April 7, 2015

Mackenzie Valley Environmental Impact Review Board
200 Scotia Centre
P.O. Box 938
Yellowknife, NT
X1A 2N7

Attention: Chuck Hubert, Senior Environmental Assessment Officer

Re: EA1314-01 Jay Project Dominion Diamond Corporation Developer's Assessment Report – Stakeholder Engagement, Diavik Diamond Mine Inc.

Dear Mr. Hubert:

In our letter to you dated March 19, 2015 we described the engagement that Dominion Diamond has been undertaking with Diavik Diamond Mine Inc. (DDMI). The discussions with DDMI resulted in three items for which Dominion Diamond has developed additional information relevant to the environmental assessment of the Jay Project. Dominion Diamond wishes to share that information with the Mackenzie Valley Environmental Impact Review Board (MVEIRB) and asks that the attached information be posted to the MVEIRB public registry for the benefit of all parties.

The three items addressed are:

1. Waste Rock Management Alternatives
2. Pit Flooding Timeframes
3. Minewater Management Alternatives

Dominion Diamond recognizes the importance of all Parties' concerns and is committed to meet with and work diligently to provide information and responses in a timely manner throughout the DAR review process.

Sincerely,

Richard Bargery
Manager, Permitting Jay Project
Dominion Diamond Corporation

C: Gord Macdonald

DDMI

DOMINION DIAMOND

Information Request Number:	DAR-DDMI-IR-Waste Rock Management Alternatives
Source:	Engagement with DDMI
Subject:	Waste rock management alternatives
DAR Section(s):	2.5.2 (Level 2 Alternatives Assessment)

Request (DDMI):

1) Guidance has been provided on cover systems for northern mines WLWB Guidance Link. Section 5.4.3 describes a Permanent Frozen Layer design concept. This design concept should be assessed.
2) In pit disposal of waste rock and aqueous cover is a recognized approach. The alternative of segregating this fraction with disposal in a completed open-pit followed by water cover should be assessed.

Response:

Seepage water from waste rock storage areas (WRSAs) at the Ekati Mine is sampled at least twice per year (spring and fall) through a walking survey around the outside of each WRSA. Samples are collected according to a protocol approved by the Wek’èezhìi Land and Water Board (WLWB) that requires collecting samples as close as practical to the toe of the WRSA to reduce the effects of surface water dilution, or other surficial effects externally to the WRSA. Details of how water flows through a rock pile is a technically challenging subject that has been and continues to be the subject of research projects undertaken by numerous organizations, including the long-standing industry-government Mine Environment Neutral Drainage (MEND) program. At the Ekati Mine, seepage water has been sampled regularly throughout construction of each of the three WRSAs, and therefore, represents changes over time. Evidence of changing internal flowpaths have been observed through occasional changes in the locations where water emerges from the toe of the WRSAs. At the Ekati Mine, seepage water has never been observed emerging at a location elevated above ground level.

Research into the internal flowpaths within waste rock piles is underway at the Diavik Mine and the results of this work may be applicable to understanding the internal workings of WRSAs at the Ekati Mine. However, for current purposes, the assumption is necessarily made that seepage water sampled from the toe of the Ekati Mine WRSAs is representative of water that has been in contact with waste rock placed in the WRSA. This is a reasonable assumption that is supported by a 15-year record of seepage water monitoring. The record of chemical analysis of seepage water reflects the presence of various rock types (such as kimberlite, granite, and metasediment) that are present in the WRSAs. As described in the Ekati Mine annual seepage reports to the WLWB, these chemical ‘signatures’ are at very low concentrations, which do not result in any adverse environmental impact.

Because research on flowpaths through rock piles is an ongoing study generally, professional judgement brings current technical understanding of the internal behaviour of rock piles to bear on analysis and interpretation of monitoring results. The Ekati Mine works with qualified professionals in the design of the seepage sampling program and in the interpretation of results. Results are publically reported annually and a 3-year interpretive report undergoes public review and approval by the WLWB. Through the WLWB review processes, broad-based technical expertise, in addition to that retained directly by the Ekati Mine, is routinely used to review the seepage sampling protocol and the interpretation of results. This provides an additional means of ensuring that the seepage monitoring program is current with the most recent published research results.

Response, Waste Rock Alternative Scenario 1

Summary Response

The Jay Project waste rock management plan is consistent with MEND Report No. 1.61.5c, *Cold Regions Cover System Design Technical Guidance Document, July 2012* (MEND 2012), which is posted by the Mackenzie Valley Land and Water Board under its general reference documents. The report was commissioned by the federal government to aid in its remediation of contaminated sites (primarily abandoned mines) in Canada's North. The report also contains information relevant to mine waste management in Northern environments generally.

