SNC·LAVALIN

REPORT

Dam Safety Inspection, Gallowai Bul River Mine Tailings Storage Facility, Bull River, BC

Bul River Mineral Corp.

SNC-LAVALIN INC.

November 24, 2014

FINAL REPORT

Project 623505

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EXECUTIVE SUMMARY

The Gallowai Bul River Mine operates a Tailings Storage Facility (TSF) which is the subject of this dam safety inspection, commissioned in accordance with an Order issued by the Chief Inspector of Mines in August 2014. The TSF was constructed in 1970 to 1971 and was reclaimed approximately 4 to 5 years later. The facility is understood to have a low consequence classification.

Based on the present inspection, the reclaimed TSF was in good condition and appeared to be stable. Some groundwater is likely present in a perched condition within portions of the tailings but its nature is unknown due to the absence of instrumentation in the reclaimed facility. Seepage was not encountered; nor did the dam structure exhibit signs of instability. Surface water is managed by diverting through pipes and ditches around the TSF to the west and east sides into natural gullies. The only surface water to contact the TSF is precipitation falling directly within its footprint, and it is observed by mine staff to consistently infiltrate into the soil cover and tailings with minimal areas of ephemeral standing water. The water balance appears to be favorable in the long term. Recent significant changes to stability and to surface water control were not observed.

A gully in the reclaimed TSF in a portion of the dam has encountered periodic erosion events and there is evidence of small sliver failures on over-steepened slopes. Some minor slope re-dressing and gully channel cross-berm work is recommended as low to medium priority work.

Design documents and correspondence submitted by engineers during construction were reviewed; however, as-built drawings for the dam or the reclamation work were not available.

The TSF appears to be potentially in a condition where it may be possible to consider a change its status from a TSF to a dump and to be managed as a major dump. Consideration could be given to applying to the Chief Inspector's Office at the Ministry of Energy and Mines to enact this change. Some due diligence engineering may be required as part of the process.

This TSF does not appear to meet the definition of a major impoundment as defined in the Health, Safety and Reclamation Code for Mines in British Columbia; the definition can be interpreted as being intended for materials stored in a slurry or liquid state. However, the TSF configuration meets the definitions for a major dam and a major dump. An Operation, Maintenance and Surveillance Manual is likely required for this TSF but SNC-Lavalin did not receive a copy if one exists. An Emergency Preparedness Plan is not required for this particular TSF due to its low consequence classification. Low consequence dams are not subject to a specified minimum frequency of dam safety reviews; however, the Canadian Dam Association recommends that the consequences of failure are reviewed periodically since the consequences may change with development downstream. A consequence review is required under the Chief Inspector's Order.

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1 INTRODUCTION

Bul River Mineral Corporation (BRM) retained SNC-Lavalin to conduct a dam safety inspection of the tailings storage facility (TSF) at the Gallowai Bul River Mine near Bull River, B.C. On August 18, 2014 the Chief Inspector of Mines for the Province of British Columbia, Ministry of Energy and Mines, issued an order to all mining companies to conduct a Dam Safety Inspection for tailings storage facilities at their permitted mines by December 1, 2014. Under the Order, the inspection reports must be reviewed by an independent, qualified, third-party, professional engineer from a firm not associated with the tailings facility. Further, the Dam Safety Inspection is to be conducted in accordance with the Ministry of Energy and Mines' Guidelines for Annual Dam Safety Inspection Reports, dated August 2013.

We performed a preliminary site visit on September 3, 2014 in order to understand site conditions for preparing a proposal to BRM, who authorized SNC-Lavalin to proceed on October 15, 2014. SNC-Lavalin performed a site visit and visual inspection on October 16; this report presents the results of our Dam Safety Inspection.

The purpose of the visual inspection was to provide a qualitative evaluation of the TSF condition. No attempt was made to conduct a quantitative evaluation of the TSF stability, as it would be impractical to do so using only visual observations, and such work is not part of the scope of work of most annual dam safety inspections.

The scope of the work is to:

1. Gather and review available relevant background and historical information;

2. Interview mine staff regarding the history and operation of the TSF;

3. Visually examine and photograph the facility;

4. Analyze the TSF and document our observations and any resulting recommendations in a report prepared in accordance with the Ministry of Energy and Mines' 2013 Guidelines for Annual Dam Safety Inspection Reports; and,

5. Correspond as required with the independent professional engineer commissioned by BRM to review this report.

2 BACKGROUND AND SITE DESCRIPTION

2.1 GALLOWAI BUL RIVER MINE

BRM operates its Gallowai Bul River Mine on mountain slopes north of the Bull River at the location shown on Figure 1, 30 km east of Cranbrook, British Columba. The site is accessed by the Wardner-Fort Steele Road and the Bull River Road. The mine is presently under care and maintenance and has operated in the past under previous owners.

