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Violet Camsell-Blondin, Chair
Wek'eezhii Land and Water Board
PO Box 32
Wekweeti, NT X1A 3S3
Canada

12 August 2016

Dear Ms. Camsell-Blondin:

Subject: DDMI Spillway and Freeboard Limit Modification Re-Submission

Diavik Diamond Mines (2012) Inc. (DDMI) received notification from the Wek'èezhíi Land and Water Board (WLWB) on May 30, 2016 that the proposed modification to the PKC spillway design (Part G Item 2) and the change to the minimum freeboard specified in Part H Item 21a were not approved. In the Reasons for Decision attached to the May 30, 2016 notification the WLWB explained that DDMI's proposal was not approved for two reasons:

1. DDMI has not demonstrated that the proposed 1:100 year environmental design flood (EDF) is appropriate given that a 1:500 year EDF was used in the most recently submitted design for the PKC Facility.

2. DDMI has not demonstrated that Pond 3 will be able to contain the EDF.

The Board also requested that DDMI clearly describe the minimum freeboard limit change that is being requested in Part H Item 21a.

The May 30, 2016 notification also informed DDMI that Section 4 of Golder (2015) was accepted by the Board so the Board will not need to review this work again.

DDMI requested that Golder Associates, as the Engineer of Record for the PKC, consider the Reasons for Decision provided by the WLWB May 30, 2016 and address the two items noted above as well as the proposed change to the freeboard limit. In summary the result of their analysis is that:

3. The PKC Facility spillway design presented in Golder (2015) can accommodate a 1:100 year and a 1:500 year EDF. To simplify the regulatory approval process, DDMI has requested that the EDF remain at 1:500.

4. Pond 3 has sufficient available storage capacity to also store the 1:100-year 24-hour, 30-day, and 60-day, and 1:500-year 24-hour and 30-day EDF inflows without pumping to the North Inlet. Approximately 76,000 m^3 of water would need to be pumped to the North Inlet to store the 1:500-year 60-day EDF flows. Pond 3 currently has an installed pumping capacity of approximately 8,500 m^3/day through a pipeline to the North Inlet. Longer duration events were not considered as the net balance of inflow and outflow (pumping) decreases for longer duration events.

DDMI submits the attached Golder Technical Memorandum (Golder 2016) and request that the Board consider if this additional information addresses the two deficiencies noted in your letter of May 30, 2016.

With regard to the Board request that DDMI describe the change being requested for Part H Item 21a, DDMI requests the following be considered:

Currently Part H Item 21a states:

> *a minimum Freeboard limit of 1.5 metres below the lowest surveyed point of the liner or of the engineered emergency Spillway, whichever is lower, shall be maintained at all times; or as recommended by a Geotechnical Engineer and as approved by the Board;*

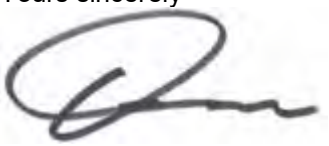
DDMI request the minimum Freeboard limit referenced in Part H Item 21a be approved as:

> *a minimum Freeboard limit of 0.4 metres from the normal operating water level to the lowest surveyed point of the dam crest liner.*

DDMI notes for the Board that the change described above is consistent with the Board's expectations as is included in the May 30, 2016 Reasons for Decision (page 7). In this regard DDMI and the Board appear to be in agreement.

We trust that the re-submission of this additional information satisfies the Board's requirements and we look forward to your decision on this matter.

Yours sincerely



David Wells
Superintendent - Environment

Cc: Anneli Jokela, WLWB

Attachment : Golder (2016)

References:

Golder. 2015. Processed Kimberlite Containment Facility Operations Spillway Review. Prepared for Diavik Diamond Mines (2012) Inc. Submitted October 2, 2015. Document No. 1521339-1419-TM-Rev0-4000.