Review of MEND (2012) (as described below) supports the proposed design for the Jay WRSA. The design of the Jay WRSA avoids the increased risks of complex covers which are unnecessary for the Jay Project, in favour of the simpler approach that is already in use (and approved) at the Ekati Mine. The proposed design appropriately mitigates environmental risk without introducing unnecessary complex construction and performance risks.

Supporting Rationale

There are two important aspects of the scope of MEND (2012) that are relevant to understanding its applicability to waste rock management for the Jay Project:

- The geographic scope for 'cold regions' in MEND (2012) ranges from areas of discontinuous or scattered groundfrost to the continuous permafrost found in the central Arctic at the Ekati Mine. Much of the report addresses issues related to covering mine wastes in areas south of the Arctic tundra where most of Canada's abandoned mines are located and where more extensive freeze/thaw effects, discontinuous ice lensing, increased precipitation, and boreal soils/vegetation create additional technical complexities.
- The report focusses to a large degree on issues related to covering tailings (i.e., rather than waste rock), which is of primary importance at many abandoned mines in Canada's North. As a result, the report addresses technical complexities that are relevant to covers over mine tailings, which are not applicable or of lower risk for waste rock.

The geological and geochemical characteristics of the waste rock to be mined from the Jay open pit (predominantly granite and metasediment) are effectively the same as the waste rock that has been encountered and effectively managed at the Ekati Mine over the past 15-years of mine operations. This is documented in the Geochemistry Baseline Report that has been provided as Appendix VIII of the Jay Project Developer's Assessment Report (DAR). Therefore, it is appropriate that Jay Project waste rock is managed in the same way.

Waste rock at the Ekati Mine is managed according to plans that are periodically updated by Dominion Diamond for review and approval by the WLWB. Management of the Jay Project waste rock is to be integrated into the current approved *Ekati Mine Waste Rock and Ore Storage Management Plan* and the current approved *Ekati Mine Interim Closure and Reclamation Plan*. These plans describe the primary closure measure for WRSAs containing potentially acid generating (PAG) material, such as metasediment, as placement within a thermally protective cover encapsulating the reactive materials. This approach is being implemented at two of the Ekati Mine WRSAs: Misery and Pigeon.

Many aspects of closure cover planning that are described in MEND (2012) are already established for WRSAs at the Ekati Mine. These aspects will be applied to the Jay WRSA, and include:

- desired final landscape;
- community engagement;
- understanding local climate, permafrost, hydrogeology, and hydrology;
- understanding waste rock physical and geochemical properties;
- understanding cover material properties and availability;
- understanding site access and constructability limitations;
- long term objectives for chemical stability, physical stability and land use; and,
- thermal modelling of cover performance incorporating a 100-year climate change scenario.

MEND (2012) (Section 2.3.1) identifies three primary failure mechanisms that have affected mine waste covers in past case studies:

1) shortened construction and vegetative timelines;
2) entrapment of ice layers within deposits; and,
3) glaciation of surface water channels.

For the Jay Project, items 1 and 3 above are well understood risks at the Ekati Mine that are effectively managed using experience gained through 15-years of operating experience. Item 2 above is, as stated by the report authors, is applicable to tailings deposits and not waste rock piles.

MEND (2012) (Section 5.4.3) provides one conceptual description of a closure cover relevant to PAG waste rock in an Arctic environment. The concept is a variant of “Barrier-Type Cover Systems” that intends to provide a “low hydraulic conductivity layer to control the ingress of atmospheric water, and in some cases atmospheric oxygen” (MEND [2012], page 62). The basis for this concept is to make use of natural conditions to utilize permafrost as a planned design feature to mitigate environmental risk. This is consistent with the approach being implemented at the Ekati Mine.

The approach in place at the Ekati Mine for covering of PAG material is a cover of non-acid generating material (typically granite and/or glacial till) that is thick enough to serve as the seasonally thawed active layer, such that PAG material is maintained in a frozen condition, year round. This provides two primary long term benefits:

- as stated in MEND (2012) (page 65), "… the infiltration capacity is 3 to 5 orders of magnitude less for a frozen material than for the same material in an unfrozen state"; and,
- oxidation reactions are substantively inhibited under freezing temperatures. MEND (2012) (page 24) suggests that "… chemical oxidation rates are less than 15% of their value at 25°C". This appears to be a conservative approach because other research suggests that the rate of oxidation is noticeably less than 15% at freezing temperatures.