According to Snowden (2013), the site contains a mill, assay laboratory, shops, offices, underground facilities and infrastructure, two open pits, various dumps, the TSF and associated electricity supply and mining facilities. One of the open pits has been backfilled and the other pit, north of the TSF, is being used as a settling pond.

The mine was first developed in approximately 1968 by Placid Oil. First called the Dalton Mine and the Bull River Mine, design and construction of the TSF and other facilities took place in 1970 and 1971, with production of copper, silver and gold beginning in October 1971 from the open pits. Pit production ceased in approximately summer 1974 and underground exploration and development was attempted soon after; Placid Oil encountered difficulties in initial tunnelling. The TSF was reportedly reclaimed at about this time. Placid Oil sold the property and assets in 1976.

In the 1980's through until 2009, exploration occurred. In 1996 underground development began. In 2005 the Ministry of Energy and Mines granted a permit (# M33) for production of up to 75,000 tonnes per year; however tailings disposal on surface was not included in the permitted activities or disturbance areas. More detailed information can be found in Snowden's 2013 technical report.

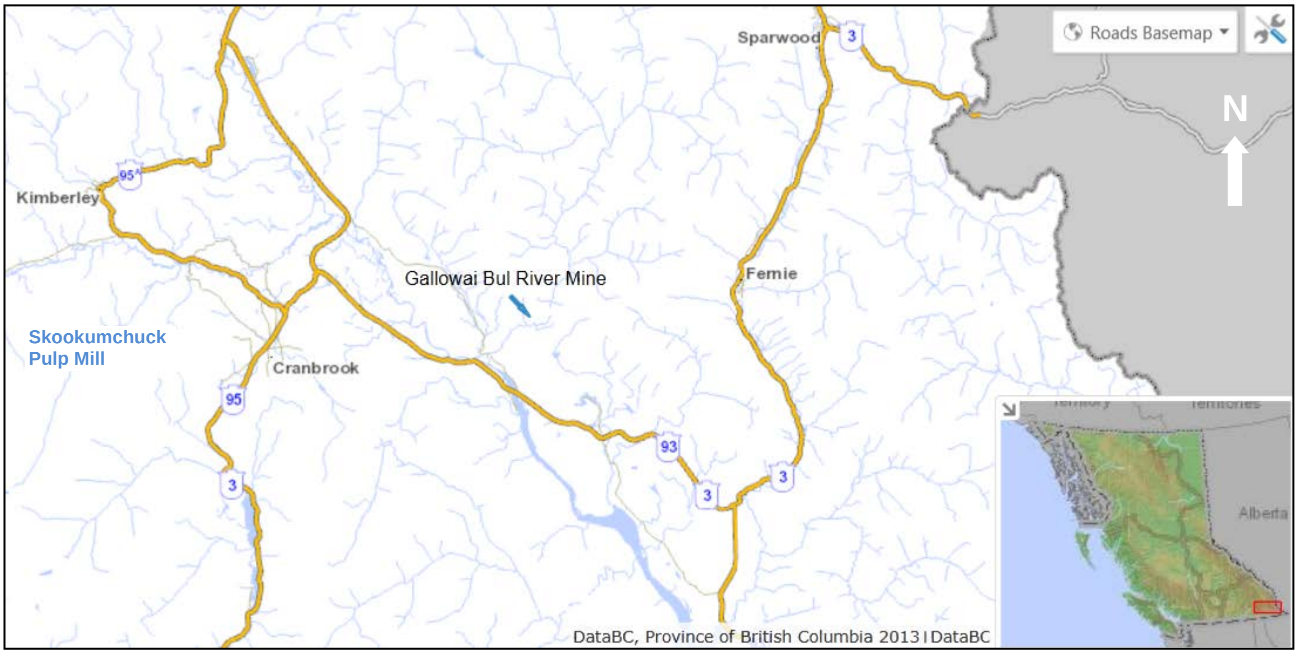

Figure 1: Site Location

(Map source: iMapBC website, Province of British Columbia)

2.2 PHYSIOGRAPHY

The mine site is located on gentle to moderate slopes at the base of Bull Mountain in the Steeples Range of the Rocky Mountains, at the east margin of the Rocky Mountain Trench. The Bull River flows east to west in the site vicinity in a canyon approximately 700 m south of the TSF, approximately 135 m lower in elevation. Burntbridge Creek flows down the mountain from headwaters at the peak and through the property to the west of the TSF and into the Bull River.