Golder. 2016. Processed Kimberlite Containment Facility Operations Spillway Design – Support to DDMI on Resubmission of Proposed Modification. Prepared for Diavik Diamond Mines (2012) Inc. Submitted August 8, 2016. Document No. 1648001-1518-TM-Rev0-2000.

TECHNICAL MEMORANDUM

DATE	August 8, 2016	**GOLDER REFERENCE No.**	1648001-1518-TM-Rev0-2000
		WORK PLAN No.	493 Rev 1
		DIAVIK PO No.	K48769
TO	Gord Stephenson Diavik Diamond Mines (2012) Inc.		
CC	Dan Guigon and Gord Macdonald		
FROM	James Ogilvie, Germán Pizarro, and John Cunning	**EMAIL**	James_Ogilvie@golder.com; German_Pizarro@golder.com; John_Cunning@golder.com
TASK DESCRIPTION	**PROCESSED KIMBERLITE CONTAINMENT FACILITY OPERATIONS SPILLWAY DESIGN – SUPPORT TO DDMI ON RESUBMISSION OF PROPOSED MODIFICATION**		

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) prepared the Phase 6 Processed Kimberlite Containment (PKC) Facility dam raise design and construction drawings (Golder 2013), which include the design for a spillway located near the south end of the West Dam. A spillway is required to discharge water from the PKC Facility during extreme flood events. As part of the 2015 PKC Facility construction works, Diavik Diamond Mines (2012) Inc. (DDMI) requested Golder to review the Phase 6 PKC Facility spillway freeboard calculations and spillway location and to consider the use of available volume in Pond 3, located to the northwest of the PKC Facility, for flood storage.

The revised PKC Facility spillway design criteria, freeboard calculations, recommended spillway invert elevation, and an updated spillway location were presented in a technical memorandum (Golder 2015). DDMI submitted this document, along with a cover letter requesting a modification to the PKC Facility minimum freeboard, to the Wek'èezhìı Land and Water Board (WLWB) on December 10, 2015. The WLWB accepted the normal freeboard, minimum freeboard, and spillway calculations presented in Section 4 of Golder (2015) memorandum, but did not approve the modification to use Pond 3 to store the environmental design flood (EDF). The WLWB provided a document outlining its directive and reasons for the decision (WLWB 2016). The two main reasons highlighted by the WLWB to not approve the modification were that DDMI did not demonstrate that:

- "The 1 in 100 year storm is an appropriate basis for the environmental design flood (EDF)"; and
- "Pond 3 will be able to contain the EDF."

This technical memorandum has been prepared to provide clarification about the selection of the EDF and the containment of the EDF in Pond 3. It is understood that this document will be provided to the WLWB as part of a resubmission of DDMI's request for the WLWB to consider this spillway modification.

2.0 ENVIRONMENTAL DESIGN FLOOD

The EDF is defined as the most severe flood that is required to be managed without the release of water from the facility to the environment. The revised PKC Facility Normal Operating Water Level (NOWL) presented in Golder (2015) considers that the EDF inflow is diverted through the Phase 6 PKC Facility spillway and contained in Pond 3.

The Canadian Dam Association (CDA) *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams* (CDA 2014) states that typical return periods of the EDF range from 1:50-year to 1:200-year. Using guidance in this document, Golder recommended that the EDF event considered for the design of the PKC Facility spillway be the 1:100-year 24-hour rainfall event (Golder 2015). This recommendation was based on the PKC Facility consequence of failure classification (CDA 2013), knowledge of the Diavik Mine water management system and years of experience in operating the PKC Facility pond along with the collection ponds and the North Inlet pond.

The spillway design was carried out with the selected 1:100-year return period EDF but was checked for higher intensity flow conditions, up to a 1:500-year event, and longer duration flow conditions, up to a 60-day event. Table 1 presents the PKC Facility inflow volume for 1:100-year and1:500-year events, as a comparison. The details and assumptions used to determine the inflow volume were presented in Golder (2015). The 1:500-year event is only 6% larger (20,000 m^3) than the inflow volume of a 1:100-year 24-hour rainfall event, and neither exceed the storage capacity in Pond 3 (see Section 3.3).

