

November 28, 2014
Project No: 1CB30.000

Mr. Rex Johnston
Boliden Limited
P.O. Box 476
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Attention: Mr. Johnston,

RE: Third-Party DSI Review of the Premier Gold Project Tailings Facility

1 Introduction

In August 2014, British Columbia's Chief Inspector of Mines ordered inspection of all tailings dams within the province (BCMCM 2014). The owners, agents, or managers responsible for tailings dams were ordered to:

- Conduct a dam safety inspection (DSI). The inspection must be completed by a certified professional engineer and reviewed by independent qualified third-party professional engineer from a firm that has not been associated with the tailings dam.
- Submit a letter outlining the findings of the DSI, review of the DSI, and commitment to and schedule for carrying out all related recommendations.
- Develop (or update) an emergency preparedness and response plan and complete a dam break inundation study completed by a qualified professional engineer for dams with a failure consequence classification (or *DCC* for dam consequence classification) above *high*. The plan and study must be developed (or updated), tested, and reviewed consistent with the Canadian Dam Association's Dam Safety Guidelines (CDA 2007).
- All requirements found in the order (BCMCM 2014) must be completed and submitted to the Chief Inspector of Mines by December 1, 2014.

SRK was retained by Boliden Group to carry out the third-party independent review of the DSI for the tailings dam at the Premier Gold Project (PGP). While SRK is involved in other aspects of consulting work with the Boliden Group in Europe, it has not been associated with any work for the project. This letter documents the scope, approach, findings, conclusions, and recommendations of the independent review carried out by SRK.

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2 Scope of Work and Reviewed Documents

The 3rd party independent DSI review was carried out as a desktop study, without a site inspection. A site inspection was deemed unnecessary as the 2014 DSI and dam break inundation documents provide sufficient information for the review. The objective of the independent review carried out by SRK was to evaluate the completeness and validity of the dam break inundation study (Golder 2005) and DSI report (URS 2014), including findings and recommendations, as per the Chief Inspector's order.

The following documents were assessed for this review:

- Report on 2014 Dam Safety Inspection (URS 2014).
- Dam Breach and Inundation Study, Tailings Storage Facility, Premier Gold, Stewart BC (Golder 2005).
- Operation Maintenance and Surveillance Manual – Emergency Preparedness Plan (Boliden 2014).
- Premier Gold Project, Mine Water Treatment Ponds, Dam Breach and Inundation Study (Klohn Crippen Berger 2014).

The DSI report references a number of supporting technical reports that were not reviewed by SRK but were certified and signed by professional engineers. SRK relies on the professional qualifications by others for the appropriateness and completeness of the referenced technical reports for verification on the review DSI. These reports include:

- Water Quality Report, 2014 (prepared and submitted by Boliden to BC Ministry of Environment).
- 2013 Annual Geotechnical Review (prepared for Boliden by Klohn Crippen Berger).
- 2010 Dam Safety Review (prepared for Boliden by URS Corporation).

The evaluation was done in accordance with the Canadian Dam Association's (CDA) Dam Safety Guidelines (CDA 2007) and Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (BCMCM 2008). Table 2-1 provides the dam failure consequence classifications (CDA 2007) used in SRK's review.

According to the Code, the DSI report shall contain the following information:

1. Executive Summary
 - (a) Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2.1 of the CDA Dam Safety Guidelines (2007).
 - (b) Significant changes in instrumentation and/or visual monitoring records.
 - (c) Significant changes to dam stability and/or surface water control.

- (d) For major impoundments, as defined in Part 10 of the Code, a current Operation, Maintenance and Surveillance (OMS) Manual are required. The annual report shall indicate the latest revision date of the OMS manual.
 - (e) 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.
 - (f) 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.
2. Summary of past years' construction (if any) with a description of any problems and stabilization.
 3. Plan and representative cross sections.
 4. Site photographs.
 5. Review of climate data.
 6. Water balance review.
 7. Freeboard and storage availability (in excess of the design flood).
 8. Water discharge system, volumes, and quality.
 9. Seepage occurrence and water quality.
 10. Surface water control and surface erosion.
 11. Instrumentation review including:
 - (a) Phreatic surfaces and piezometric data.
 - (b) Settlement.
 - (c) Lateral movement.

