



July 24, 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, Additional Information Request and Follow-up from Community and Regulatory Engagement

Dear Mr. Hubert:

Accompanying this letter, Dominion Diamond is pleased to submit a number of documents for the Public Registry in response to an additional information request (IR) and follow-up from recent community and regulatory engagement activities regarding Jay Project monitoring and management plans, and water quality modelling.

More specifically, Dominion Diamond is submitting the following documents:

- In response to the letter issued by the Mackenzie Valley Environmental Impact Review Board (MVEIRB), dated July 15, 2015, please find attached the following additional IR response for the Jay Project:
 - Assessment endpoints - downstream industrial and domestic uses of water in Lac de Gras (Assigned Document Code: DAR-MVEIRB-IR2-32)
- Draft Engagement Program for Amendments to the Ekati Mine Wildlife and Air Monitoring Management Plans that will Incorporate the Jay Project;
- Letter outlining engagement discussions with the Government of the Northwest Territories, Environment and Natural Resources (GNWT) and their technical consultants on hydrogeological and water quality modelling; and,
- The technical memorandum “Jay Project – Pit Lake Hydrodynamic Modelling – Extreme Wind Scenario” in response to our commitment during the



meeting with GNWT on July 6, 2015 to conduct additional water quality modelling to address an “Extreme Wind” Scenario.

In accordance to our commitment to provide information and responses in a timely manner, we look forward to address any further concerns through the remainder of the Jay Project Environmental Assessment review process.

Regards,

A handwritten signature in black ink, appearing to read 'R. Bargery', is written over the printed name.

Richard Bargery

**Manager, Permitting Jay Project
Dominion Diamond Corporation**

Attach.

Information Request Number: DAR-MVEIRB-IR2-32

Source: Mackenzie Valley Environmental Impact Review Board Information Requests from JoAnne Deneron

Subject: Assessment endpoints - downstream industrial and domestic uses of water in Lac de Gras

DAR Section(s): Jay Technical Sessions (April 22, 2015 Transcript, Pages 240 to 243)

Preamble (MVEIRB):

The Review Board is requesting a follow-up response to a question that originated during the technical sessions in April between a representative from Diavik Diamond Mines Inc. (DDMI) and Dominion Diamond. The discussion and question from DDMI is found on pages 240-243 of the [April 22 technical session transcripts](#).

The specific request made in this discussion by DDMI was for Dominion Diamond to consider industrial uses of water as an assessment endpoint in the effects assessment for the Jay Project. During the technical sessions, the Review Board agreed to consider this request.

Request (MVEIRB):

Please provide an effects assessment of the Jay Project with consideration of downstream industrial and domestic uses of water in Lac de Gras as an assessment endpoint. This effects assessment should consider inputs from the Jay Project, the Ekati Mine and Diavik Mine including A21, from the present until closure of the mines and include proposed mitigation and monitoring.

Response:

The requested assessment is incorporated within the effects assessments that have been provided to the Mackenzie Valley Environmental Impact Review Board (MVEIRB), as described below.

Assessment endpoints represent the key properties of the valued component (VC) that should be protected for use and enjoyment by future human generations, and are general statements regarding what is to be protected. The assessment endpoints for VCs, such as water quality, in the Developer's Assessment Report (DAR) were determined in part from the outcome of community feedback, including available local and traditional knowledge, and the public and regulatory engagement process, including the MVEIRB scoping sessions. In Section 8 of the DAR, and as described at the Technical Sessions on April 22, 2015, the assessment endpoints for water quality are protective for aquatic life, wildlife, and human use.

The level of protection for the environment and human consumption used as a screening in the effects assessment for the Jay Project (Project) is greater than what would be required for industrial uses. However, if industrial use were to be explicitly included in the assessment endpoint for the water quantity and quality key line of inquiry, it would not change the significance determination for water quality in the DAR. Since the submission of the DAR, the assessment endpoint for the water quantity and quality has

been revised to include water use and drinking quality, as provided in response to Adequacy Review DAR-MVEIRB-18:

the suitability of surface water quality to support and maintain healthy and sustainable aquatic and terrestrial ecosystems, ecological function, aquatic life that is not impaired, traditional uses, and water that is good to drink

A re-evaluation of this assessment endpoint did not change the confidence in the effects predictions or determination of significance provided in the DAR (Adequacy Review DAR-MVEIRB-18).

Domestic use (i.e., drinking water) was considered in the assessment endpoint from a water quality perspective. In the Traditional Land Use assessment (Section 16 of the DAR), the assessment endpoints of *continued opportunities to participate in traditional fishing* and *continued opportunities to participate in other culturally important uses of the land* considered drinking water use, and the use of the Narrows for navigation.

In the DAR, effects to water quality during the Jay Project operations through to post-closure were assessed in Section 8.5.4.2.2, with detailed water quality modelling (described in Section 8.5.4.1.2 and associated appendices) conducted to predict changes to surface water quality in Lac de Gras resulting from Project discharges. The Project minewater discharges to Lac du Sauvage are planned to occur over the last five years of mine operation (2024 to 2029). Limiting minewater discharge to the receiving environment (Lac du Sauvage) is one of the principal mitigation strategies provided by the water management plan for the Project. The secure storage of minewater in the mined-out Misery Pit defers the need for discharge to Lac du Sauvage for approximately half of the life of the mine operation. The timing of the discharge also reduces cumulative effects in Lac de Gras, because commencement of discharge is planned the year following the shut-down of the Diavik Mine (currently planned for 2023) or later. As such, effluent discharge from the Diavik Mine to Lac de Gras would have ceased before Misery Pit minewater discharge to Lac du Sauvage would begin to migrate into Lac de Gras. Therefore, there would be no concurrent discharges of mine effluent and limited cumulative interaction between the two operational discharges in Lac de Gras (some time lag effects of the Diavik Mine discharge are anticipated).

The hydrodynamic water quality model developed for Lac de Gras (Appendix 8F in the DAR) and in subsequent modelling updates (Golder 2015a,b) incorporates changes to Lac de Gras as a consequence of the Project, and the projected changes resulting from the operation and closure inputs from the Diavik Mine and the Ekati Mine. For the Diavik Mine, these include: direct effluent discharge to Lac de Gras including the A21 pit development, runoff from the reclaimed surfaces, and operational withdrawals for domestic use. For the Ekati Mine, these include: Long Lake Containment Facility (LLCF) reclamation and pit back-flooding activities. These predictions represent the best estimates of changes to water quality in Lac de Gras due to the cumulative influences of the Ekati Mine, the Diavik Mine, and the Jay Project.

In terms of overlapping water withdrawals for industrial use, Section 8.5.3.3.2 of the DAR provides an assessment of the Ekati and Diavik mines operations and closure activities potentially overlapping with the Project, including the back-flooding of pits. Responses to Round 1 information requests (IRs) DAR-MVEIRB-IR-21, DAR-MVEIRB-IR-46, and DAR-MVEIRB-IR-78 provide an update based on the A21 Pit development. However, it is expected that Diavik pit back-flooding would not occur concurrently with Jay and Misery pit back-flooding at closure, which takes place from 2030 to 2033. More information on Ekati

(including Jay) and Diavik back-flooding activities is provided in the response to DAR-DDMI-IR-Pit Flooding Timeframes included in Appendix G of the Round 1 IRs.