Table 1: PKC Facility Environmental Design Flood Inflow Volume

Flow Event	Total Freshet Inflow (mm of water, rain plus snow equivalent)	EDF Inflow Volume to the PKC Facility (m^3)
1:100-year EDF (24-hour rainfall and average snowpack)	249	350,000
1:500-year EDF (24-hour rainfall and average snowpack)	260	370,000

Source: Golder 2015.

EDF = environmental design flood; PKC = processed kimberlite containment.

3.0 POND 3 STORAGE CAPACITY

3.1 History and Planned Use

Pond 3 was initially designed to store sediments and water from the dredging of the A154 Dike footprint, and was designated the On-Land Dredged Sediment Storage Facility (OLDSSF). This facility consisted of three perimeter dams and one pervious dam, namely the OLDSSF North, East, and West dams and the Pervious Dam. The OLDSSF was used as a clarification pond during dredging of the A418 Dike footprint and dewatering and is now used as a multi-purpose water management facility, including for surface runoff and seepage collection from the PKC Facility and North Country Rock Pile (NCRP). The OLDSSF is now called Pond 3.

The OLDSSF East Dam, Pervious Dam, and North Dam have been completely covered by the NCRP. A mine haul road (Ring Road) has been constructed across the Pond 3 area from the advancing NCRP to the northwest corner of the PKC Facility. The OLDSSF West Dam is now the only structure forming Pond 3, and it will be used for the life of the mine operations. Pond 3 is planned to be used to store sediments and water from the dredging of the A21 Dike. The A21 project expects to pump about 1.2 million m^3 of water with an estimated 10% solids content into Pond 3 during the summer of 2016. This will deposit an estimated total of 120,000 m^3 of solids into Pond 3. After the summer of 2016, sufficient storage capacity in Pond 3 will be made available for storage of the Pond 3 and PKC Facility flows from an EDF storm event. Details of the inflows and storage capacity are provided in the following sections.

3.2 Inflows

The current inflows to Pond 3 are runoff from the NCRP and pumped flows from Pond 4. Intermittent minor seepage from the PKC Facility, less than about 6 l/s, has reported to Pond 3 to date. Pond 3 water management capabilities allow pumping from Pond 3 to the North Inlet. Assuming that no seepage from the PKC Facility and pumping into Pond 3 would take place during an extreme flood event, the inflow reporting to Pond 3 would consist of only the EDF inflow diverted from the PKC Facility to Pond 3 and the direct catchment area of Pond 3 itself. The catchment area of Pond 3 is approximately 0.75 million m^2 and is shown in Figure 1.

The inflow to Pond 3 from its direct catchment and the PKC Facility catchment was estimated using Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) software (USACE 2010). The Soil Conservation Service curve number method (USDA-SCS 1986) was used to estimate general catchment losses; losses are taken into account when determining the amount of rainfall during a storm that becomes direct runoff. It was assumed that the ground would be frozen during the design storm event, so a curve number of 95 was used.

Table 2 shows Pond 3 inflow volumes for 1:100-year and 1:500-year 24-hour events.

Table 2: Pond 3 Inflows from Catchment Area and Diverted from PKC Facility during Environmental Design Flood

Flow Event	Inflow Volume to Pond 3 (m^3)
1:100-year EDF (24-hour)	532,000
1:500-year EDF (24-hour)	560,000

Note: Inflow into Pond 3 considers the diverted EDF flow from the PKC catchment and the direct inflow from the Pond 3 catchment.

EDF = environmental design flood; PKC = processed kimberlite containment.

Calculations were also completed to verify that inflows from longer duration events could be managed in Pond 3. Table 3 shows Pond 3 inflow volumes for 1:100-year and 1:500-year 30-day and 60-day events.