The review of the dam consequence classification is evaluated according to the CDA Guideline shown below.

Table 2-1: Dam Consequence Classification as shown in Table 2.1 of CDA GL

Dam Class	Population at Risk ¹	Incremental Losses		
		Loss of Life ²	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	Significant loss or deterioration of <i>important</i> fish or wildlife habitat Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very high	Permanent	100 or fewer	Significant loss or deterioration of <i>critical</i> fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances)
Extreme	Permanent	More than 100	Major loss of <i>critical</i> fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

1. Definitions for population at risk:

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.

Temporary – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

2. Implications for loss of life:

Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

3 Independent Review Findings

Table 3-1 contains a summary of SRK's findings. The table is organized according to the components specified in Dam Safety Guidelines and references the Health, Safety and Reclamation Code ("the Code").

Table 3-1: Summary of third-party dam safety inspection review and findings based on the Dam Safety Guidelines (CDA 2007) and Health, Safety and Reclamation Code (BCMEM 2008)

Article ID	Topic	DSI (URS 2014) and Dam Breach and Inundation Reports Summary				Dam Guidelines and Health, Safety and Reclamation Code Completeness	Comments and Recommendations (SRK)	
1	Executive Summary							
a	Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2-1 of the Dam Safety Guidelines (CDA 2007)	<i>Dam</i>	<i>Classification</i>				Completed. The TSF dam consequence classifications are reported according to CDA guidelines.	SRK concurs with the DCC of the Main Dam, East Access Road Dam, the Cascade Creek Deflection Berm (CCDB) and the Monitoring Dam. The CCDB is classified as significant from the perspective of failure from the upstream to downstream (releasing tailings into environment). SRK recommends that Boliden review the consequence and impact of flooding of the Cascade Creek and overtopping the CCDB from the downstream and flooding of the TSF.
			<i>Loss of Life</i>	<i>Economic and Social Loss</i>	<i>Environmental and cultural loss</i>	<i>Dam Consequence Classification</i>		
		Main Tailings Dam	Low	very high	significant	very high		
		East Access Road Dam	Low	very high	significant	very high		
		Monitoring Pond Dam	Low	Low	Low	Low		
		Cascade Creek Deflection Berm	Low	Low	significant	Significant		
		MWTP Upper Dam	Low	very high	Low	very high*		
		MWTP Divider Dam	Low	low	low	Low*		
	MWTP Lower Dam	Low	significant	low	Significant	Completed. The MWTP dam consequence classifications are reported and recommendations are provided for further review.	SRK concurs with the recommendation to review the DCC of the MWTP dams. An asterisk (*) indicates which dams to be reviewed.	
b	Significant changes in visual monitoring records and/or instrumentation	Seepage measurement was not done in 2014 due to the rock fall hazards at monitoring location but historical readings are reported in Section 8 of the DSI report. Section 10 of the DSI report indicated there are some unusual piezometric readings as the phreatic surface is increasing as it approaches the dam the dam, instead of falling as per conventional phreatic surface behavior within earth dams, which prompted recommendation for further review. TSF dam monitoring points are reported in Section 10.2 of the DSI report. Recommendations provided for mitigation of the issues in Section 12 of the DSI.				The DSI report included monitoring records according to the Code and provided recommendations.	SRK concurs to reported information and recommendations.	
c	Significant changes in dam stability and/or surface water control	Section 4 of the report stated no changes in visual monitoring records in geotechnical stability (slump, cracks, and sinkholes).				Visual observations are included according to the Code.	SRK concurs with the report findings.	
		Section 4.1.4 stated that the low level outlets control at the Monitoring Pond Dam is non-operational and the seepage flows into the Monitoring pond is allow to pass through uncontrolled.				Visual observations are included according to the Code.	SRK concurs with the report findings and recommendations.	