The site is vegetated with various grasses in disturbed areas, which are grazed by cattle and wild ungulates. Trees are dominantly interior douglas firs in the TSF vicinity, with aspens and larches in gully bottoms outside the TSF to the west and east. Site and mine property features are depicted in Figure 2.

2.3 GEOLOGY

The upper slopes of the mine site have generally thin soil cover over faulted bedrock of the Aldridge Formation comprising turbidites, siltstones and argillites (Snowden, 2013). Diorite and gabbro sills have intruded the Aldridge Formation rocks. The ore of the Gallowai Bul River Mine is found in veins of quartz and carbonates that also contain sulphide minerals.

The surficial geology comprises glacial till and colluvium in upper slopes of the mine site. Lower slopes are underlain by thick glaciofluvial sand and gravel deposits. The bedrock surface dips very steeply down to the south under the mine site, notably under the TSF.

2.4 CLIMATE

Environment Canada monitors a weather station at the Cranbrook Airport weather station, located 31 km to the west-northwest. Information in this paragraph is derived from the averages reported between 1971 and 2000. The mean annual temperature is 5.7º C with warm summers (high temperature of 25º C in July/August) and cold winters with minimum daily average temperatures of -11.8º C in January. Average annual precipitation at the airport is 383 mm (water equivalent) with 53 mm in June (the wettest month) and 18 mm in October (the driest month). February through April are also relatively dry. December and January snowfall average 36 cm and 33 cm, respectively, along with approximately 4 to 7 mm of rainfall.

Precipitation can vary substantially by location in the Cranbrook and Kimberley vicinity, with higher amounts occurring near the mountains on the west and east sides of the Rocky Mountain Trench.

2.5 TAILINGS STORAGE FACILITY

Some documents were provided to SNC-Lavalin by BRM during our site visits. Scanned photocopies are presented in Appendices B and C and listed in Section 7, References. TSF design and construction features described in succeeding subsections are interpreted from these documents.

2.5.1 Design

Golder Brawner Associates Ltd. (Golder Brawner) performed geotechnical investigations and made subsequent recommendations and analyses in 1970 that informed tailings storage facility design and construction specifications produced by Wright Engineers Ltd. (Wright). The drawings are presented in Appendix B (scanned images not to original scale). The geotechnical report and related design correspondence are in Appendix C.

Initially, two proposed TSF locations were put forward and Golder Brawner advised design and construction of Scheme A which was ultimately selected for construction. Scheme B was rejected due to the presence of coarse, pervious soils in Burntbridge Creek and the risks of floods and debris flows entering the tailings pond with the potential for overtopping or other failure modes.

The constructed TSF is located east of Burntbridge Creek, upslope of the Bull River Road. According to design drawings, its crest elevation was 3025 feet (922 m) with a design freeboard of 3 feet. It was 12.3 acres in area with an estimated storage capacity of 650,000 yd^3 (500,000 m^3) impounded by 475,000 yd^3 (360,000 m^3) of dam embankment material. The dam crest length is approximately 540 m and has at least three bends linking straight crest segments. The crest width was specified as 20 feet (6 m). Drawing D-611-21-4301 proposed tailings dam slope angles of 2.5H:1V and 2H:1V for the upstream and downstream faces, respectively. However, Drawing 4302 shows design cross sections with 2H:1V (27º) slopes on both dam faces.

Due to undulating pre-construction topography and relic drainage gullies in the TSF footprint, the dam embankment height ranged from nearly zero at the west and east abutments where it tied into existing terrain sloping upward, to approximately 30 m height over a partial gully fill on the east side.

Based on a review of the historical reports, borehole and test pit logs and related correspondence, the tailings dam foundation soils comprised compact to dense glaciofluvial sand and gravel with cobbles and a trace of silt. At the north end of the impoundment, closer to the open pit, the surficial soils were glacial till rather than glaciofluvial sands and gravels. Golder Brawner concluded the dam foundation materials and pond floor area were pervious and predicted the facility would leak water excessively unless it was fitted with an impermeable liner comprising a PVC membrane, soil and drainage layer liner, or asphaltic concrete (asphalt).

Later correspondence omitted the soil and drainage liner option and listed a sprayed asphalt method instead. An asphaltic concrete liner was ultimately selected in the correspondence as the preferred option. However, several years later M.G. Sveinson, Mill Superintendent wrote (report in Appendix C) that the tailings pond was lined with Dupont Fabrene “C”.