Table 3: Pond 3 Inflows from Catchment Area and Diverted from PKC Facility during Longer Duration Environmental Design Flood Events

Flow Event	Inflow Volume to Pond 3 (m^3)
1:100-year EDF (30-day)	782,000
1:100-year EDF (60-day)	956,000
1:500-year EDF (30-day)	860,000
1:500-year EDF (60-day)	1,076,000

EDF = environmental design flood; PKC = processed kimberlite containment.

3.3 Storage Capacity

The water level in Pond 3 has been maintained low in recent years, at or below the upstream toe of the Pond 3 dam near elevation 422 to 424 m, by pumping to the North Inlet. Based on the storage capacity curve provided by DDMI (DDMI 2016), Pond 3 has an estimated total storage capacity of approximately 1.0 million m^3. The storage curve includes an estimate of the reduced storage capacity due to the deposition of sediments from dredging of the A21 Dike (as discussed in Section 3.1) and it does not account for storage capacity within the voids in the rockfill of the NCRP. The estimated storage capacity curve of Pond 3 is presented in Figure 2. The storage capacity curve demonstrates that Pond 3 has sufficient available storage capacity to store the 532,000 m^3 from the design 1:100-year 24-hour EDF event and longer return period events such as the 1:500-year 24-hour EDF inflows (560,000 m^3).

Pond 3 has sufficient available storage capacity to also store the 1:100-year 24-hour, 30-day, and 60-day, and 1:500-year 24-hour and 30-day EDF inflows without pumping to the North Inlet. Approximately 76,000 m^3 of water would need to be pumped to the North Inlet to store the 1:500-year 60-day EDF flows. Pond 3 currently has an installed pumping capacity of approximately 8,500 m^3/day through a pipeline to the North Inlet. Longer duration events were not considered as the net balance of inflow and outflow (pumping) decreases for longer duration events.

4.0 DISCUSSION

Based on discussions between DDMI and the WLWB, Golder understands that DDMI prefers to continue using a 1:500-year 24-hour EDF event for the design of the PKC Facility spillway to simplify the approval process. The PKC Facility spillway design presented in Golder (2015) can accommodate for a 1:100-year and a 1:500-year EDF event. Pond 3 has sufficient available storage capacity to store the 1:500-year 24-hour EDF inflows. Pond 3 also has sufficient available storage capacity to store longer duration events such as the 1:500-year 30-day EDF inflows without pumping to the North Inlet. Pending confirmation of the volume of solids that will be deposited in Pond 3 during dredging of the A21 Dike, approximately 76,000 m^3 of water would need to be pumped to the North Inlet to store the 1:500-year 60-day EDF flows. The current in place pumping infrastructure in Pond 3 allows for pumping of about 8,500 m^3 per day to the North Inlet. Pond 3 should be re-surveyed after dredging of the A21 Dike is complete to confirm the total available storage capacity of Pond 3.

5.0 CLOSURE

The reader is referred to the Study Limitations, which follows the text and forms an integral part of this technical memorandum. We trust this technical memorandum meets you present requirements. If you have any questions or concerns, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

James Ogilvie, P.Eng. (BC)
Water Resources Engineer

ORIGINAL SIGNED

Germán Pizarro, P.Eng. (BC)
Geotechnical Engineer

ORIGINAL SIGNED AND SEALED

John Cunning, P.Eng.
Principal, Senior Geotechnical Engineer

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature ORIGINAL SIGNED
Date
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

JO/GP/JCC/bb

Attachments: Study Limitations
Figure 1: Pond 3 Catchment Area
Figure 2: Pond 3 Storage Capacity Curve

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REFERENCES

CDA. (Canadian Dam Association). 2013. *Dam Safety Guidelines 2007 (Revised 2013)*. Canadian Dam Association.

CDA. 2014. *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams.* Canadian Dam Safety Guidelines, 2014. Canadian Dam Association.