d	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.	The OMS was updated in July 2014.				OMS is updated and included as per CDA requirement.	SRK confirms the completeness of the report according to the Code.
e	For tailings dam classified as High, Very High, or Extreme Consequence, an Emergency Preparedness (EPP) is required. The annual report shall indicate the latest revision date of the EPP document.	The updates to the OMS included EPP in July 2014. EPP test trial was completed in November 2014.				EPP is updated and included in the OMS as per CDA requirement.	SRK confirms the completeness of the report according to the Code.
f	Schedule 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.	The last formal dam safety review (DSR) was completed in 2010. The next scheduled review is 2015.				The dam safety review is completed and scheduled as per CDA guidelines.	SRK concurs with the report findings.
2	Summary of past years' construction (if any) with a description of any problems and stabilization.	The DSI report stated the rockfall at the Cascade Creek Diversion Channel in May 2014 could be a risk to affect the capacity of the diversion if further rockfall occurs. Separately, the rockfall hazard is limiting maintenance and monitoring activities. Boliden is considering mitigative actions for the hazard. Additional maintenance activities were carried out including clearing of basins, brushes, and culvert realignment. Dewatering was done in the mine water treatment pond (MWTP).				Summary of work is provided according to the Code.	SRK concurs with the report findings and recommendations.
3	Plan and representative cross sections.	Plans and sections are included in the DSI report.				Plan and sections are included as per the Code.	SRK confirms the completeness of the report according to the Code.
4	Site photographs.	DSI report included photos from the site inspection.				Photographs are included as per the Code.	SRK confirms the completeness of the report according to the Code.
5	Review of climate Data	Review of the climate data is included in Section 5 of the report. Based on existing information, there have been no climatic events of concern.				Review of climate data is included as per the Code.	SRK concurs with the report findings based on information available at the time of writing of the DSI report.
6	Water Balance review	Water balance review was completed in Section 6 of the report.				Review of water balance is included as per the Code.	SRK concurs with the report findings based on information available at the time of writing of the DSI report.
7	Freeboard and storage availability (in excess of the design flood)	Facility	Design Water Elevation (m)	Inspected Water Elevation (m)	Dam Crest Elevation (m)	Freeboard (m)	Freeboards are reported in the report as per the Code. The DSI report indicates there is insufficient freeboard in the event of the design 1:200 year flood. The recommendations for pond level reduction and re-evaluation are included in section 7 of the report but not in Section 11 in the summary of recommendations. No significant amount of water is being held in the monitoring pond as the outflow controls are non-functional. Completed Completed
		TSF	329	331.5	336.6	5.1	
		Monitoring Pond	N/A	N/A	290	N/A	
		MWTP Upper Dam	226	224.25	226	1.75	
		MWTP Divider Dam	226	224.25	226	1.75	