Similar to the discussion for water quality, the assessment endpoints for fish and fish habitat (i.e., *maintenance of self-sustaining and ecologically effective fish populations and ongoing fisheries productivity*) in Section 9 of the DAR provides a level of protection for the environment that is also greater than what would be required for industrial uses. The industrial water transfers discussed above were considered in the fish and fish habitat assessment, and the conclusions were that the Project would not have a significant adverse effect on fish and other aquatic life VCs.

One aspect of industrial use inferred from this request from DDMI is the potential for the projected changes to Lac de Gras from the Project to affect their operation from a regulatory perspective (i.e., would cumulative changes to water quality in Lac de Gras result in regulatory benchmark exceedances associated with the Diavik Mine operation or intended use of the water by DDMI?).

An example of a potential scenario where this could occur is if during the Jay dike construction there is a large-scale sediment loading event to Lac du Sauvage and associated elevated turbidity migrates to Lac de Gras. The Jay dike construction activities are scheduled for 2016 and 2017, which has the potential to overlap temporally with the A21 dike construction activities scheduled to occur in Lac de Gras between 2015 and 2017. Effects on water quality from the sediment associated with the construction of the Jay Dike in Lac du Sauvage were assessed in Section 8.4.2.4.2 of the DAR. Also, the potential for cumulative effects to Lac de Gras from the Jay Project and the A21 Pit dike construction activities was discussed in the response to Round 1 IR DAR-MVEIRB-IR-78. A large-scale sediment loading event to Lac du Sauvage is considered a low-likelihood event, primarily due to planned mitigation that will be implemented for the Jay dike construction. A detailed dike construction plan will be developed and implemented, which will require regulatory approval, and will include information relevant to mitigation, inspection, and monitoring. For example:

- erosion and sediment controls will be implemented in Lac du Sauvage during dike construction, where appropriate;
- the majority of dike construction activities (i.e., central trench excavation, removal of lakebed sediment, and backfilling activities) will occur during the open-water season with use of turbidity (silt) curtains;
- silt curtains will be installed upstream of the dike (within Lac du Sauvage) and downstream of the dike (within the isolated portion of Lac du Sauvage) during the open-water seasons;
- rockfill will be placed during the winter months at a slower rate that, in the absence of wind effects on open-water, reduces sedimentation; and,
- turbidity and total suspended solids (TSS) will be regularly monitored at designated locations throughout open-water and under-ice conditions, within and outside of the zone of the turbidity curtains to provide feedback for adaptive management (if turbidity or TSS concentrations approach monitoring thresholds during construction activities, a review of local conditions and activities will be immediately conducted, and activities ceased, if necessary).

Construction of the Jay Dike is expected to result in a minor, localized change to the water quality in Lac du Sauvage (Section 8.4.2.4.2). The use of turbidity curtains, consistent with those successfully used at the Diavik and Meadowbank Gold mines, will restrict the transport of TSS into Lac du Sauvage (outside of the localized area) and limit the potential for water with elevated suspended sediment to migrate to Lac de Gras. Regular monitoring during construction will allow for an early warning indication and additional mitigation (e.g., temporary cessation of construction, installation of supplemental, or different types of, silt curtains or barriers) to be implemented, if required. Outside of the silt curtains, changes to water quality and sediment quality resulting from dike construction are not anticipated (i.e., into Lac de Gras).

DDMI is required to collect, analyze, and interpret annually, water quality data from Lac de Gras, and to review it relative to operational benchmarks set in their water licence. This is required during the operational phase of the Diavik Mine. It is assumed that once direct discharges from the Diavik Mine to Lac de Gras cease (currently scheduled for 2023), monitoring relative to these operational benchmarks will not be required; however, transition to monitoring relative to closure objectives will occur. The Jay Project minewater discharges to Lac du Sauvage are planned to occur over the last five years of mine operation (2024 to 2029), and after discharge from the Diavik Mine has stopped. Therefore, it is expected that there will be no effect of minewater discharge from the Project on operational limits imposed on Diavik Mine. Dominion Diamond will monitor receiving water quality relative to benchmarks set for the Jay Project, which would occur in parallel with DDMI's closure monitoring.

Based on the modelled water quality predictions for Lac du Sauvage and Lac de Gras, the Project will not have a significant adverse effect on the maintenance or suitability of water to support a healthy and sustainable ecosystem, or on the continued opportunity for the traditional use of water, including use as a drinking water source. As a consequence, the Jay Project is not expected to impact the industrial or domestic use requirements of the Diavik and Ekati mines. The water quality modelling for Lac de Gras included conservative assumptions for source terms, and yet, throughout the life of the Project, concentrations of constituents in Lac de Gras are projected to be less than guidelines and benchmarks at all prediction locations and during all phases. Based on this assessment, the Diavik Mine and Ekati Mine (with the Project) are expected to continue to operate and meet their regulatory requirements.

As part of the permitting process with the Wek'èezhìi Land and Water Board (WLWB), the Project will be incorporated into the Water Licence for the Ekati Mine. Dominion Diamond will meet its regulatory requirements under the Water Licence. For example, the minewater discharge to Lac du Sauvage will be monitored for compliance against the criteria defined in the Water Licence. Similarly, an Aquatic Effects Monitoring Program (AEMP) will be developed to monitor effects in the receiving environment (i.e., hydrology, water and sediment quality, benthic invertebrates, plankton, and fish) throughout the Project phases to monitor for changes that diverge from DAR projections. A Conceptual AEMP for the Jay Project was submitted to the MVEIRB public registry on June 1, 2015 (Dominion Diamond 2015). As described in the Conceptual AEMP, the approach for monitoring cumulative effects in Lac de Gras, if necessary, will be finalized through engagement with DDMI.

Dominion Diamond is willing to work collaboratively with other operators (i.e., DDMI) on regional or cumulative effects monitoring programs and to minimize potential effects from overlapping activities as appropriate (i.e., pit back-flooding).

References:

Dominion Diamond (Dominion Diamond Ekati Corporation). 2015. DRAFT Conceptual Aquatic Effects Monitoring Program Design Plan for the Jay Project. Prepared for Dominion Diamond Ekati Corporation by Golder Associates Ltd. June 2015.

Golder (Golder Associates Ltd.). 2014. Diavik Diamond Mines Inc. Aquatic Effects Monitoring Program Study Design Version 3.5. May 2014. Submitted to Diavik Diamond Mines Inc, May 2014.

Golder. 2015a. Jay Project – Lac de Gras Hydrodynamic Model Updates. Technical Memorandum prepared for Rick Bargery, Dominion Diamond Ekati Corporation, from Michael Herrell, Jerry Vandenberg, and John Faithful. January 19, 2015.

Golder. 2015b. Jay Project - Compendium of Supplemental Water Quality Modelling. Submitted to Mackenzie Valley Environmental Impact Review Board. April 2015.



July 24, 2015

Draft Engagement Program for Amendments to the Ekati Mine Wildlife and Air Monitoring and Management Plans to Incorporate the Jay Project

Dominion Diamond's Jay Project is currently undergoing Environmental Assessment through the Mackenzie Valley Environmental Impact Review Board (MVEIRB). As the Jay Project is an extension to the existing Ekati Mine, Dominion Diamond has provided conceptual plans for amendments to the Ekati Mine Wildlife and Air Monitoring and Management Plans that describe how the Jay Project will be incorporated.

