

27 October 2014

Regional District of Central Kootenay
Box 590, 202 Lakeside Drive
Nelson, BC V1L 5R4

Attn: Amy Wilson, B.Sc., A.Sc.T
Environmental Technologist

**Re: HB Dam
Independent Third Party Review of Dam Safety Inspection**

Dear Ms. Wilson:

1. INTRODUCTION

This letter presents the observations and conclusions of a third party review of the dam safety inspection (DSI) of the HB Mine Tailings Dam, near Salmo, BC. The review was carried out in accordance with a Consulting Services Agreement signed by the writer and the Regional District of Central Kootenay (RDCK), dated 6 October 2014. The third party review was mandated by the British Columbia Ministry of Energy and Mines, Chief Inspector's Orders, dated August 18, 2014, which stipulated that a DSI be carried out to cover all dam structures for all tailings storage facilities in British Columbia, and that the DSI must be reviewed by an independent qualified engineer from a firm that has not been associated with the tailings dam. The Independent Third Party Review must include a review of the dam consequence classification.

The most recent DSI of the HB Dam was carried out by Tetra Tech EBA, dated September 15, 2014. In carrying out this review of the DSI, the writer also reviewed a Dam Safety Review completed by Tetra Tech EBA, dated May 28, 2014. In addition, the writer reviewed historical documents listed in the References. The writer did not make a site visit for this review, relying on reports, drawings and photographs for the conclusions and recommendations presented.

2. BACKGROUND

The HB Mine tailings dam is located about 6 km south of Salmo, BC. The mine was operated by Cominco from 1955 to 1978, and for a period by David Minerals in the 1980's. The dam is currently owned by RDCK. The dam was constructed as a cross valley fill at the south end of a natural basin. Tailing slurry was discharged at the head (north) end of the basin, with the result that the water pond was adjacent to the dam, and was decanted from the pond at the south end. The dam is about 27m high and 240 m long, impounding about 1,000,000 m³ of tailings and some water. The dam dimensions and impoundment capacity fall under the categories of *major dam* as defined by the *Health, Safety and Reclamation Code for Mines in British Columbia*. The dam was initially constructed as a rock-filled timber crib, and later, following failure of the timber crib structure, was constructed of locally borrowed

silt, sand and gravel fill. BGC Engineering prepared a decommissioning plan for the dam in 2002, which was implemented in 2005. The decommissioning plan included construction of a permanent spillway with a bedrock sill and riprap outlet channel, and a stabilising toe berm on the downstream side of the dam. A number of standpipe piezometers have been installed in the downstream shell of the dam at various times.

Stewardship of the HB Dam appears to have been well managed by RDCK. DSIs have been carried out annually, and maintenance of the dam has been carried out regularly in response to DSI observations. An Emergency Preparedness Plan (EPP) and an Operation, Maintenance and Surveillance Manual (OMS) were prepared in 2011. The level of stewardship was based on a dam consequence classification of Significant.

In July 2012 a pair of sinkholes was noted on the upstream slope of the dam, near the left abutment, accompanied by shallow slumping. Pumps were mobilized to lower the level of the water retained by the dam. The sinkholes and slumped area were repaired, and the permanent spillway sill was lowered from elevation 106.7 m to 105.75 m. Also in response to the sinkhole/slumping event and increased concern with the integrity of the dam, several studies were commissioned, including:

- A Dam Break Analysis, Consequence Classification Review and Inflow Design Flood Study (Draft) was completed by Tetra Tech EBA in 2013. This study concluded that, from a hydrotechnical standpoint, the dam had sufficient freeboard and spillway capacity to safely pass an Inflow Design Flood. It also concluded that a dam break could have potential for loss of several lives, moderate environmental damage, and high economic consequences due to inundation of Highway 3. This led to the recommendation that the dam consequence classification be revised to Very High.
- A Dam Safety Review was completed by Tetra Tech in May 2014, integrating the results and recommendations of the above study. The DSR made a number of recommendations. Several of the recommendations were for maintenance issues which have subsequently been completed, but also the following:
 - The dam consequence classification should be revised to Very High, subject to confirmation by the Ministry of Energy and Mines (very high priority)
 - A feasibility engineering study should be undertaken to assess various modifications that could be made to the embankment to reduce its vulnerability to internal erosion (medium priority)
 - The existing EPP and OMS Manual are satisfactory in content but should be updated to reflect the higher consequence classification (very high priority)
 - Survey plans should be updated to a common elevation datum to avoid confusion with historical plans (high priority).

