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Project No.: 0954-005-08

Ms. Janis Cardiff
Barkerville Gold Mines Ltd.
15th Floor – 675 West Hastings St.
Vancouver, BC, V6B 1N2

Dear Ms. Cardiff,

**Re: 2014 Independent Review/Audit of Tailings Dam Safety Inspection and
Consequence Classification: Goldstream Mine, BC**

1.0 INTRODUCTION

1.1. Background

BGC Engineering Inc. (BGC) was retained by Barkerville Gold Mines Ltd. (BGM) to conduct an independent third party review/audit of the 2014 Dam Safety Inspection (DSI) report for the tailings dams at BGM's Goldstream Mine, as well as a review of the failure consequence classification for the associated dams. The Goldstream Mine is located about 70 km northwest of Revelstoke, British Columbia (BC).

This work was carried out in general accordance with our proposal, dated October 22, 2014, and BGM's authorization to proceed on October 27, 2014. This work is subsequent to the BC Chief Inspector of Mines' Order (the "Order"), dated August 18, 2014, requiring an independent review of 2014 DSI's prior to December 1, 2014 (BCMCM 2014).

The Goldstream Mine started operation in 1983 and then was shut down in May 1984. Production resumed on May 2, 1991, and continued until January 1996. Currently, the Goldstream Mine is on "care and maintenance".

The Goldstream Mine tailings storage facility (TSF) consists of the North and West Tailings Dams. The dams consist of a low permeability upstream zone of glacial till, and a silty sand and gravel downstream shell. These zones are separated by a thin sand filter, which is connected to the foundation filter, extending to the downstream toe of each dam. The North Dam is approximately 16 m high and the West Dam is approximately 23 m high.

Diversion ditches along the south side of the pond were constructed to minimize runoff into the TSF. During mine operation, removal of excess water (as permitted by regulatory authorities) was performed by pumping and siphoning from the tailings pond over the south abutment of the West Dam into the natural drainage course downstream of the dam. The pump/siphon

system is no longer used. Excess water in the tailings pond is discharged via the emergency spillway on the east side of the facility.

Klohn Crippen Berger Ltd. (KCB) in their 2014 DSI report state that they and their predecessors were involved in the construction of the TSF since the late 1970's and later in the 1990's for the design of the tailings dam to El. 694.5 m, which was not completed. KCB reports, prior to their 2014 DSI that they have not been on site since their last annual inspection in 2009, when the site was owned by International Bethlehem Mining Corporation and Bethlehem Resources Corp.

1.2. Scope of Work

BGC's scope of work for this audit, as noted in our proposal of October 22, 2014, was limited to the following:

- Document Review: review of KCB's draft 2014 DSI report for the Goldstream Mine Tailings Storage Facility, dated November 24, 2014.
- DSI Independent Audit: comparison of the 2014 DSI report to the BC Ministry of Energy & Mines Guidelines for Annual Dam Safety Inspection Reports (BCMAM, 2013) and review of hazard classification.
- Reporting: Preparation of a letter report for the DSI Independent Review/Audit of the QR Mine TSF.

Note this work was also to include a review of the hazard classification of the structures, as determined by others. However, insufficient background information on the dam failure consequences was available at the time of completing this report to complete a review of the classification.

1.3. Limitations

Our report addresses whether the 2014 DSI report was in conformance or deficient to the guidelines presented in BCMAM 2013. This audit report does not address the safety of the structures, as this was beyond the scope and intent of our work.

As this audit work was a desktop study, no site visit was conducted by BGC. Further to this, BGC relied on the site observations and thorough review of data on site by other third parties for completeness, without any independent verification directly by BGC. These limitations are important and should be acknowledged. As such, BGC's review herein does not relieve the professional engineer conducting the DSI or engineer of record (EOR) work and/or the owner of their relevant responsibilities.

2.0 AUDIT REVIEW

2.1. Consequence Classification

Based on the data provided, and referenced in KCB 2014, classification of the dams were conducted in 2004 by Klohn Crippen Consultants Ltd. for the previous owner of the Goldstream Mine. At that time, the Goldstream Mine TSF Dam classifications were considered to be “High” as outlined in the Canadian Dam Association (CDA) 1999 Guidelines. BGC understands this classification was based on the environmental impact of the release of potentially acid generating tailings and the associated clean-up costs, together with undefined potential loss of life downstream.

However, as limited background information was available to assess the hazard classification of the dams, we could not comment on the current failure consequence classification of these structures in accordance with CDA 2007 Guidelines. Further, it appears there has not been a rigorous evaluation of the hazard classification of the dams between BGM, the current owner and the EOR. *We recommend this work be conducted.*

2.2. DSI Report

The 2014 DSI for the Goldstream Mine TSF was conducted by Mr. Chris Grapel, P.Eng. of KCB on October 28, 2014. It was reported, at the time of the inspection, the weather was overcast with periods of rain. It was also noted there had been periods of rain in the preceding week. Note the report provided to us for this audit was in draft and was not signed and stamped.