Complete details and final amendments cannot be provided at this time because the Jay Project has not yet received Environmental Assessment approval from the MVEIRB, and final operating and design plans have not yet been developed. Dominion Diamond has committed that the amendments will be finalized before the Jay Project begins, including further engagement. The engagement program for the amendments is described here and is provided to the parties to the Jay Project Environmental Assessment Review process for comment.

There are other Ekati Mine environmental monitoring and management plans that will also be updated for the Jay Project, such as the Aquatic Effects Monitoring Program, Wastewater and Processed Kimberlite Management Plan, and the Waste Rock and Ore Storage Management Plan. These other plans are directly regulated under the Ekati Mine Water Licence by the Wek'èezhìi Land and Water Board (WLWB), and as such, the established WLWB processes will be followed, which provide for public review and engagement.

Dominion Diamond conducts regular and constructive engagement with Aboriginal governments, community members and regulatory agencies. The Ekati Mine Engagement Plan is approved by the WLWB and, along with guidance documents published by the Boards, provides the basis for individual engagement programs.

All aspects of the Jay Project have undergone engagement since Dominion Diamond assumed ownership of the Ekati Mine in April 2013. This has included Dominion Diamond's pre-application engagement program, engagement through the WLWB and MVEIRB, and Dominion Diamond's ongoing engagement in parallel with the Boards' processes. The conceptual amendments and their content were developed in response to that engagement.



The specific documents that will be the subject of the engagement program described herein are:

- Air Quality and Emissions Monitoring and Management Plan (AQEMMP); and
- Wildlife Effects Monitoring Plan (WEMP), which is inclusive of:
 - Wildlife and Wildlife Habitat Protection Plan (WWHPP);
 - Wildlife Management Plan (WMP); and
 - Caribou and Roads Mitigation Plan (CRMP).

The essential requirements for the AQEMMP are described in the Ekati Mine Environmental Agreement and various Government of the Northwest Territories and Environment Canada guidance documents. The essential requirements for the WEMP are described in the NWT Wildlife Act and the Ekati Mine Environmental Agreement. The amendments will also reflect feedback received through this engagement program. In the future, the amendments will become part of the various ongoing engagement, review and adaptive management cycles that apply to all of the Ekati Mine Environmental Monitoring and Management Plans.

Consistent with the Ekati Mine Engagement Plan and the Jay Project Environmental Assessment Review process, the following parties will be included in this engagement program:

- Deninu Kue First Nation
- Fort Resolution Métis Council
- Kitikmeot Inuit Association and Hamlet of Kugluktuk
- Łutselk'e Dene First Nation
- North Slave Métis Alliance
- Tłıchǵ Government
- Yellowknives Dene First Nation
- Environment Canada
- Government of the Northwest Territories
- Independent Environmental Monitoring Agency

Consistent with the Ekati Mine Engagement Plan and guidance documents published by the Boards, the following types of engagement are planned for this program:



- Circulation by Dominion Diamond of draft amendments and other written material for written response and feedback from the parties;
- Face-to-face meetings with individual parties and/or combined group workshops to review draft material and receive direct feedback; and
- Telephone or teleconference communications where face-to-face meetings are not practical.

Dominion Diamond will organize the engagement activities and will provide reasonable time for review/comment by the parties, and will provide financial assistance for community representatives consistent with previous workshops.

A staged approach is planned for finalization and implementation of the amendments. Dominion Diamond will seek to continually refine the amendments through the engagement program such that final amendments that incorporate the Jay Project into the Ekati Mine environmental monitoring and management plans are in place before each stage of the Jay Project begins (i.e., construction, operations, closure and reclamation). This approach provides a process so that the most current knowledge is applied to each successive stage of the Project. This approach also enables amendments appropriate for the planned construction activities to be implemented in a timely manner while amendments for operating activities are finalized.

Engagement that has taken place on the amendments to date is summarized as follows:

- April 2013 to April 2015: Commitments made by Dominion Diamond that amendments will be in place before the Jay Project begins.
- April 20-24, 2015: Conceptual amendments discussed and requested at the Jay Project Technical Sessions.
- June 1, 2015: Conceptual amendments provided by Dominion Diamond for comment.
- June 25-26, 2015: Conceptual amendments discussed at a focused workshop.
- July 20, 2015: Focused technical workshop on AQEMMP amendment.
- July 31, 2015: Draft amendments engagement program circulated by Dominion Diamond for comment.



The planned engagement schedule is as follows:

By October 31, 2015:

- Dominion Diamond anticipates that it will receive comments on the engagement program through the MVEIRB Public Hearing process (Public Hearings scheduled for September 2015)
- Dominion Diamond requests that parties who may wish to provide specific written comment on the engagement program do so by October 31, 2015

By November 30, 2015:

- Dominion Diamond will finalize the engagement program in a manner that considers and addresses the feedback received

Within one month of receipt of Environmental Assessment Approval:

- Dominion Diamond will circulate draft amendments for construction and operations in a manner that considers and addresses feedback and direction received through the MVEIRB process

Prior to Jay Project Construction Activities:

(begins with Jay Road construction conceptually planned for late summer 2016)

- Dominion Diamond will host a technical workshop to discuss and receive input on the draft amendments for construction and operations
- Dominion Diamond will circulate revised draft amendments for construction in a manner that considers and addresses feedback received for final written comment (Note: circulation of draft amendments for operations after addressing feedback will occur prior to operations [see below])
- Dominion Diamond will finalize amendments for construction in a manner that considers and addresses feedback received

Prior to Jay Project Operations Activities:

(begins with mining at Jay Pit conceptually planned for late 2019)

- Dominion Diamond will circulate revised draft amendments for operations in a manner that considers and addresses feedback received and reflecting findings of the Jay Project construction programs and the ongoing Ekati Mine operations programs



- Dominion Diamond will host a technical workshop to discuss and receive input on the revised draft amendments for operations
- Dominion Diamond will circulate final draft amendments for operations in a manner that considers and addresses feedback received for final written comment
- Dominion Diamond will finalize amendments for operations in a manner that considers and addresses feedback received

Prior to Jay Closure and Reclamation Activities:

Dominion Diamond will finalize amendments for Closure and Reclamation through the established WLWB process for development of the Interim and Final Closure and Reclamation Plans



July 24, 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, Government of the Northwest Territories, Environment and Natural Resources

Dear Mr. Hubert:

Dominion Diamond is committed to engaging with potentially affected stakeholders on the Jay Project and has undertaken numerous engagement discussions with the Government of the Northwest Territories, Environment and Natural Resources (GNWT) and their technical consultants specifically on hydrogeological and water quality modelling. Summaries of the engagement to date have been provided to the MVEIRB public registry:

http://www.reviewboard.ca/upload/project_document/EA1314-01_Jay_Project_Hydrogeology_Modelling_Meeting_Follow-up_Package.PDF

http://www.reviewboard.ca/upload/project_document/EA1314-01_Dominion_letter_re_GNWT_Engagement_on_WQ_modelling.PDF

The following provides a summary of the main discussion topics, commitments, follow-up, and work completed by Dominion Diamond to provide additional information to address issues raised by the GNWT outside of the formal information request process.

Quantification of the Uncertainty in the Hydrogeological Model

Discussion Topic: At and following the April 2015 Technical Sessions in Yellowknife, the GNWT requested quantification of the uncertainty in the Environmental Assessment (EA) Conservative Scenario and the Reasonable Estimate Case to ensure that the potential effects to the environment in the Developer's Assessment Report (DAR) were not underestimated. A Monte Carlo analysis was suggested by the GNWT as a potential approach to assigning confidence limits to predicted groundwater inflows.