3. 2014 DAM SAFETY INSPECTION

The 2014 DSI carried out by Tetra Tech EBA included:

- A summary of the dam history
- A review of background documentation
- Observations of a site reconnaissance carried out on May 15, 2014. Key observations included:
 - A pump is permanently stationed on the left abutment of the dam in case of any future issues with the dam that may require the water level to be drawn down below the spillway level
 - A number of minor maintenance items were noted
 - A minor surface slough occurred during the 2014 freshet above the right abutment toe berm
 - Seepage observed at the left abutment toe was flowing clear
 - Readings were taken of the installed piezometers, with no significant changes from historical readings.
- The consequence classification was reviewed, with the same conclusion as the DSR that the classification should be revised to Very High, based on the potential economic costs of a dam failure
- The dam safety management documents, the EPP and OMS Manual, were reviewed and recommendations made for updating, primarily to reflect the changed consequence classification
- A review of minimum frequency of safety activities, based on the consequence classification

Recommendations in the DSI included:

1. Consequence classification - Due to the estimated economic losses that would occur due to a breach of the consequence classification of the HB Dam should be increased to "Very High".
2. Site reconnaissance
 - A snow shed should be built over the emergency draw down pump and it should be protected with a tarpaulin to facilitate easy access and in the event of an emergency in the freshet. (High priority).
 - A drainage hole should be drilled in the side of the P5/P6 piezometer casing as it is accumulating surface water (High priority).
 - The area where the shallow slump occurred above the right toe berm should be continued to be monitored. Should any further slope movement occur during the 2015 freshet the area should be armoured with riprap (High priority).
 - Geotextile exposed along the upstream face of the dam should be secured with the placement of additional riprap (High Priority).
3. Dam Safety Management Review
 - If the dam consequence classification rating is increased, the OMS Manual will require revision to reflect the updated classification (High priority).

- The OMS Manual should include a plan indicating the location of all instrumentation and areas of seepage to be monitored during inspections (High priority).
- The OMS Manual should include the most updated drawings of the dam reflecting the modifications made to the dam in 2012 (High priority).
- If the dam consequence classification rating is increased, the EPP will require revision to reflect the updated classification (High priority).
- The EPP should include the inundation plan developed during the 2013 Dam Safety Review (High priority).

4. CONCLUSIONS AND RECOMMENDATIONS OF 3RD PARTY REVIEW

4.1 Stewardship of the HB Dam appears to have been well managed by RDCK. DSIs have been carried out annually, and maintenance of the dam has been carried out regularly in response to DSI observations. An OMS Manual and EPP are in place. A DSR was completed in 2014. Regular surveillance is carried out by RDCK personnel.

4.2 The 2014 DSI appears to have been thorough and to have substantially addressed the key issues as per the Ministry of Energy and Mines Guidelines for Annual Dam Safety Inspection Reports. Recommendations provided in the 2014 DSI are considered appropriate and should be followed.

The report does not include any representative cross-sections of the dam. It is recommended that, in the 2015 DSI, cross sections be provided, preferably along the line of piezometers, and that the phreatic levels as recorded from piezometer readings be shown on the cross sections.

4.3 The consequence category of the HB Dam should be revised to Very High, as recommended by Tetra Tech EBA.

4.4 Geotechnical stability of the dam appears to be satisfactory, but the actual construction history of the dam was not fully documented so that internal stability from a potential piping standpoint is not fully understood. The 2012 sinkholes and slumping of the downstream slope, and minor slumping of the slope noted in the 2014 DSI, indicate that there may be some internal weaknesses in the structure. Lowering the water level in the pond by lowering the spillway will certainly have improved the seepage regime. Ongoing surveillance of the dam must be maintained. As recommended in the 2014 DSR, a study should be undertaken to assess potential modifications that could be made to the embankment to reduce its vulnerability to internal erosion. As recommended in the DSR, this activity is medium priority, to be addressed within 3 years.

4.5 The HB Dam appears to be in a safe condition from a hydrotechnical standpoint. There is considerable freeboard and a spillway with bedrock control. Tetra Tech EBA assessed the IDF for the Very High consequence category, in accordance with CDA Dam Safety Guidelines, which suggest an IDF 2/3 between a 1/1000 year return period flood and a Probable Maximum Flood (PMF). They determined that the spillway will safely pass the estimated IDF peak inflow of 39.3 m³/s.

5. CLOSURE

Thank you for the opportunity to undertake this 3rd party review of the HB Dam DSI. I would be pleased to provide any additional information or clarification you may require.

Yours truly,


October 27, 2014

Peter C. Lighthall, P. Eng.
Consulting Geotechnical Engineer

REFERENCES

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