DDMI (Diavik Diamond Mines [2012] Inc.). 2016. Pond 3 - Future Storage Curve.xlsx. Received on June 2, 2016.

Golder (Golder Associates Ltd.). 2013. *Diavik Diamond Mines Inc. Processed Kimberlite Containment Facility – Phase 6 Design Report*. Prepared for Diavik Diamond Mines Inc. Submitted March 1, 2013. Document #1197 Ver. 0.

Golder. 2015. Processed Kimberlite Containment Facility Operations Spillway Review. Prepared for Diavik Diamond Mines (2012) Inc. Submitted October 2, 2015. Document No. 1521339-1419-TM-Rev0-4000.

USACE (US Army Corps of Engineers). 2010. Hydrologic Modeling System HEC-HMS. Version 3.5, released August 2010.

USDA-SCS (United States Department of Agriculture – Soil Conservation Service). 1986. *Urban Hydrology for Small Watersheds*. TR-55, 164 p.

WLWB (Wek'èezhìı Land and Water Board). 2016. Decision from the Wek'eezhii Land and Water Board meeting of May 18, 2016. Letter to Diavik Diamond Mines (2012) Inc., May 30, 2016.

STUDY LIMITATIONS

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

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Pond 3 Catchment Area

PKC Facility Catchment Area

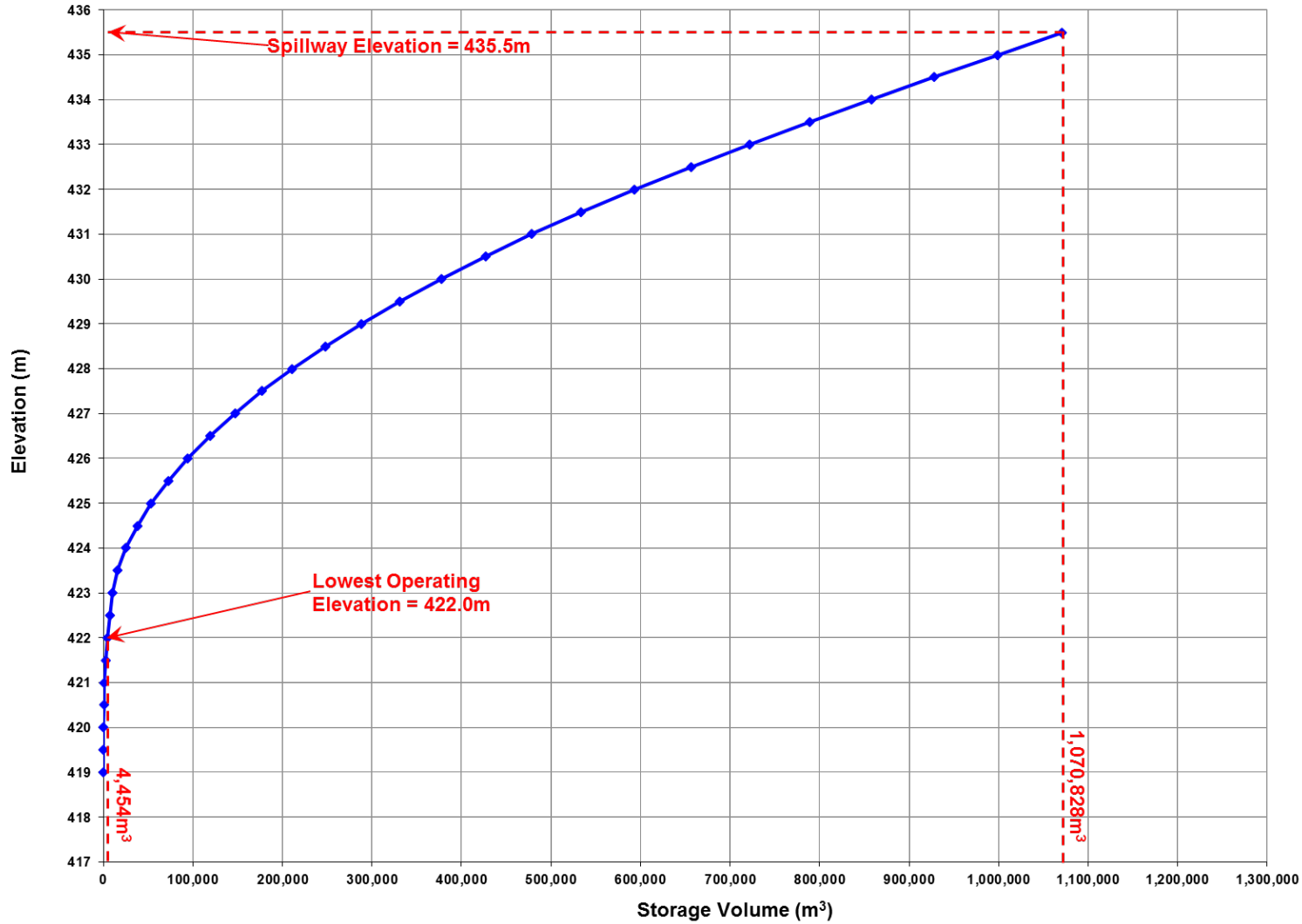
PROJECT
DIAVIK DIAMOND MINES (2012) INC.
PROCESSED KIMBERLITE FACILITY
PHASE 6 SPILLWAY

