

## Review Comment Table

<b>Board:</b>	WLWB
<b>Review Item:</b>	Diavik - PKC - Spillway Modification Request and Revised Freeboard Limit (W2015L2-0001)
<b>File(s):</b>	<a href="#">W2015L2-0001</a>
<b>Proponent:</b>	Diavik Diamond Mines Inc.
<b>Document(s):</b>	<a href="#">PKC Spillway Modification and Freeboard Limit Request</a> (1 MB)
<b>Item For Review Distributed On:</b>	Jan 4 at 17:12 <a href="#">Distribution List</a>
<b>Reviewer Comments Due By:</b>	Feb 19, 2016
<b>Proponent Responses Due By:</b>	Mar 2, 2016
<b>Item Description:</b>	<p>On December 9, 2015, the Wek'eezhii Land and Water Board (WLWB) received a request from Diavik Diamond Mines (2012) Inc. (DDMI) for approval for modification of the Processed Kimberlite Containment (PKC) spillway design and freeboard limit.</p> <p><i>Update (February 19, 2016): The WLWB hired SRK Consulting to review the technical aspects of the modification request; SRK and Board staff jointly prepared the WLWB staff comments and recommendations. SRK was provided the following background materials: PKC Design Report; PKC Operating Plan; relevant excerpts from the approved ICRP v3.2, and, the Water Licence (W2015L2-0001).</i></p>
<b>General Reviewer Information:</b>	The Board invites reviewers to provide comments and recommendations to the Board on the requested modification and freeboard limit via the WLWB Online Review System.
<b>Contact Information:</b>	Jessica Pacunayen Patty Ewaschuk 905-852-1516 Sarah Elsasser 867-765-4583

## Comment Summary

GNWT - Environment and Natural Resources: Central Email GNWT				
ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Response
5	General File	<b>Comment</b> <a href="#">(doc)</a> ENR Letter with Comments and Recommendations and attached Technical Memo <b>Recommendation</b>		
1	General File	<b>Comment</b> <a href="#">(doc)</a> Brodie Consulting Technical Memo <b>Recommendation</b> See Attached		
1	Topic 1: Environmental Design Flood	<b>Comment</b> It is unclear which return period (1:500 or 1:100) has been used in the design of the EDF for the PKC and the Collection Ponds. However, ENR notes that a wet period of a more sustained duration, such as a 90 day wet period (vs single short term storm event), may provide a more appropriate EDF. It is conceivable that during such a wet period that the water treatment facility and/or other storage ponds could be over-whelmed by water from other mine sources (e.g. pit, dump seepage) and it may not be feasible to reduce the pond inventory in this period. Designing the PKC Spillway and overall site water	<b>Mar 1:</b> The EDF event considered for the design of the PKC Facility Phase 6 spillway is the 1:100-year 24-hour rainfall event plus the snowpack from an average year melting over a two-week period (Section 5.0 of the Processed Kimberlite Containment Facility Operations Spillway Review Technical Memorandum). This design event considers that the PKC Facility pond is at maximum normal operating water level at the start of the rainfall event and that all runoff during the EDF is discharged through the PKC Facility spillway to Pond 3. This design scenario is considered to be appropriate because it provides a high	

		<p>management for a wet period instead of a single precipitation event would provide a more conservative basis for the design and for site operations.</p> <p><b>Recommendation</b> 1) ENR recommends that DDMI account for a more conservative EDF for the design.</p>	<p>design flow for the PKC Facility spillway. Longer-term wet events would provide a larger flow volume, but a smaller peak design flow, which would not be appropriate to use for designing the PKC spillway.</p>	
2	Topic 2: Pumping During 1:100 Year Event	<p><b>Comment</b> Section 2.3 recommends modification of the PKC O&amp;M Manual to assume no pumping of water from catchment ponds to the PKC during the 1:100 year event. ENR accepts that pumping above the 1:100 year event may not be warranted (or practical). However, the volume up to the 1:100 year event should be assumed to be pumped, and only the volume above that should be assumed released.</p> <p><b>Recommendation</b> 1) ENR recommends that the PKC O&amp;M Manual indicate that volumes up to the 1:100 year event should be assumed pumped to the PKC.</p>	<p><b>Mar 1:</b> The current site water management facilities are designed to store 1:100 year freshet size event, and spill to the environment any inflows greater than this size of event. The recommendation is that if the ponds are spilling (greater than a 1:100 year event has occurred), to not pump and add any additional water from the ponds to the PKC Pond, until after the storm event has been routed through the PKC facility.</p>	
3	Topic 3: Spillway Design	<p><b>Comment</b> ENR notes that, while the methodology for the spillway design is appropriate, the resulting freeboard limits are relatively small, i.e. only 0.4 m between the operating water level and the crest of the dam. ENR is concerned that such a small freeboard</p>	<p><b>Mar 1:</b> The spillway design presented in Golder (2015) is for the operational emergency spillway. During operations, the spillway invert elevation and the elevation of the dam crest will be surveyed yearly to confirm that the required 0.4 m</p>	