As part of our audit of the DSI, BGC compared the KCB 2014 document to the BCMEM 2013 guidelines, which defines the requirements for a DSI report. Our comparison is provided in Table 1, with associated commentary including factual information in regular font (KCB 2014) and BGC's interpretation in *italics*.

Note KCB in their 2014 report states, “KCB cannot state that the dams of the Goldstream Tailings Storage Facility reviewed as part of this report are safe or that they are in compliance with design requirements. Additional assessments are required to verify the dams are safe.” BGC notes that this statement issued by the engineer conducting the DSI, who is the EOR by default (BCMEM, 2013), is very significant and follow up to properly verify the safety of the dam is strongly recommended.

Table 1. DSI Report Audit Compared to BCMEM 2013 Requirements

Requirement No.	BCMEM 2013 Requirements	Discussion Included in Report	Comments
1a	Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2-1 of the CDA Dam Safety Guidelines (2007).	Yes and No	Both the North and West Dams were classified as 'High' consequence of failure based on CDA 1999. KCB 2014 recommends a dam breach and tailings run-out analysis be conducted to establish the classification. <i>As it appears there has not been a rigorous evaluation of the hazard classification of the dams between BGM and the EOR, BGC recommends this work be conducted. We also note that the Chief Inspector's letter (BCMEM, 2014) recommends a dam breach inundation study for dams of high consequence according to CDA 2007.</i>
1b	Significant changes in instrumentation and/or visual monitoring records.	Yes	KCB reports turbid water at the downstream toe of the North Dam and recommends this cause and source should be assessed as soon as possible. <i>BGC concurs with this recommendation.</i> KCB reports that the site is monitored after each heavy rainfall and least once a week by the site caretaker. Further, the site caretaker reports regularly to BGM. KCB 2014 notes with increases in piezometric readings and seepage flows that are no longer being monitored, indicates a dam safety monitoring deficiency. <i>BGC recommends former seepage monitoring stations be re-installed, that the functionality of the existing piezometers be assessed and that piezometric alert levels be assigned to the functioning piezometers.</i>

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
1c	Significant changes to dam stability and/or surface water control.	Yes	KCB 2014 notes it is unclear if the dams have the required degree of stability to safely impound the TSF and that the factor of safety against instability for the existing dams should be verified. <i>BGC concurs with this recommendation and that work be completed as soon as possible.</i> KCB 2014 notes the West Dam toe drain is no longer functional as of 2006. KCB 2014 notes the West and North Dams appear in good condition with the exception of increases in piezometric levels. KCB 2014 noted the dams' slopes appeared stable and that over steepened portion of the dams were observed. KCB reports the slopes had been constructed this way, during the 1993 construction work. KCB recommends that the flood and dam designs be assessed in light of the updated CDA Guidelines. <i>BGC concurs with these recommendations.</i>
1d	For major impoundments, as defined in Part 10 of the Code, a current Operation, Maintenance and Surveillance (OMS) Manual is required. The annual report shall indicate the latest revision date of the OMS manual.	Yes this was addressed in the report and No there is no OMS.	KCB reports that no OMS exists for the site and that one should be prepared. <i>BGC concurs with this recommendation.</i>
1e	For tailings dams classified as High, Very High, or Extreme Consequence, an Emergency Preparedness Plan (EPP) is required. The annual report shall indicate the latest revision date of the EPP document.	Yes this was addressed in the report and No there is no EPP.	KCB reports that no EPP exists for the site and that one should be prepared. <i>BGC concurs with this recommendation.</i>

Requirement No.	BCMEM 2013 Requirements	Discussion Included in Report	Comments
1f	Scheduled date for the next formal Dam Safety Review in accordance with Table 5-1 of the CDA Dam Safety Guidelines (2007). Formal Dam Safety Reviews are required every 5 to 10 years (depending on consequence classification) and differ from annual dam safety inspections. The requirements for Dam Safety Reviews are included in Section 5 of the CDA Dam Safety Guidelines. Dam Safety Reviews may be conducted by the Engineer of Record with third party review, or by an independent third party with involvement of the Engineer of Record.	Yes and No	KCB reports that a DSR was to be completed in 2011 and has yet to be completed, and recommends a DSR be conducted but gives no time frame. <i>BGC concurs this work should be carried out as soon as practical.</i>
2	Summary of past years' construction (if any) with a description of any problems and stabilization.	Yes	KCB 2014 reported no construction work took place in 2014. Ongoing maintenance has focused on beaver control.
3	Plan and representative cross sections.	Yes	KCB 2014 provided these figures in Appendix I of their report.
4	Site photographs.	Yes	KCB 2014 provided these photos in Appendix IV of their report. KCB notes the vegetation in places is quite dense and restricted visual assessment of the condition of the dam's face. KCB recommended the vegetation growth be cut both from the dam faces and diversion ditches. <i>BGC concurs with this recommendation.</i>
5	Review of climate data.	Yes	KCB 2014 reported the precipitation in 2014 has been wetter than historic averages and that 2014 temperatures have been close to historic monthly mean values.