TITLE
POND 3 AND PKC FACILITY CATCHMENT AREAS

Golder Associates

PROJECT No.	1648001		PHASE No.	2000
DESIGN	GP	14JUN16	SCALE NTS	REV.0
CADD	-	-		
CHECK	GP	12JUL16		
REVIEW	JCC	13JUL16		

Figure 1



Note:

The Pond 3 storage capacity curve assumes that an estimated 120,000 m^3 of solids will be deposited in Pond 3 as a result of A21 dredging activities.

Reference:

DDMI (Diavik Diamond Mines Inc.) 2015. Pond 3 - Future Storage Curve.xlsx. Received on June 2, 2016

PROJECT	**DIAVIK DIAMOND MINES (2012) INC. PROCESSED KIMBERLITE FACILITY PHASE 6 SPILLWAY**
TITLE	**POND 3 STORAGE CAPACITY**

Golder Associates

PROJECT No.	1648001		PHASE No.	2000
DESIGN	GP	14JUN16	SCALE NTS	REV.0
CADD	-	-		
CHECK	GP	12JUL16		
REVIEW	JCC	13JUL16		

Figure 2

From: Macdonald, Gord (DDMI) [mailto:Gord.Macdonald@riotinto.com]
Sent: August 15, 2016 3:57 PM
To: Wells, David (DDMI) <David.Wells@riotinto.com>; Anneli Jokela <ajokela@wlwb.ca>; Patty Ewaschuk <pewaschuk@wlwb.ca>
Cc: Sarah Elsasser <selsasser@wlwb.ca>; English, Colleen (DDMI) <Colleen.English@riotinto.com>
Subject: RE: Diavik Spillway Modification Re-Submission

Anneli,
Please see the attached with pg 2 of the cover letter revised to clarify that we are not asking to amend Part H Item 21a but to have the Freeboard limit change approved.
Let me know if you need anything else.
Gord

From: Wells, David (DDMI)
Sent: Friday, August 12, 2016 4:28 PM
To: Anneli Jokela; Patty Ewaschuk (pewaschuk@wlwb.ca)
Cc: (selsasser@wlwb.ca); Macdonald, Gord (DDMI); English, Colleen (DDMI)
Subject: Diavik Spillway Modification Re-Submission

Anneli / Patty,

Please find attached a re-submission of the Diavik Spillway Modification request.

Regards,
David

David Wells
Superintendent - Environment - HSE

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