		would be sensitive to several factors including: . Variability in constructed elevations; . Possible effects of settlement of the dam crest and/or frost heave in the spillway invert; and . Partial or complete blockage of the spillway due to blocks of ice which may exist in the PKC pond (note that a runoff coefficient of 0.95 is used which implies that the precipitation events are assumed to occur either just before or just after winter). <b>Recommendation</b> 1) ENR recommends that the dam crest be raised by a small amount, e.g. 0.5 m, to provide additional confidence in system performance should an extreme event occur.	elevation difference is maintained. This will be included in the PKC Operations Management Plan and internal OMS manual. The spillway design will be revisited for potential future raises of the PKC Facility and for the closure spillway.	
4	Technical Memo	<b>Comment</b> Att: Technical Memo - Diavik Diamond Mine; Proposed Modifications; PKC Spillway, February 18, 2016 - Brodie Consulting Ltd. <b>Recommendation</b> None		
<b>GNWT - Lands: Tracy Covey</b>				
<b>ID</b>	<b>Topic</b>	<b>Reviewer Comment/Recommendation</b>	<b>Proponent Response</b>	<b>Board Staff Response</b>
1	Maintaining beaches between the PKC Pond and the PKC Dams.	<b>Comment</b> Pg. 5, Section 3.0, First Paragraph, states "For this assessment, the PKC Pond has been assumed to be maintained in a	<b>Mar 1:</b> Yes, approximately 10 to 20 m long beaches between the PKC Pond and the PKC Facility dam slopes are	

		<p>centralized location with FPK beaches between the PKC Pond and the PKC dams. This requirement should be confirmed". Pg. 7, 4th paragraph, further adds that "maintaining the PKC Pond in a centralized location with FPK beaches around the PKC Facility's entire perimeter would require approximately 10 to 20 m long FPK beaches between the PKC Pond and the PKC dam slopes". Given all that, should this request be approved, is the Engineer saying that the Engineers recommended reduction of the freeboard requirements is conditional upon the maintenance of a 10-20 m long beach at all times between the PKC Pond and the PKC dams?</p> <p><b>Recommendation</b> Answer the question: Is the Engineers recommended reduction of the freeboard requirements conditional upon the maintenance of a 10-20 m long beach at all times between the PKC Pond and the PKC dams? ie., the Inspector should consider this to be a condition of the Engineers approved modification.</p>	<p>required once the pond exceeds an elevation of 462.7 m.</p>	
<p>WLWB: Patty Ewaschuk</p>				

ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Response
1	Golder Memo dated October 2, 2015: Processed Kimberlite Containment Facility Operations Spillway - Section 2.1, 3rd paragraph, Section 2.3, 2nd and 3rd paragraphs and Section 5, 1st and 2nd paragraphs	<p><b>Comment</b> The Golder memo indicates that an Environmental Design Flood (EDF) corresponding to the 1:100-year event has been selected for design purposes. The revised freeboard calculations for the PKC Facility show no EDF storage allowance; instead, the memo states that the EDF storage requirement will be met by diverting water in the PKC Facility to Pond 3 (it is understood that water inflows to Pond 3 in excess of the EDF will be pumped or discharged to North Inlet). This implies that this diversion to Pond 3 must occur prior to, but no later than when pond levels reach the normal operating water level (NOWL, El 464.6 m). Conversely, as it is understood that water from Ponds 7 and 12 (and optionally from Ponds 1 and 5) would be pumped to the PKC, the factors which will determine when and in which direction water will be pumped between these facilities are unclear.</p> <p><b>Recommendation</b> DDMI should provide an explanation of what pumping arrangements will be when the water level is below the NOWL (El</p>	<p><b>Mar 1:</b> The revised PKC Facility spillway design does not modify the existing pumping arrangements for the PKC pond or site ponds. The details of the current site water management capabilities for pumping from site ponds to other site ponds, North Inlet and/or PKC Facility are described in section 2.3 (Golder 2015). The current site water management facilities are designed to store 1:100 year freshet size event, and spill to the environment any inflows greater than this size of event. The recommendation is that if the ponds are spilling (greater than a 1:100 year event has occurred), to not pump and add any additional water from the ponds to the PKC Pond, until after the storm event has been routed through the PKC facility.</p>	