Over the long term, the closure objective for Ekati Mine rock piles is that infiltrating water will slowly freeze within the rock pile, somewhat from the bottom upwards, such that the flow path for infiltrating water will ultimately be restricted to the seasonally-thawed cover layer. Three important additional aspects of rock pile design at the Ekati Mine that contribute to the effectiveness of the covering approach are:

- The final surface of the covered rock pile is kept relatively flat such that snow accumulation and the resulting insulating effect is discouraged. This approach encourages convective cooling through the pile, which is acknowledged in MEND (2012) (page 50) as follows: "Convective flow of cold winter air through coarse rock materials can cause significant cooling".
- Rock piles containing PAG materials are underlain by a constructed basal layer of granite rock that encourages permafrost aggradation upwards into the rock pile from the frozen ground, and that provides a physical barrier between PAG waste rock and the naturally reduced-pH surface runoff water that can occur in tundra soils.
- Final sideslopes constructed of physically competent rock (i.e., granite) are stepped rather than smoothed to a constant continual slope as a means of encouraging convective cooling.

The concept described in MEND (2012; Section 5.4.3) is similar to current practice at the Ekati Mine in that it incorporates permafrost as a planned mitigation measure. However, a significant difference is that the concept in MEND (2012) also considers the potential formation of a moisture-rich 'barrier' layer at the base of the cover, which could occur if either the cover material and the waste material being covered have physical properties that would retain an elevated moisture content uniformly across the pile. The implications of this 'perched' higher-moisture layer at the base of the cover could be to reduce infiltration, and to slow freezing of the waste material beneath it.

The formation of a higher-moisture 'barrier' layer at the base of the cover as contemplated in MEND (2012) is neither desirable nor likely for the Jay WRSA for the following reasons:

- A barrier layer of this nature is not desirable for the Jay WRSA because it would be likely to negatively affect the primary objective (freezing into permafrost) by inhibiting convective cooling and by inhibiting the downward aggradation of permafrost (as acknowledged in MEND [2012]). Further, reliance on such a barrier layer to achieve closure objectives for the WRSA would introduce new complex risks associated with long term performance of a layer buried and inaccessible within the rock pile. In short, the Jay WRSA will more readily aggrade permafrost (providing the desired environmental protection) in the absence of such a barrier layer.

- A barrier layer of this nature is not likely to form in the Jay WRSA because of the relatively coarse particle size and the relatively similar particle size of waste rock being covered (PAG/granite) and the waste rock being used as the cover (granite). Individual and contrasting particle size is a key consideration for moisture retention. The Jay WRSA will be constructed of blasted 'run-of-mine' waste rock. Waste rock in the Jay WRSA will be predominantly (75%) granite, and the lesser amounts of the more friable and schistose metasediment will be co-deposited with granite, which will avoid the potential for compaction of the schistose metasediment into a finer mass that might have increased moisture retention capacity. The WRSA as a whole will consist of relatively coarse textured rock which would not be expected to retain elevated moisture across a continuous 'layer'. There would likely be greater potential for the formation of this type of internal barrier in a cover over mine tailings rather than waste rock. Mine tailings (as distinct from fine processed kimberlite) are typically very fine-grained relative to the cover materials and, in combination according to complex design and construction methods, likely provide greater potential (by nature or by design) for capillary effects that might form such a barrier layer.

MEND (2012) provides a mock risk assessment (Failure Modes and Effects Analysis) for a cover constructed over mixed waste rock/landfill debris that had been relocated onto tailings in a region of continuous permafrost (Case Study #3, Section 7.4). The case study is not directly relevant to the Jay WRSA because the case study addresses landfilled solid waste overlying mine tailings, and assumes strong acid generating potential and high concentrations of arsenic that must be controlled. The case study cover is a synthetic (bituminous) liner covered by esker sand/gravel. For the Jay Project, the metasediment has low acid generation/metal leaching potential relative to most mine tailings and waste rock at other types of mines, and the overall net neutralization potential (NNP) of the Jay WRSA will be greater than the commonly used conservative screening threshold of +2 as a result of the proportionally small volume of potentially acid generating material to be mined.

What is of interest to the Jay WRSA, however, is one of the two "high risk" items identified for this scenario, which is "cover system constructability". In the MEND (2012) case study, this failure mode was assigned a moderate consequence and the highest likelihood rating of "expected" (defined as >50% likelihood). The use of the highest likelihood category appears to appropriately reflect the complexities of constructing, maintaining, and repairing complex covers in an Arctic environment. MEND (2012) further finds that there is no effective means to address this risk, stating the following: "… the TAG's [ed: Technical Advisory Group] recommendation for mitigation is limited to a change in cover design to avoid these constructability issues" (page 124).