The embankment was to be constructed of glacial till derived from stripping and site grading at the open pits and mill site. Laboratory tests from 1970 indicate the till was composed generally of gravelly silty sand with some variation of those components in the samples. Atterberg Limits results reported in the documents indicate the material behaved as nearly non-plastic to low plastic silt (ML). Optimum moisture content for compaction was 8 % on two samples subject to Standard Proctor moisture-density tests, and the natural water content of samples was below this level. Golder Brawner concluded the glacial till was relatively impermeable and competent once compacted and was suitable for dam construction.

Golder Brawner performed a consolidated undrained triaxial shear test on laboratory-compacted samples of the till, and reported and used an internal friction angle of 32º and zero cohesion. In later correspondence (December 1970), they noted that these strength values may be conservative and that a higher friction angle on as-constructed embankment fill was likely present because constructed fill densities were somewhat higher than those used in laboratory compacted specimens. Additionally, the engineer stated that a small amount of cohesion was likely present which would increase stability conditions notably. Based on the assumed parameters, the engineer calculated that the global stability of the dam had a factor of safety of 1.33 in static conditions, reduced by 12 % for a seismic event at 0.05 g. Golder Brawner concluded later in the documents that regardless of earlier calculations and assumptions, they judged that the tailings facility dam had a factor of safety of at least 1.5.

The till borrow was to be placed on a scarified and recompacted, stripped surface. It was to be placed in 8-inch maximum thickness lifts measured before compaction (10 inches in final construction specifications), at 98 % of its Standard Proctor maximum dry density. Within 15 feet of the upstream face of the embankment, stones greater than 6 inches diameter were to be removed (8 inches diameter was stipulated in final construction specifications).

Where foundation soils could have low hydraulic conductivity, a drain filter blanket under the dam's downstream toe was detailed on the drawings. Based on a review of correspondence, it appears Golder Brawner advised that the filter drain would only be selectively required in the eastern approximately 120 m of the proposed dam as well as two small locations within the western approximately 100 m of the dam. The drain material was specified as 3-inch minus, well graded sand and gravel with less than 5 % fines. It was to be constructed 3 feet thick vertically and 30 feet wide in the design drawings (minimum 50 feet wide drain shown in the initial soils report). Letters written during embankment construction included supporting drawings that noted the drains would have varying 10 foot to 30 foot widths.

One spillway culvert (12-inch diameter) at each of the west and east terminus points of the dam crest were included on the drawings to direct excess supernatant water down into gullies situated on either side of the TSF. Reclaim pumphouse and piping facilities were also shown on the drawings.

2.5.2 Construction

Some construction related information is available in letters written by Golder Brawner discussing observations and recommendations arising from site visits during construction. No as-built drawings were discovered by BRM.

In November 1970, Golder Brawner submitted a letter describing site observations made on October 15 and 16, 1970. Where natural foundation soils were granular and relatively free-draining, the drain filter under the embankment downstream toe was allowed to be omitted. Silty subgrade areas observed during the site visit were recommended to be topped with a filter, and a site plan was produced, showing the areas that did require a toe drain.

During embankment construction, Golder Brawner reported that fill was being placed in lifts not exceeding 6 inches in thickness and that boulders were being removed. Based on measured fill densities and moisture contents, compared to the laboratory Standard Proctor moisture-density curves, Golder Brawner allowed a one or two percentage point reduction from the minimum 98 % of Standard Proctor maximum dry density, depending on whether samples were +/- 1% or +/- 2 % of the optimum moisture content. The letter did allude to potential construction challenges related to working with some ambient temperatures below freezing.

2.5.3 Operation and Reclamation

The TSF was operated for approximately four to five years. Sveinson's report indicated that the Dupont synthetic liner was torn by fill weight and wind and patched several times in early operation before being covered with fine overburden.

Placid Oil reported that on April 15, 1976 following ten days of unusually warm weather, high runoff led to a washout on the south dam of the TSF, transporting approximately 3000 yd^3 of sand and gravel onto the Bull River Road. Approximately 4 acres of the TSF surface was disturbed and the area was recontoured. Surface ditches were diverted away from the TSF and seeding and fertilizing were conducted.

There were no records available relating to planning or execution of the reclamation of the TSF. It was reclaimed in approximately 1976. Presently, the ground surface of the former tailings pond is grassy and contains a soil cover. It is sloped approximately 2 % down to the north, into the mountain. A gully was eroded approximately 38 years ago into the south embankment, west of its center. The abutment area spillway culverts and reclaim facilities are no longer present.