Commitment: In early May 2015, Dominion Diamond agreed to conduct stochastic modelling to address this concern and provide a technical memorandum presenting the results of the analysis with the Round 2 information request responses (IRs).

Follow-up: The GNWT provided input into the Monte Carlo analysis in subsequent correspondence, which was considered in determining the final model approach for addressing uncertainty in predicted groundwater inflows. A memo was prepared (Golder 2015a) and provided to the GNWT outlining the proposed approach for addressing the degree of uncertainty or probability associated with the EA Conservative Scenario, Reasonable Estimate Case, and the model input parameters that would be used in a deterministic Lower Bound Scenario that was being developed in parallel. As described in the memo, a first order approximation (FOA) approach was conducted on the 3-dimensional (3D) hydrogeological model, as well as a Monte Carlo simulation on a 2-dimensional (2D) model of the enhanced permeability zone (EPZ). The combination of the FOA and Monte Carlo methods allowed probabilities to be assigned to both the 2D and 3D model results. The memo (Golder 2015a) summarized the model approach and details of the probability distribution functions (PDFs) that were selected for the Monte Carlo simulation input parameters. Following review of the memo, additional questions from the GNWT were received through email regarding the value of the FOA, detailing of unrealistic cases, and how the results of the modelling influence meromictic conditions; clarification of approach was provided by Dominion Diamond.

Work Completed: The results of the uncertainty analysis were provided in the technical memo "Jay Project – Uncertainty Analysis Methods and Results for Hydrogeological Modelling" (Golder 2015b) which was submitted to MVEIRB with the responses to the second round of IRs. The memo confirmed that the predictions of groundwater inflow and quality presented in the DAR for the EA Conservative Scenario and the Reasonable Estimate Case provide conservatively high estimates of the actual groundwater inflow quantity and quality that are likely to be encountered

during mining. The results also show that the Lower Bound Scenario provides a reasonable lower estimate of the actual groundwater inflow quantity and quality that could occur during mining of the Jay Pit.

Stitching Together of the 2D and 3D hydrogeological models

Discussion Topic: At and following the Technical Sessions, GNWT requested additional information on how the 2-dimensional (2D) and 3-dimensional (3D) hydrogeological models were linked together in the DAR.

Commitment: Dominion Diamond committed to providing a written response to the GNWT.

Work Completed: A formal response was prepared and submitted to the GNWT on May 25, 2015, and provided to the MVEIRB public registry. It was clarified that the initial condition for the total dissolved solids (TDS) of groundwater within the pit walls in the post-closure hydrogeologic model presented in Appendix 8B relied on the TDS profile predicted for the end of Period 12 (the end of mining) which corresponds to maximum upwelling of high TDS water beneath the pit. In addition, summary information requested for Jay Pit inflow volumes and TDS concentrations was extracted from five interlinked models. Cross-sectional profiles detailing hydraulic conditions and TDS concentrations across the model domain were also provided.

Lower Bound Scenario

Discussion Topic: At and following the April 2015 Technical Sessions in Yellowknife, MVEIRB, and the GNWT raised concerns that the water quality modelling for the evaluation of meromixis in the Misery and Jay pits was based on conservative input parameters both in the Conservative EA Case in the DAR and the Reasonable Estimate Case, and that meromixis may not form and be stable over the long term if water quality has been over predicted in the Jay and Misery Pits.

Commitment: During a telephone/online meeting at the end of April 2015, Dominion Diamond committed to develop a Lower Bound Scenario for the hydrogeological model and carry the results of this modeling forward into the pit lake hydrodynamic models to evaluate the stability of meromixis in the Misery and Jay Pits based on predicted TDS concentrations. The timeline for this work was to occur in parallel with the uncertainty analyses described above and to provide a technical memorandum summarizing the results of the Lower Bound Scenario

modelling with the responses to the 2nd Rounds IRs. The hydrogeological parameters for the EPZ for porosity, hydraulic conductivity, and width of the zone that were to be used in the 3D numerical hydrogeological model were provided by Golder Associates Ltd. during the meeting.

Work Completed: The results of the lower bound scenario were provided in the technical memo “Jay Project –Pit Lake Hydrodynamic Modelling – Lower Bound Scenario” (Golder 2015c) provided with the responses to the 2nd round IRs.. The memo describes the model updates and the results for the Jay Pit hydrogeological model (including groundwater quantity and quality), the site water quality model predictions, and the updated hydrodynamic model. As noted in the memo, although the Jay and Misery Pits have much lower initial mixolimnion and monimolimnion TDS concentrations in comparison to the Reasonable Estimate Case, hydrodynamic modelling indicates the pits will stratify and remain stratified during the 200 year model timeframe.

Pit Hydrodynamic Modelling

Discussion Topic: Prior to the second round of IRs and in DAR-GNWT-IR2-07, GNWT requested input files for the CE-QUAL-W2 pit hydrodynamic model.

Follow-up: As described in the response to DAR-GNWT-IR2-07, a teleconference call was held on June 30, 2015 to discuss the model input data. Dominion Diamond and Golder Associates Ltd. explained that the inputs to the hydrodynamic model are a function of several other models and the pit lake hydrodynamic models cannot be run in isolation of these models. Dominion Diamond also reiterated a Lower Bound Scenario was being conducted. Based on this information, Dominion Diamond understood the GNWT were satisfied that a Lower Bound Scenario was being evaluated, and as a result, no longer required the model input data requested in the IR DAR-GNWT-IR2-07.

Commitment: Dominion Diamond committed to host a water quality modelling workshop for GNWT and their consultants in Toronto on July 6, 2015 to go through the pit lake hydrodynamic models in detail, including the model input files, model setup, structure, and inherent assumptions, and also to present the results of all the model scenarios that have been completed to date, including the Lower Bound Scenario requested by the GNWT.

Work Completed: Dominion Diamond prepared presentation material and held a workshop with GNWT staff in Toronto on July 6, 2015 to provide further explanation of the water quality modelling conducted to date, including water quality modelling scenarios requested by the GNWT, and discussions of the GNWT and MVEIRB water quality modelling IRs. MVEIRB staff and technical experts also participated in this meeting.

Follow-up to Modelling Workshop

Discussion Topic: There were a few outstanding questions on hydrogeological modelling at the July 6, 2015 workshop. As well, there was a discussion related to low-likelihood events which could cause the pit to overturn.

Commitment: Dominion Diamond committed to the following:

- having a follow-up call with the GNWT on July 20, 2015 to discuss hydrogeological modelling; and,
- conducting additional water quality modelling to address an “Extreme Wind” Scenario. The extreme Wind Scenario considered the observed 99.99th percentile wind speed would persist for a one-year period, and was modelled to evaluate the influence of such an event on meromixis in the Jay and Misery pit lakes.

Work Completed: Dominion Diamond prepared presentation material and held an online meeting with GNWT on July 20, 2015 to answer the remaining questions on hydrogeological modelling. The presentation was submitted to MVEIRB on July 20, 2015. The extreme case modelling is being completed and will be summarized and provided in a technical memorandum “Jay Project – Pit Lake Hydrodynamic Modelling – Extreme Wind Scenario” (Golder 2015d).