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
6	Water balance review.	Yes and No	KCB 2014 reports that a preliminary hydrotechnical study was completed in 2010 by KCB and based on their findings, recommended a detailed hydrotechnical study be conducted. In the KCB 2014 report, they further recommend the study take into account the proposed logging operation in proximity to the TSF. <i>BGC concurs with KCB's recommendations.</i>
7	Freeboard and storage availability (in excess of the design flood).	Yes and No	KCB 2014 reports that pond levels are referenced to natural features and that no pond level monitoring measures are in place. KCB also notes that the design pond level was to be 1 m lower than the spillway and that the pond level was raised to 1 m above the design criteria for the spillway when the dams were raised in 1993. KCB states "The existing spillway geometry, pond level and elevations of TSF dam crest is insufficient to prevent overtopping during the original 1:1,000 year event." No information was provided with respect to existing storage capacity and design freeboard. In this regard, KCB 2014 recommends a detailed hydrotechnical study be conducted to assess the available freeboard or additional spillway capacity and that a staff gauge be installed at the spillway channel. <i>BGC concurs with KCB's recommendations.</i>

Requirement No.	BCMEM 2013 Requirements	Discussion Included in Report	Comments
8	Water discharge system, volumes, and quality.	Yes and No	KCB 2014 reports that the only discharge from the TSF is from either seepage or the Emergency Spillway, which was constructed in 1993. At the time of the inspection, the Emergency Spillway was partially blocked by beaver activity and that the caretaker clears the debris at least once a week in this area. KCB recommended to continue to remove the beaver dams and notes this will require more frequent removal than is currently undertaken at the site. <i>BGC concurs with KCB's recommendation.</i> No water discharge values were presented. However, water quality test results were noted to be within the Goldstream Mine site release criteria. KCB however notes that, tailings, which were anticipated to be acid generating, are exposed in various locations and the need for the water cover should be assessed. <i>BGC concurs with KCB's recommendation based on future water quality monitoring data.</i>

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
9	Seepage occurrence and water quality.	Yes and No	KCB 2014 noted flowing clear water at the toe of the West Dam, very wet ground conditions above the mid-slope of the West Dam, a very wet area above the mid-slope of the North Dam, right abutment, likely exacerbated by recent rains, ponded water at the toe of the North Dam and an area of discoloured "turbid" water at the toe of the North Dam. KCB recommended that additional monitoring should be undertaken at the West Dam to assess the wet ground conditions and that the nature of the turbidity should be determined as soon as possible. KCB notes the v-notch weirs are no longer being read and/or are in place and should be re-established. <i>BGC concurs with KCB's recommendations for the West Dam, re-establishment of weirs and recommends additional monitoring be established for the North Dam as well.</i>

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
10	Surface water control and surface erosion.	Yes	KCB notes diversion ditches were initially constructed to intercept surface water and divert it away from the TSF. KCB 2014 also noted continuing beaver control has been on-going for the East Diversion Ditch, with limited success. It was also noted erosion was occurring in a tributary creek to the East Diversion Ditch and that vegetation growth is heavy, specifically in the Virginia Creek Diversion raising the concern that water could flow into the TSF. KCB recommended the vegetation growth be cut and the mid-slope bench on the North Dam be graded to minimize ponded water. <i>BGC concurs with KCB's recommendations with respect to removal of vegetation, re-grading and their previous recommendation to continue beaver control (See 8 above).</i>

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
11a	Instrumentation review including: Phreatic surfaces and piezometric data.	Yes, visual	KCB noted the piezometric levels for the West Dam were above historical levels and for the North Dam the upper level piezometer was consistent, with previous readings whereas the lower level piezometric indicated a sudden drop with no apparent drop in the pond level. KCB recommended the piezometric readings should be reviewed as soon as possible and the damaged upper piezometer at the North Dam be repaired. <i>BGC concurs with these recommendations and recommends that the functionality of the existing piezometers be assessed and that piezometric alert levels be assigned to the functioning piezometers.</i> KCB noted the phreatic surface is likely close to surface near the downstream toe of the dams, based on vegetation growth and observations in the vertical risers situated along the toe of the West Dam. KCB noted that the West Dam toe seepage collection system was no longer operational as of 2006. As previously noted, KCB indicated the v- notch weirs are no longer being read and/or are in place. KCB recommended re-establishing the weirs and that the West Dam toe drain system should be repaired or replaced. <i>BGC concurs with re-establishing the weirs and recommends assessing the need for the West Dam toe drain.</i>