According to BRM staff, five test pits were excavated in the TSF in August 2014 in order to assess the tailings material for studying cement powder addition to future tailings from the mill which may be generated should production re-commence. We understand the test pits revealed approximately 1 to 1.5 m of a surficial soil cover containing some organics, overlying tailings consisting of alternating coarse and fine sand layers. Moisture content of tailings sand samples were in the order of 10 %.

2.5.4 Dam Safety Inspections

BRM could not locate records from previous dam safety inspections. However, a Ministry of Energy and Mines inspection and Order by a Geotechnical Mines Inspector was documented, along with the mine manager's response, included in Appendix C.

The Ministry inspection report noted that tailings were covered, re-vegetated and dry. The dam toe was reported as dry with no evidence of seepage or vegetation types that grow in moist areas. The west and east downstream dam faces were assessed as stable with no significant erosion. The report noted that a drainage swale was cut down through the dam just west of its middle. The report noted that erosion had occurred in 1992 and that a previous Order by a Mines Inspector (presumably conducted in 2000) for site re-vegetation had not resulted successful vegetation reestablishment. The Order required a plan and cross sections to be submitted along with a design for permanent water diversions, spillway design and erosion protection, to be constructed by November 30, 2000.

On September 29, 2000 the mine manager responded in a letter that some waste rock had been placed in part of the gully and noted that surface water from the TSF could not report to the gully due to topography around the gully head, with ground surface sloped away to the north. The permanent water diversion system was reported to comprise ditches and pipes that convey surface water around the TSF and/or to the former open pit and its pump system.

2.5.5 Dam Consequence Classification

From conversations with BRM representatives, we understand the consequence rating of the TSF is “low”. A document outlining this rating was not available for review. An Operation, Maintenance and Surveillance Manual is likely required for this TSF but SNC-Lavalin did not receive a copy if one exists. Dams with a low consequence classification do not require Emergency Preparedness Plans. Further, low consequence dams are not subject to a specified minimum frequency of dam safety reviews; however, the Canadian Dam Association recommends that the consequences of failure are reviewed periodically since the consequences may change with development downstream. A consequence rating assessment and recommendation is not part of the scope of the Guidelines for Annual Dam Safety Inspection Reports; however, the Chief Inspector’s Order requires that the Independent Third Party Review of the DSI Report includes a review of the dam consequence classification.

3 METHODOLOGY

A visual inspection of the TSF and surrounding area was conducted by Jeremy Zandbergen of SNC-Lavalin on October 16, 2014. BRM personnel provided a site tour in the morning, giving verbal background information and providing TSF design and construction documents. Photocopies and scans/images of the documents were made and are appended to this report.

Field conditions were suitable for performing a visual inspection. The temperature was approximately 8º C. Weather conditions were cloudy; ground conditions were nearly dry, although light rain showers had fallen during the previous two days and night. The site was photographed during the inspection and selected photographs are included in this report. SNC-Lavalin’s waypoint locations were plotted using a handheld GPS. The waypoints from the foot traverse are shown on Figure 3 below.

Image source: Bing Maps. www.flashearth.com

Figure 2: **Site Layout**

Image source: Google Earth PRO, Licenced to SNC-Lavalin.

Figure 3: Tailings Storage Facility Layout and Visual Inspection Waypoint Locations

4 OBSERVATIONS

General comments and visual observations of the integrity of the TSF, slope stability, cracks, seepage and erosion are documented in the following sections of this report. Site observations are supported by the photographs in Appendix A.

Recommendations for maintenance or remedial work (if any) are assigned priorities as follows:

High priority: Immediate action should be taken to maintain/restore the integrity of the dam or the TSF system. No high priority recommendations are presented in this report.

Medium priority: Action should be taken but not necessarily immediately. Maintenance is recommended within the next year or two.

Low priority: Housekeeping issues or cosmetic repairs are recommended but not critical to maintain the TSF integrity. While an action may be low priority, it may yet be important to undertake regularly rather than deferred.

4.1 General Layout

Overall, the TSF is situated on relatively gentle to moderate pre-construction slopes above a steep-faced natural glaciofluvial terrace north of the Bull River Road. A second flat to gentle terrace extends south from the road toward escarpments above the Bull River. The TSF is pictured in Photographs 1 and 2 in Appendix A. Figures 2 and 3 show the general layout of the TSF and surrounding features.

The old open pit is now being used to manage sediment. It was estimated to be approximately 10 to 15 m lower in elevation than the TSF ground surface at its north side.