Dominion Diamond recognizes the importance of all Parties concerns and is committed to work diligently to provide information and responses in a timely manner throughout the DAR review process. Dominion Diamond is of the view we have adequately responded to the concerns of the GNWT and provided a comprehensive and exhaustive package of water quality modelling to address the original request for quantification of the uncertainty in the Environmental Assessment (EA) Conservative Scenario and the Reasonable Estimate Case.



Regards,

A handwritten signature in black ink, appearing to read 'Richard Bargery', is written over the printed name.

Richard Bargery

Manager, Permitting Jay Project
Dominion Diamond Corporation

c. Nathen Richea
Manager, Water Regulatory
Environment and Natural Resources, GNWT

References

- Golder (Golder Associates Ltd.) 2015a. Jay Project – Uncertainty Stochastic Approach and Response to the GNWT. May 11, 2015.
- Golder. 2015b. Jay Project – Uncertainty Analysis Methods and Results for Hydrogeological Modelling. July 3, 2015.
- Golder. 2015c. Jay Project –Pit Lake Hydrodynamic Modelling – Lower Bound Scenario. July 3, 2015.
- Golder. 2015d. Jay Project – Pit Lake Hydrodynamic Modelling – Extreme Wind Scenario.

DATE July 24 2015**PROJECT No.** 1419751**TO** Richard Bargery
Dominion Diamond Ekati Corporation**CC** Claudine Lee (Dominion Diamond), Elliot Holland (Dominion Diamond), Eric Denholm (E. Denholm Consulting), Kristine Mason (Golder)**FROM** Alison Snow, Michael Herrell, and Jerry
Vandenberg**EMAIL** Alison_Snow@golder.com,
Michael_Herrell@golder.com and
Jerry_Vandenberg@golder.com**JAY PROJECT – PIT LAKE HYDRODYNAMIC MODELLING – EXTREME WIND SCENARIO**

1.0 INTRODUCTION

On July 6, 2015, a modelling workshop was conducted with representatives from Dominion Diamond Ekati Corporation (Dominion Diamond), Golder Associates Ltd. (Golder), the Government of the Northwest Territories (GNWT), and the Mackenzie Valley Environmental Impact Review Board (MVEIRB). The purpose of the workshop was the following:

- Present the results of the modelling scenarios completed since the Jay Project technical sessions in April 2015:
 - 2-dimensional (2D) Monte Carlo hydrogeological model;
 - 3- dimensional (3D) First Order Approximation (FOA) hydrogeological model; and,
 - Lower bound water quality model results.
- Provide additional details regarding the inputs, assumptions, and results of the CE-QUAL-W2 pit lake hydrodynamic model inputs.

During the meeting, Dr. Neil Hutchinson, a technical advisor to the MVEIRB, from Hutchison Environmental Services Ltd. requested that an “extreme wind” scenario, considering sustained high wind speeds, be modelled to evaluate the influence of such an event on meromixis in the Jay Pit and Misery Pit lakes. This memorandum provides the results of this analysis.

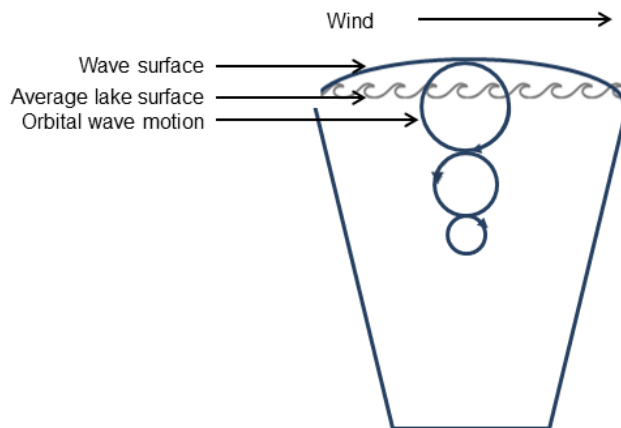
2.0 BACKGROUND

Wind exerts a shear force across a lake surface that propagates downward and generates turbulent kinetic energy. The amount of energy is dependent on the wind velocity, fetch, and the duration of the wind event. Fetch is the length of exposed water surface along the wind direction. In general, a greater wind velocity and fetch



produces larger waves. Under the lake surface, the water moves in an orbital motion causing vertical mixing (Figure 1). If the energy supplied by wind is sufficient to overcome density gradients with depth, the lake is likely to mix. The CE-QUAL-W2 model applied to the Jay Project pit lakes calculates for wind-driven energy and water density at each 1-m interval from surface to the bottom of the pit lakes at small (~5 minute) time steps for 200 years post-filling to arrive at estimates of pycnocline depth, and mixolimnion and monimolimnion total dissolved solids (TDS) vertical profiles.

Figure 1: Orbital Water Motion Induced by Wind on a Lake Surface



3.0 METHODS

As described in Appendix 8G of the Developer's Assessment Report (DAR), hydrodynamic models were developed for Jay Pit and Misery Pit lakes using CE-QUAL-W2. Hourly wind speed data were one of the meteorological inputs included in the hydrodynamic models. Hourly wind speed data were obtained from a 15-year record at an on-site meteorological station at the Diavik Mine. Where gaps existed in the data from the Diavik Mine, data from an on-site meteorological station at the Ekati Mine were used to supplement the Diavik record. The 15-year sequence was applied as a direct input to the model and recursively looped into the future.

The wind speed used in the extreme wind scenario was selected as the 99.99th percentile wind speed observed in the Diavik Mine meteorological data. This value (20 metres per second [m/s]) was input into the model as a constant for a one-year period. Therefore, the wind would exert shear forces over the lake during the entire open-water period. According to Environment Canada (2011), a sustained surface wind speed of 20 m/s is defined as a gale. While this scenario does not represent an actual wind event (i.e., a wind speed of 20 m/s for a duration of one year was not recorded in the 15-year meteorological record), it was assumed to be constant for the purpose of evaluating the sensitivity of mixing in Misery and Jay Pit Lakes to extreme conditions.

For the Misery and Jay pit lakes, the extreme wind scenario was assumed to occur in the calendar year following back-flooding of the pits. The extreme wind scenario was evaluated for the updated assessment, reasonable estimate (Golder 2015a), and lower bound model (Golder 2015b) scenarios. All other hydrodynamic model variables remained unchanged. The reader is referred to Golder (2015a,b) and Appendix 8G of the DAR for additional details related to pit lake model development.

4.0 RESULTS AND DISCUSSION

4.1 Misery Pit

Predicted TDS profile concentrations are presented in Figure 2 for the Misery Pit lake. The results of the extreme wind scenario indicate the following:

- The Misery Pit lake will remain stratified for the 200-year simulation period (Figure 2 panels a-h);
- An increase in vertical mixing occurred between the monimolimnion and mixolimnion in the extreme wind scenario;
- The pycnocline depths were predicted to increase from approximately 60, 60, and 60 metres (m) to 70, 70, and 100 m for the updated assessment, reasonable estimate, and lower bound model scenarios, respectively (Figure 2 panels c-f); and,
- Mixolimnion TDS concentrations were predicted to increase from 50, 18, and 7 milligrams per litre (mg/L) to 701, 623, and 269 mg/L for the updated assessment, reasonable estimate, and lower bound model scenarios, respectively (Figure 2 panels c-f) .