Response, Waste Rock Alternative Scenario 2

In-pit waste rock deposition with water cover for closure can be a practical and environmentally beneficial approach for some mining projects, and for this reason, was considered for the Jay Project. However, in-pit deposition of waste rock was quickly eliminated from consideration because it is not practical or environmentally beneficial for the Project. Section 2.5.2 of the DAR (Page 2-45) states the following:

> *"In addition to the alternatives discussed below, options for in-lake and in-pit waste rock storage were considered but were not selected. Storage of waste rock in the basin of Lac du Sauvage was not selected due to potential regulatory and permitting issues that may not be resolved within the required Project timeframe, and because other viable waste rock management alternatives exist. Storage of waste rock in mined pits, such as Misery, Lynx, Panda, and Koala was rejected due to uneconomic hauling and placement requirements."*

In response to the Information Request a complete rationale regarding the consideration of in-pit deposition of waste rock is provided below.

Summary / Net Environmental Benefit

The net environmental benefit of in-pit deposition of waste rock is clearly outweighed for the Jay Project by a viable alternative that is also clearly preferred on an operational and cost basis (i.e., the proposed on-land WRSA following established site-specific designs).

During Jay Pit mining, the two most proximal pits are the Misery Pit and the Lynx Pit, which are located at respective distances of approximately 6 km and 10 km. There would be significant additional economic costs to haul the rock from the Jay Pit to these pits. The Lynx pit is an unlikely deposit location because of the relatively small storage volume. Pits located at the main Ekati Mine site are further away (i.e., greater than 35 km), and as a result, movement of rock to these pits would not be economically viable.

One of the primary environmental benefits of the Jay Project as proposed is use of the mined-out Misery pit as a minewater management facility. This approach eliminates the need for construction of a new and large minewater management facility in the north arm of Lac du Sauvage. The North Arm Alternative would require diking off, fishing out, pumping out, and utilizing the north arm of Lac du Sauvage. The use of the north arm in this manner would create additional environmental risks, reclamation liabilities, and costs beyond the proposed plan. Deposition of waste rock into the Misery Pit would negate the pit's use as a primary minewater management facility because the pit would be an active waste rock deposition facility with inadequate storage volume and water management characteristics. This is a strong part of the rationale in support of the proposed water management plan.

Other aspects of the rationale against in-pit deposition for the Jay Project are summarized as follows:

- As the Misery and/or Lynx pits do not have the capacity for storing all of the waste rock from the Jay Pit (see detail below), an on-land WRSA would remain necessary, which would not be substantially smaller in area or shorter in height than the currently proposed WRSA. The WRSA would be in the order of 75% of the size. This negates the possibility that land use impacts would be substantively reduced as a result of in-pit deposition.
- It is unlikely that waste rock could be directly dumped into an open pit at the rate of production from the Jay open pit. The rate of in-pit dumping would be limited by the number of active dump locations, which would be designed according to a strategic pit filling plan. The result is that a temporary WRSA would be required with attendant environmental and cost implications.
- Deposition of waste rock into the Misery and/or Lynx open pits would represent considerable increased costs for the Jay Project (see detail below).

- Although in-pit deposition of waste rock is viable in concept, it has not been undertaken at the Ekati Mine or other northern diamond mines. New operating procedures and safety measures at the pit crest dumping locations would be required. For this reason, in-pit deposition has greater uncertainty than the established and simpler procedures for the proposed WRSA. In-pit deposition of waste rock has been proposed for the De Beers Canada Inc. Gahcho Kué Project; however, the sequential mining of three open pits under the exposed lake bed of Kennady Lake makes this a viable economic and environmental approach for this project.
- New reclamation activities would be required at the open pit(s) used for waste rock deposition for ‘cleaning’ upper benches and managing pit water (see detail below).

Open Pit Storage Capacity

In-pit deposition of waste rock for the Jay Project could only be considered, even at a conceptual level, for the Misery and Lynx open pits. Consideration of the use of any of the other open pits or to include relocation of waste rock into the Jay open pit at closure would result in the Jay Project being economically non-viable because of the costs associated for haulage of waste rock to these pits. As only a portion of the waste rock generated from the Jay Pit development could be deposited in the Lynx and/or Misery pits, a WRSA would still need to be developed to store the remaining waste rock material.