4.2 Embankment

The TSF embankment was approximately 540 m long and appears to have been recontoured since it was decommissioned and reclaimed. A gully is situated in the south segment of the dam, west of its middle and the designed 6 m wide flat crest is no longer present. Rather, the crest has been sloped back down to the north.

Some site observations are as follows:

- At WP 4, near the west embankment abutment, the surficial soils were mixed silty sandy fill with gravel and cobbles. Remnants of the crest were 5 m wide and sloped back north to the mountain. The crest surface elevation was not flat and uniformly at 3025 feet elevation as originally designed. Instead, the dam crest now slopes up 5º to the southeast toward WP 5 and 6 (see Photograph 3). The downstream face was sloped 31º. A natural draw, possibly a former side channel of Burntbridge Creek was located west of this location and some surface water was flowing (1 m wide, 0.1 m deep) down to a culvert under the Bull River Road. The haul road ditches conveyed surface water to this gully.

- WP 5 was the highest elevation point on the TSF dam crest. The ground surface was sloped 15º down to the north for approximately 16 m along slope, to the former pond area. The downstream face was sloped 28º (just over 2H:1V) for the TSF embankment area and continued at that slope approximately 80 m along slope down to the Bull River Road along natural slopes. There were no signs of cracking or slumping near or on the crest or upper slopes.
- At WP 10, the downstream face of the embankment was 29º for approximately 25 m to 30 m along slope to where the interpreted transition to original native ground was located. Below that point, natural slopes were approximately 31º down to the Bull River Road and the terrain was forested with interior douglas fir trees. The slopes and TSF crest appeared to be stable and no evidence of seepage or cracking or bulging was evident.
- WP 11 was located at a hinge point in the dam crest alignment. The downstream face was inclined 29º for at least 40 m along slope down to a natural gully vegetated with aspen and larch trees, along with scattered firs. The draw appeared to be dry but could experience ephemeral flows. The gully is pictured in Photograph 5.
- WP 12 was plotted near the east abutment of the TSF dam. This location was a low point with the TSF surface graded to the area along with the haul road. However, no evidence of surface water flows from recent years was observed (see Photograph 6).
- At WP 13, on the TSF dam toe, the slopes up to the crest were measured at 26º, and an accumulation of cobbles was scattered in the toe area. This area appears to be the highest segment of the dam, by comparison to design drawings and based on site observations. Between this location and WP 12, the filter drain at the downstream toe would have been placed; however its presence was obscured by vegetation and possible filling/ravelling during reclamation grading.
- WP 14 was estimated to be the transition point between the dam downstream toe and natural ground surface. The slopes were 26º up the downstream face and 27º overall down toward the Bull River Road. The ground on the dam face and natural ground was dry and no evidence of seepage was observed.
- At WP 15, the ground surface appeared to have small amounts of moss and some different, lusher vegetation that was not present in adjacent areas of dry ground. There was no evidence of seepage or surface flows and the site had an exposed south aspect. The area is depicted in Photograph 8. The natural ground surface down to the Bull River Road was dry and sloped 29º (see Photograph 9). The downstream dam face was sloped up 27º to the north. The area was interpreted to have some amount of increased soil moisture

content compared to most of the remainder of the TSF dam. The moist area was discrete and localized, approximately 6 m along the slope fall line and 3 to 4 m along contour.

- At WP 16, another area of potential higher moisture content conditions in the surficial soils was observed (see Photograph 10). The slopes appeared to be stable and no evidence of seepage was found. The slopes were inclined 28º down to the Bull River Road and 26º up the TSF downstream face. Similar to the location at WP 15, the moist area was localized and small. Dry ground conditions were prevalent between WP 15 and WP 16.
- At WP 18 a small bench was situated near the base of the TSF dam. The area was dry and appeared stable. The ground was sloped 32º down to the southwest.

In summary, the downstream face of the TSF dam was mostly sloped 26º to 29º and vegetated in grasses with dry conditions. Two small zones of apparent higher moisture content were observed (WP 15 and WP 16); however, no evidence of recent seepage or flows was observed. The slopes showed no sign of cracking or other deformation. The crest of the dam has been recontoured to slope back northward away from the downstream face and is sloped along its centerline with a high point at WP 5.

4.3 GROUNDWATER

The TSF has a soil cover overlying tailings sands and may have an asphaltic concrete liner on its floor and part of the upstream face of the dam which could restrict the flow of groundwater out the floor and under the dam. The dam was apparently constructed of compacted glacial till, borrowed from overburden stripping at the open pits and mill site. The compacted till would have been relatively impermeable, and the dam's downstream face was dry in all upper and middle elevations. As noted above, two localized and small zones of higher moisture content at ground surface were observed on the southern face (WP 15 and WP 16), at the estimated elevation of the dam foundation. Slopes below these zones in natural terrain did not exhibit seepage or wet conditions.

