aspect and increased snow accumulation due to prevailing winds from the NW.



# PAG Rock Segregation

- **ENR recommends that the depth of outer granite zone should be increased to a minimum of 10 m along the south side of the WRSA as it is first constructed. Modifications to this depth through the life of the pile could be based on a more comprehensive assessment of updated thermal monitoring results, supplemented by additional ground temperature cables.**



# PAG Rock Segregation

- ENR still believes that further information is required on the proposed co-placement strategy, the ratios required, and the scale of mixing that will prevent acid drainage waters.
- More detail is still required on waste rock sampling.



# PAG Rock Segregation

- **ENR recommends that a Rock Placement and Verification Plan be further developed by DDEC and included in the WROSMP. The contents shall include at a minimum the proposed recommendations by DDEC with regards to operational controls and reporting. It is recommended that the WROSMP be submitted to the WLWB for review and approval 3 months prior to operations of the Jay WRSA.**



# PAG Rock Segregation

- **ENR recommends a special study be completed to confirm whether blending and layering will achieve non-acidic drainage waters and to evaluate the sensitivity of NP/AP to imperfect mixing. A potential test regime could include humidity cell tests of various ratios of PAG rock with non-PAG rock. The co-placement strategy would be updated based on the study findings.**
- **ENR recommends that a minimum set back distance from edge of the WRSA to PAG material greater than 5 m be implemented. A value of 10 m should be considered.**



# Lake Sediments and Till Stockpiling

- ENR agrees with DDEC's modified proposal of placing till and lakebed sediments from dike construction into the waste rock pile where it will eventually be buried.
- ENR is concerned with the timing of these processes and the stockpiling of this material, since it is important that a decision regarding the use of overburden material be made before this material is buried in the rockpile.
- **ENR recommends that a decision on the use of overburden material during reclamation needs to be made prior to beginning construction of the Jay pit.**



# Reclamation Security

- Overall, ENR considers the proposed security appropriate, but notes that several items (e.g. depth of non-PAG cap over co-placed metasediments, pit flooding schedule and details) will be further refined as updates are made to the ICRP.
- Updates to the security amount, and the allocation between land and water related security, should be completed as part of the ICRP update process



# Reclamation Security

- **ENR recommends that that the Board set the security for the Jay Project at the level estimated by DDEC, that this amount be added to the current Water Licence security, and that the security be reviewed annually and adjusted to account for any deviations in the maximum annual area of exposed PAG rock.**
- **ENR recommends that further updates to the security amount, and the allocation between land and water related security, be completed as part of the ICRP update process.**



# Thank You



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