		MWTP Lower Dam	222	219.25	222	2.75		Completed
8	Water discharge system, volumes and quality	Water discharge system and volume are reported in Section 8 of the report. The seepage measurement was not taken in 2014 due to rockfall hazard. Measurements from 2002 to 2013 showed a downward trend in seepage.				Water discharge system and volume are reported as per the Code.	Reasons are provided for the lack of seepage volume readings in 2014 due to temporary hazardous site conditions in the DSI. SRK concurs with report finding and recommendations.	
9	Seepage occurrence and water quality	Section 8 indicates measurements from 2002 to 2013 showed a downward trend in seepage. Water quality summary and references are provided in the report.				Reviews of the seepage and water quality are reported as per the Code.	SRK concurs with the report findings.	
10	Surface water control and surface erosion	Heavy vegetation was identified within the spillway structures noted in Section 4. They were removed on later dates by Boliden. Surface erosion is observed to be minimal and not a concern.				Surface water control and surface erosion conditions are reported as per the Code.	SRK concurs with the report findings.	
11	Instrumentation review including:							
a	Phreatic surfaces and piezometric data	Piezometric readings are reported with unusual data stated above. URS recommended further investigation into the anomaly				Piezometric data is included as per the Code.	SRK concurs with the report findings and recommendations.	
b	Settlement	Settlements are reported in Section 10.2 of the report. Progressive downward trend was noted between 2010 and 2013 but believed to be due to survey inaccuracy. Remedies were applied to the inaccuracy and the results were normalized. The small differential in the readings are reported to be within standard practice deviations.				Settlement readings are included as per the Code.	SRK concurs with the report findings.	
c	Lateral movement.	Lateral movements are reported in Section 10.2 of the report. The small differential in the readings are reported to be within standard practice deviations.				Lateral readings are included as per the Code.	SRK concurs with the report findings.	

4 Conclusion and Recommendations

SRK concurs with the overall assessment of the DSI report and the DCC of *very high* for the Premier Gold Project tailings dams. Associated with the *very high* DCC classification, Boliden has completed an emergency response plan and the next dam safety review is scheduled in 2015, within 5 years of the previous dam safety review. Both of the requirements meet the Dam Safety Guidelines (CDA 2007). Although the dam break inundation report (Golder 2005) evaluates the dam failure impacts by analyzing each major dam failure mechanism instead of the suggested *sunny-day* and *flood-induced* failure conditions in the Dam Safety Guidelines (CDA 2007), SRK deemed that the inundation results are still appropriate to evaluate the magnitude and the limit of impact of dam failure. While SRK did not review the dam safety review and the water quality report, they are certified by other professionals and SRK relies on the professionals' judgments and qualifications on the appropriateness and completeness of these reports. SRK also concurs with the recommendations outlined in the DSI report, with emphasis on the following:

- Review the condition of the TSF piezometers, the tip locations, and the measurement procedures to evaluate the accuracy of the readings and help determine if any of the piezometers might be damaged or malfunctioning.
- Review the MWTP Divider and Upper Dam DCC.
- Update the TSF water management plan to address inconsistencies in managing the 200-year event for pre-closure, and inflow design flood event for post closure. Management of the 200-year event assumes a pond level maintained below El. 329 m, but the current pond level is approximately El. 331.5 m.

In addition to the DSI recommendations, SRK recommends that Boliden review the Cascade Creek Division Channel (CCDC) upgrade design, when it is available, to ensure the issue related to the undersized road crossing culvert is resolved. As it stands, there is a potential risk of overtopping the Cascade Creek Division Berm (CCDB) during a 200-year storm event due to this undersized culvert. SRK also recommends that Boliden review the potential consequence and impact of flooding of the TSF during storm event and breaching the CCDB from the upstream of the Cascade Creek. SRK suggests updating the dam break and inundation study using the dam break failure conditions in the Dam Safety Guidelines (CDA 2007).

Sincerely,
SRK Consulting (Canada) Inc.



Nov 28, 2014

Alvin Tong, PEng
Senior Consultant

Reviewed by:

A blue ink signature of Peter Healey, written over a horizontal line.

Peter Healey, PEng
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The opinions expressed in this document have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. While SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

5 References

- BCMCM. 2008. Health, Safety and Reclamation Code for Mines in British Columbia. Victoria (BC) British Columbia Ministry of Energy and Mines. Section 10.5.3.
- BCMCM. 2014. Notification of Chief Inspector's Orders: Tailings Dams – Independent Review of Dam Safety and Consequence Classification. Victoria (BC): British Columbia Ministry of Energy and Mines. August 14, 2014.
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- Golder Associates. 2005. Dam Breach and Inundation Study, Tailings Storage Facility, Premier Gold, Stewart BC. Report prepared for Boliden.
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