Groundwater may be present in the tailings, perched atop a potential asphaltic concrete liner. If placed, it would likely have cracked over time as the weight of tailings accumulated and the material aged. At the transition between pond floor and the constructed embankment, differential movements may have occurred, leading to cracking of the asphalt. No remnants of asphalt were discovered anywhere on or near the TSF in this inspection as a result of reclamation or in the south face gully where the dam and underlying foundation soils have been exposed. A second potential flow path for groundwater out of the TSF is provided where the south gully through the old dam exists, below the dam foundation elevation. The gully provides a lateral dewatering route to allow potential lowering of the phreatic surface to nearly 25 m below the original dam crest elevation.

As described below, surface water is not being directed to the TSF so groundwater in the tailings would originate from precipitation directly on the TSF footprint as well as potentially from groundwater flowing southward from the old open pit area. No monitoring wells are installed; so the presence of groundwater and its flow velocity and direction are unknown.

Moisture contents in the order of 10 % were measured on samples collected in TSF test pits excavated in August 2014 by BRM and the test pit depths were in the order of 4 m. The tailings are likely moist and a perched water table may exist atop a designed asphaltic liner, through which it may escape through cracks. Under the liner, the groundwater may percolate downward through a thick deposit of relatively clean glaciofluvial sands and gravels which were laterally and vertically variable. Localized silty lenses and pockets could direct groundwater horizontally within the dam foundation zones and further down to the Bull River Road elevation.

4.4 Surface Water Management

The TSF comprises an outer dam in a semi-circular configuration between two natural gullies. The eastern gully was partially infilled by the dam on its western face, and the north side of the TSF was bounded by natural slopes up to the north along the mountain toward the old open pit. An impoundment within these bounds was filled with tailings. At reclamation, a soil cover placement and recontouring apparently took place. Nearly all the surface water to infiltrate the TSF originates from precipitation falling directly on its footprint.

The former pond surface of the TSF is sloped down to the north, in toward the mountain and away from the dam structure. Slope angles are generally in the order of nearly flat (near west abutment) to approximately 2º in the remainder of the TSF pond area surface. The mine haul road crossing the north side has been ditched to shed water to the west and east into the adjacent gullies, preventing water from flowing onto the reclaimed TSF. The old open pit also takes water from ditches and pipes and is used for soil particle settlement. Intermittently, pumps and pipes convey the pit's pond water southward to the haul road where it is sleeved through a culvert, then turning west and down to discharge in the gully west of the TSF. According to BRM the pit / sedimentation pond level does not rise significantly, and pump house structures at the pond edge do not become flooded.

The above-described features are shown in Photographs 1 through 6, and 11 through 14.

A gully has been formed into the TSF dam just west of its middle in the area of WP 6, WP 7 and WP 17. Its surface catchment area is limited to a small semi-circular area around its head, less than approximately 600 m^2, and most of the TSF footprint is graded to shed water away from this area to the north (see Photograph 14). From review of available documentation, some surficial erosion and sloughing occurred in the gully in 1992 and 2000. Provincial Mines Inspectors ordered surface works to mitigate and repair the erosion.

The gully profile was sloped approximately 16 to 18º overall down to the Bull River Road, with a slightly steeper middle section and slightly flatter segments in the upper and lower slopes (see Photographs 15 to 17). Based on a review of design drawings the area appears to have been the site of a gully prior to construction, with a channel elevation at the dam centerline approximately 25 m below the design dam crest elevation.

The gully sidewalls were steep during our site inspection on October 16, measured at 36º to 37º. The east sidewall, while steep, did not appear to have recent instability, however thin sliver failures of small volumes were observed on the western sidewall, as depicted in Photographs 15 and 18. Some argillite waste rock had been placed on the upper slopes, likely from works reported to have been performed in 2000. The waste rock veneer on the upper slopes appeared to be performing adequately.

Based on evidence of fresher deposits of gravel and sand in the Bull River Road ditch, some mitigation work on the gully sidewalls and near the gully head catchment perimeter is recommended as described in later sections.