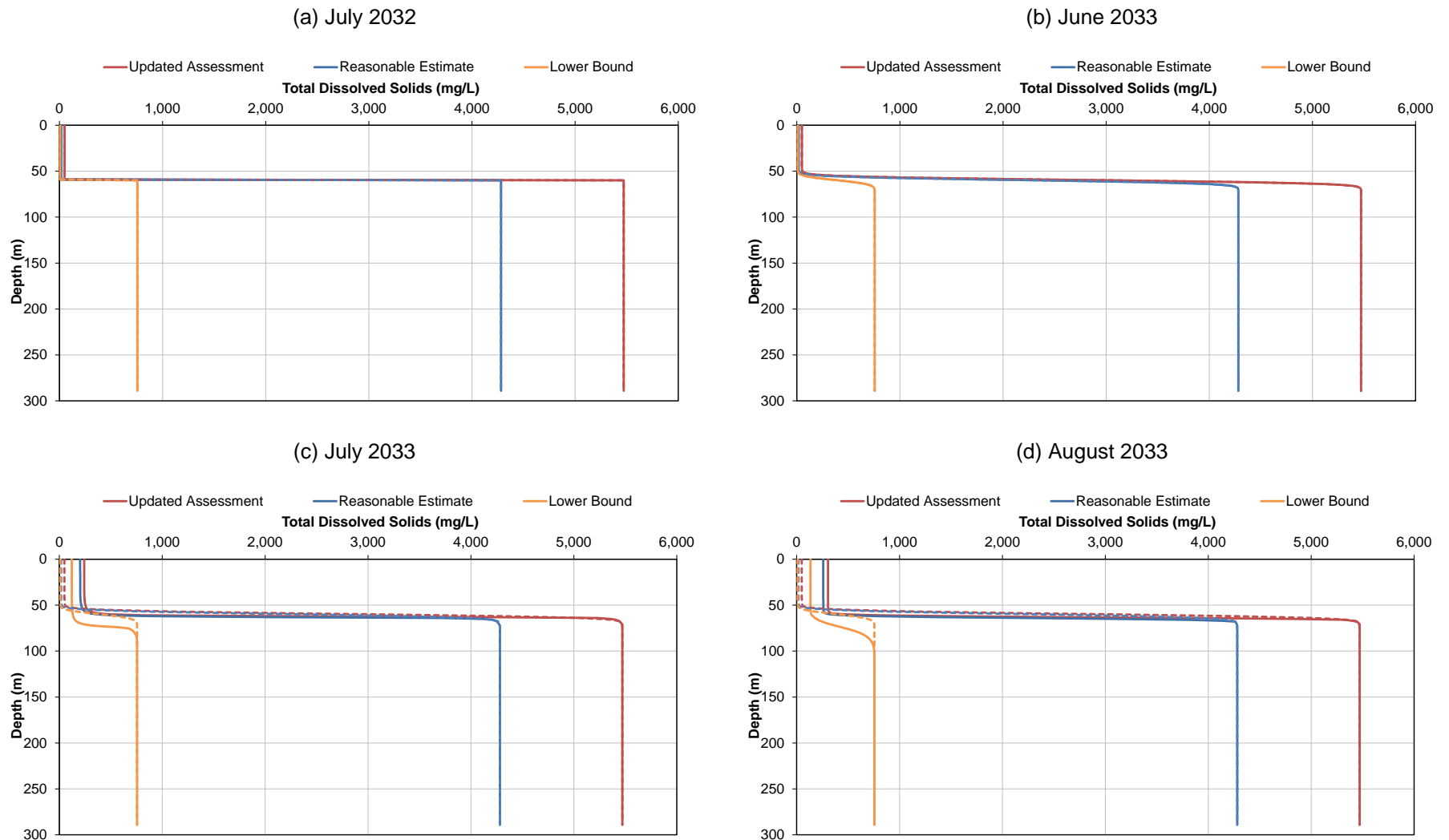
4.2 Jay Pit

Predicted TDS profile concentrations are presented in Figure 3 for the Jay Pit lake. The results of the extreme scenario indicate the following:

- The Jay Pit lake was predicted to remain stratified for the 200-year simulation period (Figure 3 panels a-h);
- Vertical mixing increased between the monimolimnion and mixolimnion during the extreme wind scenario;
- The depth of the pycnocline was predicted to increase from approximately 150, 150, and 200 m to 210, 250, and 300 m for the updated assessment, reasonable estimate, and lower bound model scenarios, respectively; and,
- Mixolimnion TDS concentrations were predicted to increase from 33, 18, and 13 mg/L to 404, 255, and 45 mg/L for the updated assessment, reasonable estimate, and lower bound model scenarios, respectively (Figure 3 panels c-f).

During the extreme wind scenario, the Jay Pit lake was predicted to undergo more vertical mixing in comparison to the Misery Pit lake (i.e., Jay Pit lake experienced a greater change in pycnocline depths than Misery Pit lake) because the surface area of Jay Pit lake is approximately ten times greater than the surface area of Misery Pit lake. As a result, the Jay Pit lake has a longer fetch than Misery Pit lake. The longer fetch transfers more wind-driven energy to the Jay Pit Lake, resulting in increased vertical mixing.

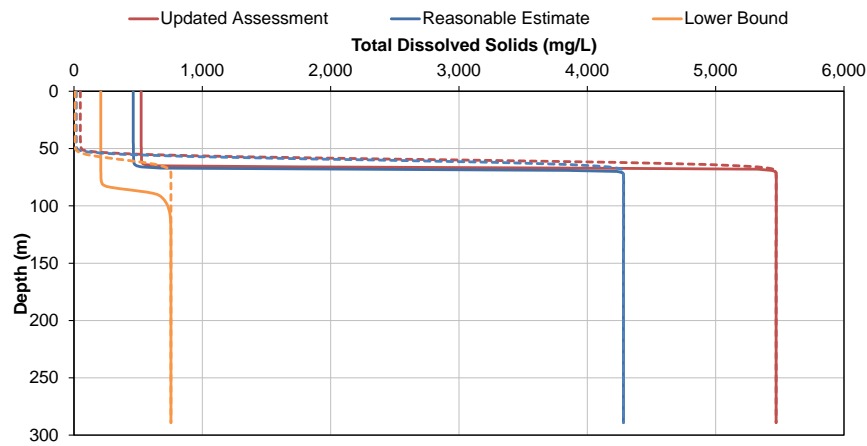
Figure 2: Misery Pit Lake Total Dissolved Solids Profile Concentrations



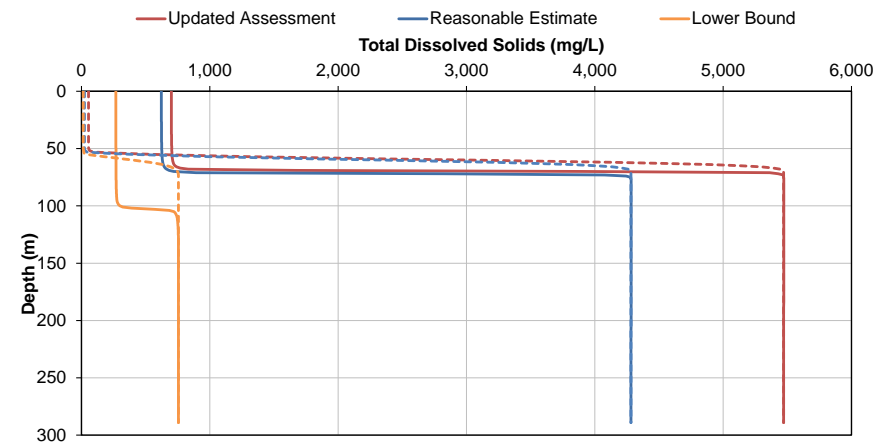
Note: Solid line = results from extreme scenario; dashed line = results using monitored wind speed data.
m = metre; mg/L = milligrams per litre.