All of the Jay open pit waste rock and overburden (estimated 111 million cubic metres [m^3]) could not be placed into the Misery and Lynx open pits. Therefore, the conceptual goal of an in-pit storage alternative would be to place all or as much as practicable of the PAG rock (i.e., a portion of the metasediment) into these pits.

Geochemical testing consistently shows that only a portion of the metasediment is potentially acid generating (PAG). However, the two geochemical populations (PAG and non-PAG) cannot practically be distinguished in the field in an operating context. Therefore, all of the metasediment is managed as PAG. The volume of metasediment to be mined in the Jay open pit is estimated to be 26 million m^3, which is approximately 25% of the waste rock to be mined.

The total volumes of the Misery and Lynx open pits are 40 million m^3 and 5.2 million m^3, respectively. However, effective storage capacity for waste rock deposition would be less. Also, space for a final water cover would be required and this is likely to be 30 m, which would be consistent with the water depth in use at the Ekati Mine for final depth of water cover over fine processed kimberlite in the Beartooth Pit. The volumes conceptually available for waste rock, optimistically assuming perfect placement to an elevation 30 m below final overflow are 32.1 million m^3 in the Misery Pit and 3.8 million m^3 in the Lynx Pit.

Therefore, it would be conceptually possible to place the metasediment mined from the Jay open pit into the Misery Pit. It is unlikely that the necessary risks and costs would be incurred to make use of the relatively small storage volume in the Lynx open pit since adequate volume is conceptually available in the Misery Pit.

Cost

Deposition of waste rock into the Misery and/or Lynx open pits would represent considerable increased costs for the Jay Project.

Many of the increased costs relate directly to the increased haulage distance compared to the proposed Jay WRSA, such as: increased diesel fuel use, increased tire wear, need for additional haulage trucks, increased maintenance costs, and increased manpower. Because a temporary WRSA would be required, waste rock would need to be re-handled, which would further increase costs.

Extra costs would also be incurred for management of open pit minewater during waste rock deposition. The open pit will accumulate water from natural precipitation and surface runoff. Dumping of waste rock would introduce a constant source of suspended sediment that would require management as the in-pit water level rose due to displacement by the infilling waste rock. This is a potentially substantive cost that would otherwise not be incurred.

Reclamation Complexity

In addition to physical reclamation of the WRSA, additional reclamation activities would be required at the pit(s) filled with waste rock. The additional work might include the following:

- Metasediment would accumulate on the upper pit benches as a result of dumping/pushing over the pit crest. In order to ensure that metasediment in the pit is below water, it would likely be necessary to cast off or otherwise remove metasediment from upper benches above the final water level.
- It would be anticipated that the initial immersion of metasediment within the contained pool of the Lynx or Misery open pits would result in water with elevated total suspended solids (TSS) and total dissolved solids (TDS). This water that may require active management or treatment prior to discharge. Given the very low natural inflow rates into the Misery and Lynx pits, there could be an extended period time before in-pit water quality was suitable for direct discharge or overflow. This potentially extended time-lag before the long-term ‘benefits’ of underwater deposition are realized is a well-established phenomenon documented in various MEND and other case studies and research projects.

References:

Mine Environment Neutral Drainage (MEND). 2012. MEND Report No. 1.61.5c, Cold Regions Cover System Design Technical Guidance Document. Prepared for MEND, funded by Aboriginal Affairs and Northern Development Canada/ July 2012. http://mvlwb.com/sites/default/files/mvlwb/documents/Cold%20Regions%20Cover%20System%20Design%20Technical%20Guidance%20Document%20(MEND%20Report%201.16.5c).pdf

Information Request Number:	DAR-DDMI-IR-Pit Flooding Timeframes
Source:	Diavik Engagement Meeting Discussion (per Gord Macdonald)
Subject:	Pit Flooding Timeframes
DAR Section(s):	3.5.8 (Project Description, Closure and Reclamation) and Appendix 3B (Jay Project Conceptual Closure and Reclamation Plan)

Request (DDMI):