		464.6 m) at the PKC Facility, what the pumping arrangements will be within the entire PKC Facility and adjacent pond system when the water level reaches the NOWL, how the 1:100 year, 24-hr rainfall event will be distinguished from lesser events (if that is indeed relevant) and how these pumping arrangements will ensure that DDMI meets EQC during a 1:100 storm event.		
2	Golder Memo dated October 2, 2015: Processed Kimberlite Containment Facility Operations Spillway - Section 2	<p><b>Comment</b> The document provides an explanation for the change in the spillway design criteria, freeboard calculations and recommended spillway invert. It is understood that, due to storage of the EDF outside the PKC Facility, a reduction in the catchment area related to changes in the pumping arrangements during the EDF, and the maintenance of tailings beaches, the required freeboard has dropped from 1.4 m (above the design spillway flow elevation) to 0.2 m. It is unclear how the revised case accounts for wind/wave action when the design flood flow (the probable maximum flood, or PMF) is passing through the spillway.</p> <p><b>Recommendation</b> DDMI should provide an explanation of how the</p>	<p><b>Mar 1:</b> The normal freeboard and minimum freeboard requirements were considered for the design of the spillway. The normal freeboard is the difference in elevation between the dam crest and the maximum operating water level of the facility. The minimum freeboard is the difference in elevation between the dam crest and the maximum water level that would result from the inflow design flood (IDF). Both freeboard requirements need to be satisfied. The minimum freeboard calculation accounts for wind/wave action when the IDF is passing through the spillway. The normal and minimum freeboard requirements for the design of the PKC Facility spillway were calculated using the sum of the</p>	

		revised spillway invert accounts for wind/wave action, and what criteria will be applied to make changes to the pumping arrangements when it will not be evident that the site is experiencing an EDF or PMF event until after it has occurred.	wind set-up and wave run-up for the wind recurrence values specified in CDA (2007). The calculations show that the normal freeboard requirement is 0.3 m and the minimum freeboard requirement is 0.2 m. Please see response to WLWB-1 for pumping arrangements.	
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February 19, 2016

Violet Camsell-Blondin  
Chair  
Wekeezhii Land and Water Board  
#1-4905 48<sup>th</sup> Street  
Yellowknife, NT  
X1A 3S3

Dear Ms. Camsell-Blondin,

**Re: Diavik Diamond Mine Inc. (DDMI)  
Water Licence – W2015L2-0001  
PKC - Spillway Modification Request and Revised Freeboard Limit  
Request for Comment**

The Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT), has reviewed the modification request at reference based on its mandated responsibilities under the *Environmental Protection Act*, the *Forest Management Act*, the *Waters Act*, the *Forest Protection Act* and the *Wildlife Act* and provides the following comments and recommendations for the consideration of the Board.

### **Topic 1: Environmental Design Flood**

#### **Comment(s):**

It is unclear which return period (1:500 or 1:100) has been used in the design of the EDF for the PKC and the Collection Ponds. However, ENR notes that a wet period of a more sustained duration, such as a 90 day wet period (vs single short term storm event), may provide a more appropriate EDF.

It is conceivable that during such a wet period that the water treatment facility and/or other storage ponds could be over-whelmed by water from other mine sources (e.g. pit, dump seepage) and it may not be feasible to reduce the pond inventory in this

period. Designing the PKC Spillway and overall site water management for a wet period instead of a single precipitation event would provide a more conservative basis for the design and for site operations.

**Recommendation(s):**

- 1) ENR recommends that DDMI account for a more conservative EDF for the design.

**Topic 2: Pumping During 1:100 Year Event**

**Comment(s):**

Section 2.3 recommends modification of the PKC O&M Manual to assume no pumping of water from catchment ponds to the PKC during the 1:100 year event. ENR accepts that pumping above the 1:100 year event may not be warranted (or practical). However, the volume up to the 1:100 year event should be assumed to be pumped, and only the volume above that should be assumed released.

**Recommendation(s):**

- 1) ENR recommends that the PKC O&M Manual indicate that volumes up to the 1:100 year event should be assumed pumped to the PKC.