Figure 2: Misery Pit Lake Total Dissolved Solids Profile Concentrations, Continued

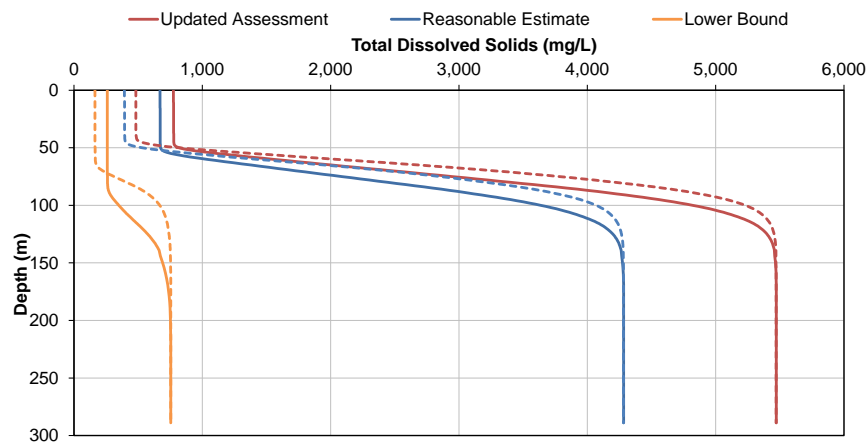
(e) September 2033



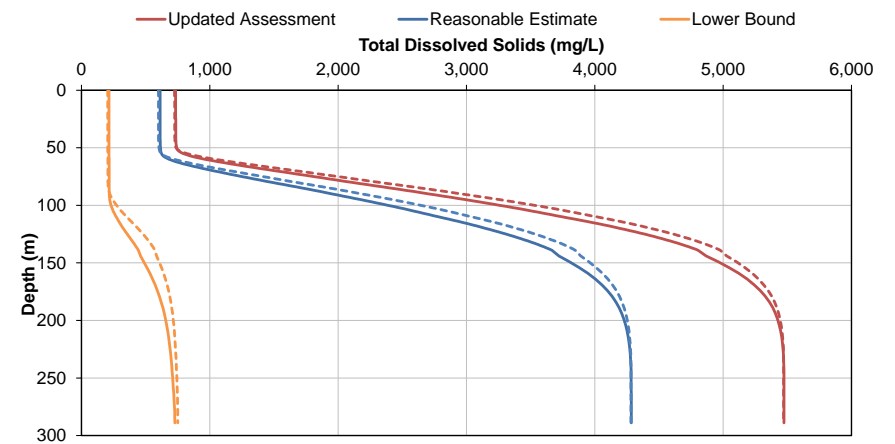
(f) October 2033



(g) July 2082

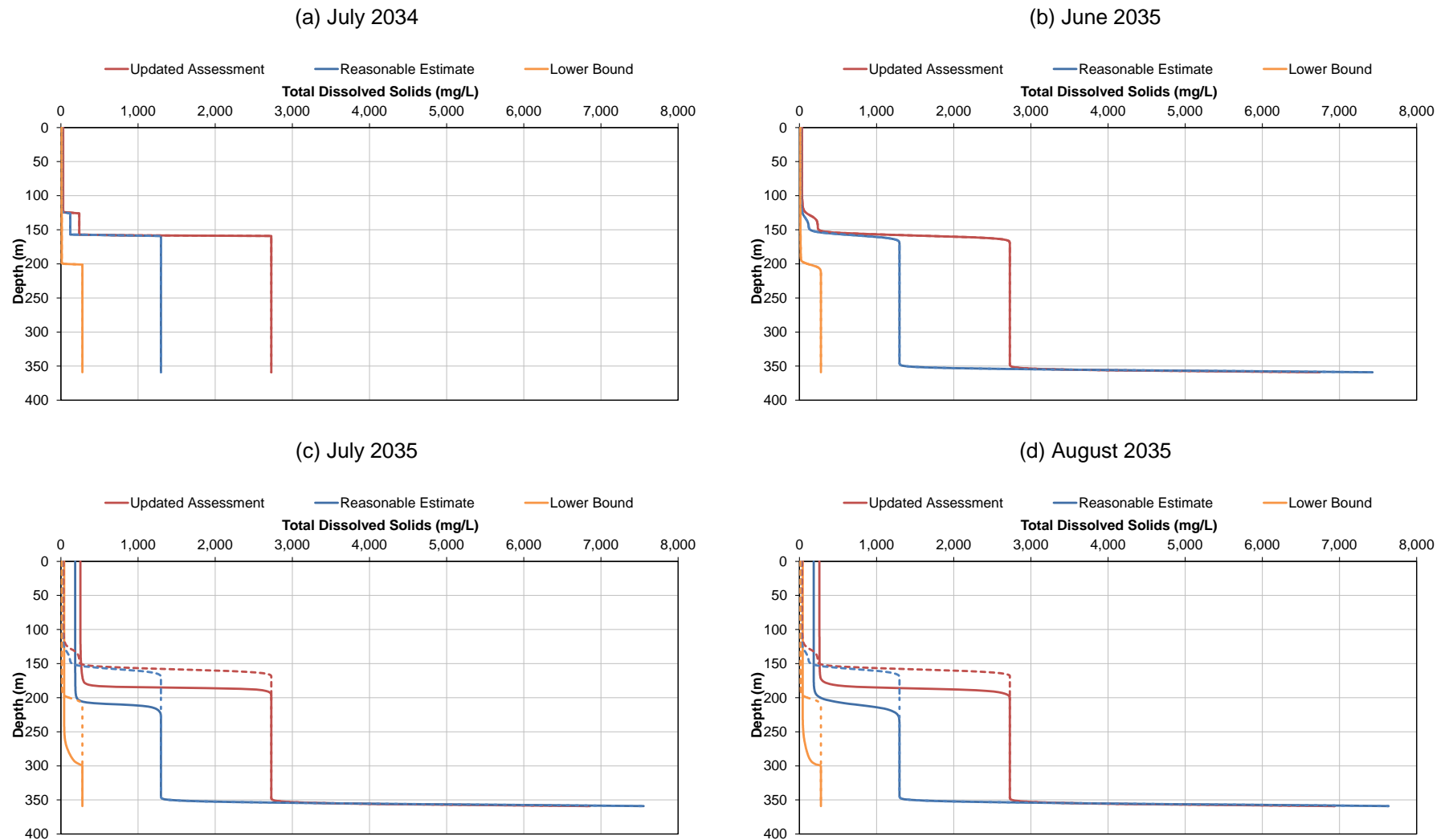


(h) July 2232



Note: Solid line = results from the extreme scenario; dashed line = results using monitored wind speed data.
m = metre; mg/L = milligrams per litre.