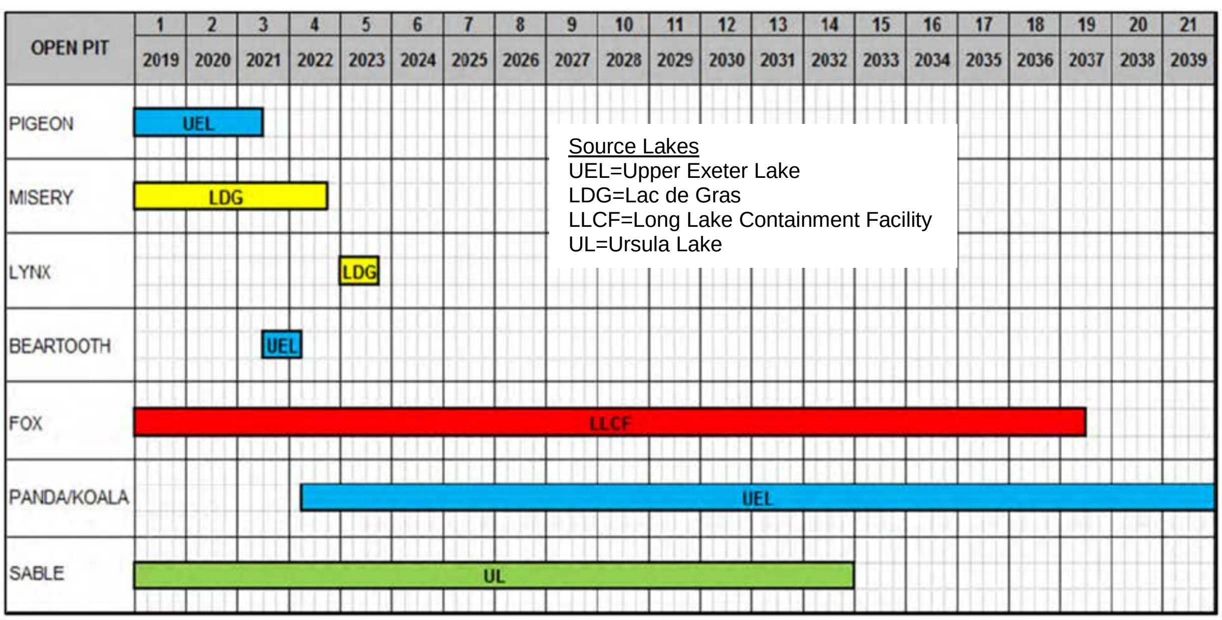
Pit flooding schedules for closure of Ekati and Diavik currently overlap. How does the Jay Project affect the overlapping water uses from Lac de Gras for pit flooding?

Response:

To understand how the Jay Project affects potential overlapping water uses from Lac de Gras for pit flooding, two water use schedules for the Ekati Mine are provided: one without the Jay Project, and one with the Jay Project.

Ekati Mine Current Water Use Schedule (without Jay Project)

The current Ekati Mine pit flooding schedule (i.e., without the Jay Project) is shown below. This schedule is an update to the schedule that appears in the 2011 Interim Closure and Reclamation Plan and was initially approved by the Wek'èezhìı Land and Water Board (WLWB) through the 2013 Annual Reclamation Progress Report. The Lynx Pit was added to the schedule following its approval in 2014. The figure shown below is from the 2014 Reclamation Progress Report.



Key elements of the pit flooding schedule related to potentially overlapping water uses with the Diavik Mine are as follows:

- The current schedule reduces the direct use of water from Lac de Gras (as compared to the original schedule) in favour of using Upper Exeter Lake and the Long Lake Containment Facility (LLCF) as source lakes.
- The only open pits filled directly from Lac de Gras are the Misery and Lynx pits.
- Water taken for pit filling from the LLCF for the Fox Pit is from within the Lac de Gras watershed and is an indirect use of water from Lac de Gras.
- Water taken for pit filling from Ursula Lake for the Sable Pit (if Sable were to be mined) is from within the Lac de Gras watershed and is an indirect use of water from Lac de Gras.
- Water taken from Upper Exeter Lake for filling the Pigeon and Panda/Koala pits is not from within the Lac de Gras watershed.
- The pumping season is assumed to be 137 days/year (avoiding winter operations) from each source lake at average rates that have been approved by the WLWB.

The direct and indirect uses of water from Lac de Gras are as follows:

Use	Average Pump Rate (137 day pumping season)	Average Annual Use	Years	Total Use
Sources				
Direct	0.8 m^3/s	10.0 Mm^3	2019 – 2023 (4.5)	45 Mm^3
Indirect (LLCF)	0.3 m^3/s	3.5 Mm^3	2019 – 2037 (18.5)	65 Mm^3
Possible Indirect (Ursula Lake)	0.2 m^3/s	2.5 Mm^3	2019 – 2032 (14.0)	34 Mm^3
Annual Use				
2019 – 2023 Total	1.3 m^3/s	16.0 Mm^3	4.5	72 Mm^3
2024 – 2032 Total	0.5 m^3/s	6.0 Mm^3	9.5	57 Mm^3
2033 – 2037 Total	0.3 m^3/s	3.5 Mm^3	4.5	16 Mm^3

m^3/s = cubic metres per second; Mm^3 = million cubic metres.