**Topic 3: Spillway Design**

**Comment(s):**

ENR notes that, while the methodology for the spillway design is appropriate, the resulting freeboard limits are relatively small, i.e. only 0.4 m between the operating water level and the crest of the dam. ENR is concerned that such a small freeboard would be sensitive to several factors including:

- Variability in constructed elevations;
- Possible effects of settlement of the dam crest and/or frost heave in the spillway invert; and
- Partial or complete blockage of the spillway due to blocks of ice which may exist in the PKC pond (note that a runoff coefficient of 0.95 is used which implies that the precipitation events are assumed to occur either just before or just after winter).

**Recommendation(s):**

- 1) ENR recommends that the dam crest be raised by a small amount, e.g. 0.5 m, to provide additional confidence in system performance should an extreme event occur.

Comments and recommendations were provided by ENR technical experts in the Water Resources Division and the North Slave Region and were coordinated and collated by the Environmental Impact Assessment Section, Conservation, Assessment and Monitoring Division (CAM).

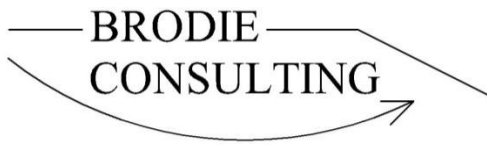
Should you have any questions or concerns, please do not hesitate to contact Patrick Clancy, Environmental Regulatory Analyst at (867) 767-9233 Ext: 53096 or email [patrick\\_clancy@gov.nt.ca](mailto:patrick_clancy@gov.nt.ca).

Sincerely,



Patrick Clancy  
Environmental Regulatory Analyst  
Environmental Assessment and Monitoring  
Land and Water Division  
Department of Environment and Natural Resources  
Government of the Northwest Territories

Att: Technical Memo – Diavik Diamond Mine; Proposed Modifications; PKC Spillway, February 18, 2016 - Brodie Consulting Ltd.



## MEMORANDUM

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DATE: February 18, 2016  
TO: Paul Green, GNWT – ENR Water Resources Division  
CC:  
  
FROM: John Brodie, P. Eng.  
  
SUBJECT: Diavik Diamond Mine; Proposed Modifications; PKC Spillway

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DDMI has submitted Processed Kimberlite Containment Facility Operations Spillway Review, GAL, December 2015 for proposed modifications. Comments are provided below.

### **EDF**

The concept of Environmental Design Flood (EDF) is described for the Diavik PKC. CDA guidelines suggest the EDF should be a recurrence between 1:50 and 1:200 years events. GAL had previously recommended to use the 1:500 year event, and now suggests that the 1:100 year event be used. The CDA does not provide guidance to suggest where in the range any given facility should be designed. In the opinion of BCL, the 1:200 year basis for the EDF would apply to high risk facilities with highly toxic water such as may occur in cyanide bearing tailings, or where runoff from exposed PAG tailings results in ARD which is high in metals. From this perspective, the GAL suggestion to use the 1:100 year event for the EDF for the PKC is reasonable, as the PKC water is not at the poor end of the range of possible mine waters.

An outstanding question is: Has GAL used the 1:500 year 24 hour event for the EDF (presumably yes). If yes, then it may be worthwhile checking if a more frequent wet period, such a 90 day wet period provides a greater EDF. It is conceivable that during such a wet period that the water treatment facility and/or other storage ponds could be over-whelmed by water from other mine sources (pit, dump seepage) and it may not be feasible to reduce the pond inventory in this period.

### **Section 2.3**

At the end of Section 2.3 GAL recommends modification of the PKC O&M Manual to assume no pumping of water from catchment ponds to the PKC during the 1:100 year event. Pumping above the 1:100 year event may not be warranted (or practical). However, the volume up to the 1:100 year event should be assumed to be pumped, and only the volume above that intensity should assumed to be released instead of pumped to the PKC.

### **Section 4 Spillway Design Elevations**

The methodology for determination of the design elevations is generally appropriate. The resulting freeboard limits are relatively small actual dimensions (only 0.4 m between nominal operating water level and the crest of the dam). This small freeboard is quite sensitive to several factors including:

- Variability in constructed elevations,
- Possible effects of settlement of the dam crest and/or frost heave in the spillway invert,
- Partial or complete blockage of the spillway due to blocks of ice which may exist in the PKC pond (note that a runoff coefficient of 0.95 is used which implies that the assumed precipitation events are assumed to occur either just before or just after winter).

Raising of the dam crest by an addition modest amount, say 0.5 m, would have a very minor impact on the overall construction of the dam, but would add significant confidence in the performance of the system should an extreme event occur.

The above comments apply to the operations phase of the PKC. The analyses should be re-assessed to determine the appropriate elevations for the closure condition, at which time there will be a cover on the tailings surface (and thus potentially altering elevations and pond storage).