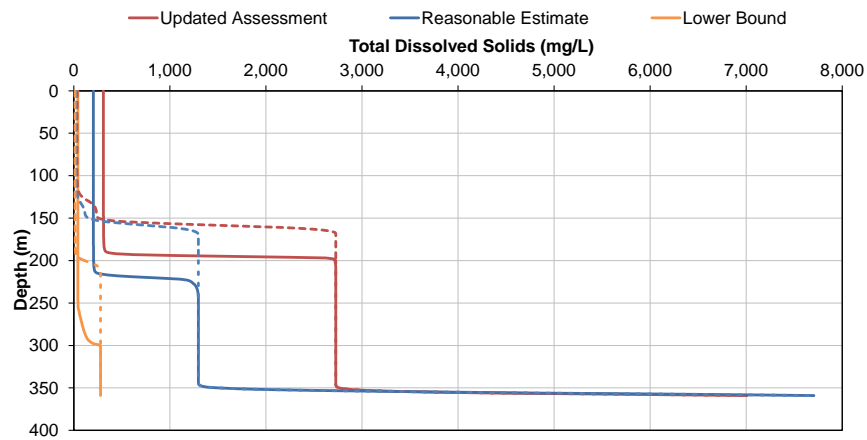
Figure 3: Jay Pit Lake Total Dissolved Solids Profile Concentrations



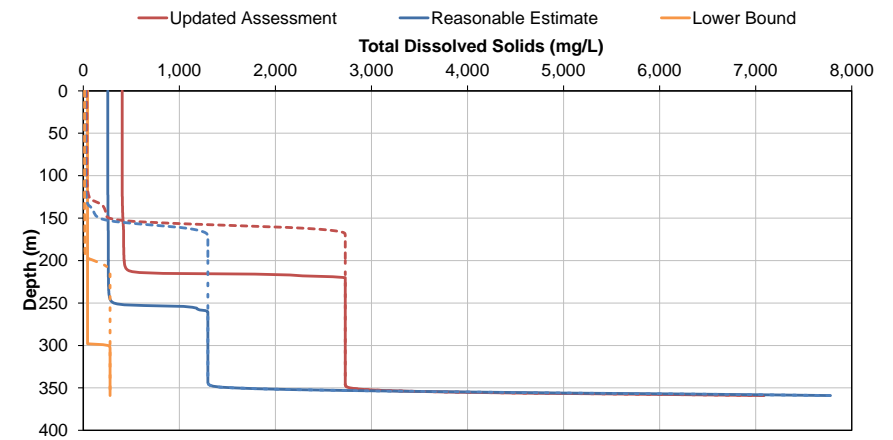
Note: Solid line = results from the extreme scenario; dashed line = results using monitored wind speed data.
m = metre; mg/L = milligrams per litre.

Figure 3: Jay Pit Hydrodynamic Lake Total Dissolved Solids Profile Concentrations, Continued

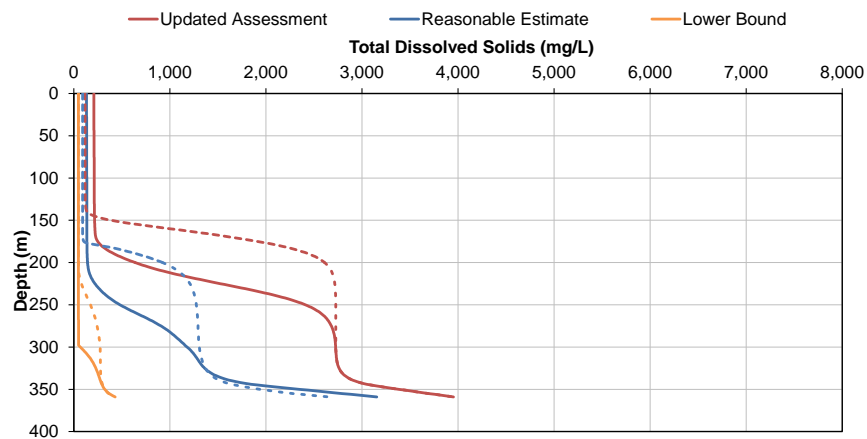
(e) September 2035



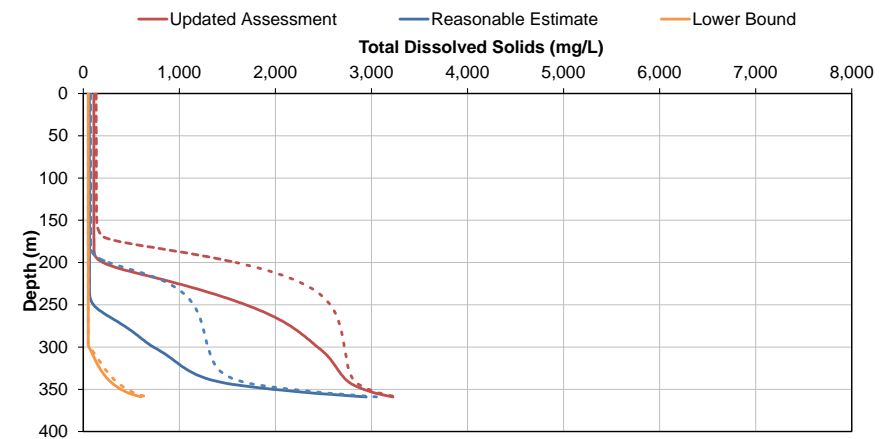
(f) October 2035



(g) July 2084



(h) July 2234



Note: Solid line = results from the extreme scenario; dashed line = results using monitored wind speed data.
m = metre; mg/L = milligrams per litre.

5.0 SUMMARY

The stability of meromixis in the Jay and Misery pits has been evaluated for the following three model scenarios using CE-QUAL-W2:

- Updated Assessment Case (Golder 2015a),
- Reasonable Estimate Case (Golder 2015a); and,
- The Lower Bound Scenario (Golder 2015b).

The above three scenarios are considered to bracket the range of initial TDS concentrations that may occur in the Misery and Jay pits following back-flooding of these pits. In all three scenarios, the hydrodynamic model indicated that meromixis will form and remain stable during the 200-year model period.

An additional case, referred to as the extreme wind scenario was included to evaluate if a prolonged wind event could result in an overturn in the Updated Assessment Case, Reasonable Estimate Case, or Lower Bound Scenarios. The wind speed used in the extreme wind scenario was selected as the 99.99th percentile wind speed observed in the Diavik Mine meteorological data. This value (20 metres per second [m/s]) was input into the model as a constant for a one-year period. It is important to note that this is not considered a realistic scenario for the Jay Project and the purpose of the model was to understand if stability of meromixis in the Jay and Misery pits is sensitive to a prolonged extreme wind event.

The extreme wind scenario resulted in deeper vertical mixing in the Jay and Misery pits resulting in deeper pycnocline depths; however, the model indicates meromixis will still form under these conditions and remain stable during the 200-year model timeframe for the Updated Assessment Case, Reasonable Estimate Case, and Lower Bound Scenarios. Therefore, the extreme wind event not only confirms previous hydrodynamic modelling predictions, but adds confidence that meromixis will form and remain stable in the Jay and Misery pits during post-closure.

6.0 REFERENCES

- Environment Canada. 2011. Beaufort Wind Scale Table. Webpage: <http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=80C039A3-1>. Modified 2011-11-07.
- Golder (Golder Associates Ltd.). 2015a. Jay Project – Compendium of Supplemental Water Quality Modeling. Report Number 1419751. April 7, 2015.
- Golder. 2015b. Jay Project – Pit Lake Hydrodynamic Modelling – Lower Bound Scenario. July 3, 2015.

7.0 CLOSURE

We trust this memorandum satisfies your current requirements. Should you have any questions or require any additional information, please do not hesitate to contact the undersigned.



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AS/MH/JV/kpl

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