Under this scheme, the greatest annual water use, and the only direct water use, from Lac de Gras for the Ekati Mine occurs prior to closure of the Diavik Mine in 2023. This schedule may alleviate the potential regulatory risk that all of the desired water uses may not be allowed to occur simultaneously. However, there are some overlapping Lac de Gras water uses (direct water use for Diavik Mine pit flooding beginning around 2023 and indirect water use for Ekati Mine).

Ekati Mine Water Use Schedule With Jay Project

The Jay Project introduces the following changes to the pit flooding/water use schedule:

- There are no direct uses of water from Lac de Gras for pit flooding of the Misery and Lynx pits.
- The Lynx Pit will be filled with water from dewatering of the diked area in Lac du Sauvage (within Lac de Gras watershed), and therefore, is an indirect use of water in Lac de Gras.
- The Misery Pit will be filled with a combination of water from the dewatering of the diked area in Lac du Sauvage (indirect source from Lac de Gras) and minewater (primarily groundwater) inflows to the Jay pit during mining.
- Filling of the Fox Pit from the LLCF is deferred to the end of Jay open pit operations (i.e., beginning around 2030). This is beyond the Diavik Mine pit flooding timeframe.
- The Jay Pit and the diked area will be filled from Lac du Sauvage, which takes place after the end of Jay operations (i.e., beginning around 2030). This is beyond the Diavik Mine pit flooding timeframe.
- Minewater discharge to Lac du Sauvage is scheduled to commence in 2025. This is an addition of water that may overlap with the Diavik pit flooding schedule, thereby, potentially offsetting water withdrawals by the Diavik Mine.
- Filling of the Sable Pit (if it is mined) from Ursula Lake is conceptually scheduled in the Sable Addendum of the Developer’s Assessment Report (Dominion Diamond 2014) to commence in 2025 (for 14 years as shown above). This may overlap with the Diavik pit flooding schedule; however, this is conceptual, as the Sable Pit is not currently in the Ekati Mine plan.

Therefore, the risks of overlapping water uses for Lac de Gras as a result of the Jay Project are characterized as negligible, and limited to:

- water additions to Lac du Sauvage as minewater discharge beginning around 2025; and,
- possible filling of Sable Pit (if mined) beginning in 2025, which is conceptual only at this time.

In both instances (i.e., with and without Jay Project), the Diavik Mine is requested to verify dates and assumptions related to the Diavik Mine.

References:

Dominion Diamond (Dominion Diamond Ekati Corporation). 2014. Jay Project Developer’s Assessment Report Sable Addendum. Prepared by Golder Associates Ltd., December 2014. Yellowknife, NWT, Canada.

DOMINION DIAMOND

Information Request Number:	DAR-DDMI-IR-Minewater Management Alternatives
Source:	Email from Gord Macdonald, Feb 14, 2015
Subject:	Minewater management alternatives
DAR Section(s):	2.5.2 (Level 2 Alternatives Assessment)

Request (DDMI):

The Jay DAR describes changes to the quality of Lac du Sauvage and Lac de Gras resulting from the preferred water management/treatment plan. The alternative of treatment and discharge of minewater should be assessed. Understanding that the primary parameters of concern are dissolved solids, at a minimum, reverse osmosis/membrane technology alternatives should be considered.

Response:

The Jay Project incorporates a number of environmental design features. One of the primary environmental design features of the Project is the use of the mined-out Misery Pit as a minewater management facility. Beneficial use of a completed mine facility such as a mined-out open pit to mitigate environmental effects is generally recognized as a best management approach, and this practice is implemented at the Ekati Mine. A primary benefit of this approach for water quality is eliminating the need for minewater (effluent) discharge during the first 5 to 6 years of the 10-year mine plan and providing for environmentally safe water quality when discharge is required. The initial 5 to 6-year time period allows for the collection of site-specific data that will enable a direct comparison of the actual water quantity and water quality to the modelling predictions. It is this ongoing assessment of performance against expectations that will lead, if necessary, to an informed decision of the need for and the nature of modified or additional mitigation measures should they be necessary (i.e., an adaptive management approach).

The Land and Water Boards of the Mackenzie Valley (the “Boards”) published a new policy in 2011 related to effluent quality, *Water and Effluent Quality Management Policy* (MVLWB 2011). The Ekati Mine effluent quality criteria were reviewed against this Policy and were subsequently approved by the Wek'èezhìı Land and Water Board (WLWB) as part of the most recent (2013) water licence renewal. This included the WLWB relying on the six site-specific water quality objectives (SSWQOs) that have been developed for the Ekati Mine.