Requirement No.	BCMCM 2013 Requirements	Discussion Included in Report	Comments
11b	Instrumentation review including: Settlement.	Yes, visual	KCB noted a lower area (10 cm) along the crest of the West Dam and minor rutting along the dams.
11c	Instrumentation review including: Lateral movement.	No	No instrumentation reported to be installed for this type of monitoring.
	The report shall be submitted by a qualified geotechnical engineer registered as a Professional Engineer (P.Eng.) in British Columbia. The professional engineer will be deemed the Engineer of Record for the facility unless another engineer is identified within the Dam Safety Inspection report as having this responsibility.	Yes	Chris Grapel, P.Eng., as noted on the APEGBC website, is registered as a Professional Engineer in British Columbia. <i>His qualifications as a tailings or geotechnical engineer were not however judged.</i> <i>Note that BGC was provided a draft version of the DSI report dated November 24, 2014. The final document should be signed and stamped by the P.Eng. who authored the report.</i>

2.3. OMS Manual

No OMS has been prepared for the Goldstream TSF. *We concur with KCB that this document should be prepared.*

2.4. Emergency Response Plan

No Environmental Emergency Response Plan has been prepared for the Goldstream TSF. *We concur with KCB that this document should be prepared.*

3.0 SUMMARY

In general, the KCB 2014 report addressed the majority of the requirements to be discussed in a DSI report, as outlined in BCMEM 2013, and provided recommendations consistent with their observations. BGC understands, as defined in BCMEM 2013 the EOR for these structures, by default, is Mr. Grapel. *However, for clarity we suggest the EOR needs to be confirmed for these structures.*

However, BGC recommends, based on our review/audit of the report, the following should be further addressed:

- *As it appears there has not been a rigorous evaluation of the hazard classification of the dams between BGM and the EOR, BGC recommends this work be conducted.*
- *BGC concurs with the recommendation that the cause and source of turbid water at the downstream toe of the North Dam should be assessed as soon as possible and that the wet ground at both the West and North Dams be assessed as soon as possible. BGC further recommends the need for the West Dam toe drain be assessed*
- *BGC recommends former seepage monitoring stations be re-installed and that the functionality of the existing piezometers be assessed and that piezometric alert levels be assigned to the functioning piezometers.*
- *BGC concurs that the factor of safety against instability for the existing dams should be verified and that work be completed as soon as possible.*
- *BGC concurs that the flood (hydrotechnical) and dam designs be assessed in light of the updated CDA Guidelines.*
- *BGC concurs that an OMS, EPP and DSR should be carried out as soon as practical.*
- *BGC concurs that vegetation should be removed from both the dam faces and diversion ditches, that the mid-slope bench on the North Dam be graded to minimize ponded water, that a staff gauge should be installed at the spillway and that beaver control continue at the site.*
- *BGC concurs that the need for a water cover be assessed based on future water quality monitoring data.*
- *The final DSI document should be signed and stamped by the P.Eng. who authored the report.*

4.0 DOCUMENT NOTES

BGC Engineering Inc. ("BGC") prepared this document (the "Report") for the account of Barkerville Gold Mines Ltd. (the "Client"). The material in the Report reflects the judgment of BGC staff based upon the information made available to BGC at the time of preparation of the Report, including that information provided to it by the Client. Any use which a third party makes of this Report or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility whatsoever for damages, loss, expenses, loss of profit or revenues, if any, suffered by any third party as a result of decisions made or actions based on this Report.

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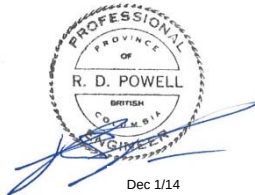
Note the conclusions provided herein will change as the recommended mitigation measures are undertaken.

5.0 CLOSURE

Yours sincerely,

BGC ENGINEERING INC.

per:



Robert D. Powell, P.Eng., PE
Principal Geotechnical Engineer

Reviewed by:

James W. Cassie, M.Sc., P.Eng.
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RDP/JWC/bb/lw

REFERENCES

British Columbia Ministry of Energy and Mines (BCMEMP). 2013. Guidelines for Annual Dam Safety Inspection Reports. Dated August 18.

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