The Boards’ Policy (MVLWB 2011) outlines several key concepts that the Jay Project Mine Water Management Plan (as described in Section 3.5.5.2 and Appendix 3A of the DAR) achieves:

- minewater to be discharged should not be acutely toxic;
- minewater to be discharged should not cause chronic (sub-lethal) toxicity effects beyond the limits of a pre-defined Effluent Mixing Zone;
- effluent quality criteria should be developed on the basis of site-specific water quality objectives where appropriate; and,
- minewater to be discharged should be managed through a continuous adaptive management process.

The Boards' Policy also identifies source reduction as a beneficial consideration. In the case of the Jay Project, the primary water quality parameter of interest, chloride, occurs naturally in groundwater that is encountered through mining of the Jay open pit, and as such, reduction of concentrations or loadings at the source is not possible. However, the Jay Project water management plan provides an effective means of reducing the concentrations and the overall amount of chloride (and associated minewater constituents) that are released to the environment. The highest concentrations and a substantive proportion of the chloride encountered through mining of the Jay open pit will be safely retained within the lower levels of the Misery and Jay open pits, proximal to the deep groundwater source.

Dominion Diamond considered whether there might be additional options for reducing chloride concentrations in discharges to the receiving environment that would be practicable for the Jay Project. A thorough and current review of minewater treatment technologies was recently conducted for the Federal Government's review of the Metal Mine Effluent Regulations (Hatch 2014). Hatch (2014) provided a comprehensive assessment of treatment technologies that is being relied on by the Federal Government in its determinations. The report concluded that there were no treatment technologies for chloride, inclusive of reverse-osmosis, that could be considered 'best available technologies economically achievable' (BATEA). It states (page 550):

> *"10.5.2.2 BATEA for Chloride Removal*
>
> *No BATEA was selected for removal of chloride, as all applicable technologies (i.e., reverse osmosis, ion exchange) are considered to be uneconomic for application to the diamond sector model. In any case, chloride is believed to be a site-specific issue due to interception of a saline groundwater feature(s) (refer to Section 6.5.1)."*

One of the important considerations for reverse-osmosis treatment of chloride-enriched waters is the management and safe disposal of a 'super-concentrated' chloride brine solution. The treatment process removes chloride from the water, but the chloride then remains as a prime constituent in residual brine at extreme concentrations. The residual brine is a hazardous material that creates new environmental risks and liabilities. Brine management and disposal is one of the reasons that reverse-osmosis was not found to be BATEA in Hatch (2014). The management of the resultant brine in a remote northern mine setting presents potentially serious challenges. If an on-site disposal option is not available, the brine must be shipped (trucked) long distances to an appropriate disposal facility.

Therefore, while reverse-osmosis could likely reduce chloride concentrations in the minewater discharge, the Jay Project water management plan as proposed in the Project Description of the Developer's Assessment Report (DAR; Section 3) is considered to be a superior alternative from environmental, operational, and cost perspectives. The water management plan provides a site-specific approach that achieves environmental protection objectives in a reasonable and practicable manner. A summary of the rationale is as follows:

- The plan is consistent with the Boards' Policy. Effluent is not harmful to the receiving environment.
- The plan is consistent with current BATEA as assessed for the Federal Government. Chloride is a site-specific issue that is appropriately addressed through a site-specific water management plan.

- The plan allows time for the collection of several years of site-specific water quality data prior to planned minewater discharge, which will enable a comparison to DAR modelled projections, and an accurate assessment of the need for and nature of possible adaptive management responses, if required.
- If a water treatment system were to be selected in future as an adaptive management response, the specifications for water treatment would be accurately known such that the system could be designed and constructed in an efficient, fit-for-purpose manner. This would be more efficient from cost, construction, operations, and environmental perspectives, than a design based solely on modelling.

References:

Hatch. 2014. MEND - Study to Identify BATEA for the Management and Control of Effluent Quality from Mines, Final Study Report - 2014-07-11. http://mend-nedem.org/wp-content/uploads/MEND_3.50.1_BATEA.pdf

MVLWB (Mackenzie Valley Land and Water Board). 2011. Water and Effluent Quality Management Policy March 31, 2011. http://mvlwb.com/sites/default/files/documents/MVLWB-Water-and-Effluent-Quality-Management-Policy-Mar-31_11-JCWG.pdf