From a TSF water balance perspective, a formal analysis was not likely ever conducted, and the original designers wrote that they expected seepage losses in permeable foundation soils under the proposed liner to be the design challenge. The TSF was reclaimed nearly 40 years ago and surface water has been directed around the TSF for most of that time. The tailings have likely dewatered notably and with the exception of a small area depicted in Photograph 13, the water tends to infiltrate and drain out, likely under the TSF floor and dam foundation elevations. Even the gully near WP 6 and WP 7 does not appear to experience surface water flows from the TSF footprint or its own main catchment area. Rather, periods of wet weather may moisten and destabilize soils forming the gully sidewalls in over-steepened areas cut through the old dam fill.

4.5 INSTRUMENTATION

According to BRM staff, no instrumentation such as piezometers, inclinometers or settlement plates/hubs have been installed at this TSF and so results cannot be analyzed. A perched and localized groundwater table likely exists within the tailings; however, it does not appear to have caused instability in the dam and no active seepage appears evident in recent years along the dam's downstream face or lower natural slopes, save for potential elevated soil moisture in two discrete locations on the south face near the dam foundation elevation.

The dam crest was recontoured so its undulating surface would obscure visually detectable evidence of settlement or slumping. Despite this, the downstream dam face did not exhibit signs of bulging, slumping or cracking, nor cracking on or near the slope crest. Based on an adequate level of performance since closure, the installation of new instruments is not presently required.

5 DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL

The Gallowai Bul River Mine TSF appears to be in good condition overall and has performed satisfactorily over the past 35 to 40 years since it was reclaimed. Due to the fact it was reclaimed in the mid- to late 1970's and no significant problems have been encountered, it has not experienced a high level of scrutiny.

From a slope stability perspective, the dam appears to be stable. Surface water diversions around the TSF serve to minimize water infiltration to the tailings and reduce the probability of breaches to very low levels.

5.2 SURFACE WATER

Since the pond level is at least 10 m lower than the TSF surface, and the pond level is reliably stable, with very infrequent pumping required, overland flow from the pond to the TSF is considered very unlikely.

A formal water balance review is not considered necessary for this dam safety inspection as the TSF is no longer operating and has been reclaimed and recontoured for nearly 40 years with relatively dry conditions.

Similarly, freeboard and storage availability are not issues for assessment in this particular reclaimed TSF where surface water is, according to BRM staff, absent on most of its surface year-round.

5.2.1 Gully on South Face

The gully through the dam near WP 6, WP 7 and WP 17 experiences periodic sidewall sloughing on over-steepened slopes and the soils are transported to the Bull River Road ditch. However, it does not experience surface water flows and its catchment is limited to less than approximately 600 m^2.

While past mitigation work was conducted in the upper section of the gully, with placement of argillite waste rock as a veneer, sidewalls along the dam footprint should be addressed. An excavator with a long stick should be used to shave back the sidewalls to flatter slopes, preferably at inclinations of 30º or flatter. Two to three small cross-gully berms should be constructed, in line with approximately the dam centerline, dam downstream toe, and a location halfway between the downstream toe and the Bull River Road. The cross berms should be approximately 0.5 m tall and 1 m wide, constructed of a well graded silty sandy gravel and tamped. They could be constructed by handwork.

The flattened gully sidewalls would reduce the probability and magnitude of any future sliver failures; cross berms in the gully channel would help to mitigate potential sediment transport from freshly exposed slopes disturbed by the excavator. The exposed slopes should be treated by methods such as seeding with grass, placement of geosynthetics such as seeded coconut matting, or angular rock cover. The site should be monitored and photographed to check on progress of the mitigative works and any areas that require additional works.

In the gully catchment upstream perimeter on the TSF surface, any areas of surface flow toward the gully should be blocked by creating small swales to drain away from the catchment and/or placing low berms to shed water back to the north with the overall TSF surface grades.

This work is considered to be low to medium priority; the rationale is to improve public safety on the Bull River Road which is maintained by the Ministry of Transportation and Infrastructure and to undertake proactive works so as to prevent a larger erosion situation from potentially developing which will be more difficult and costly to mitigate.

5.3 TSF Status

Given that the TSF was reclaimed and based on the potential case of partially or fully drained tailings, BRM may wish to consider applying to the Chief Inspector of Mines Office to change the status of the TSF to a dump. While the performance of the past 40 years is one consideration, management of the facility as a dump may be rationalized by establishing whether partial or full draining of tailings in the TSF has occurred.

A dump would still require maintenance and monitoring in accordance with industry standards, protocols and regulations; however, it would not be subject to requirements for annual dam safety inspections and TSF related regulations, which may be unwarranted for this particular facility.

Szymanski and Davies (2004) wrote, “for any engineer to judge a dam stable for the long-term simply because it has been apparently stable for a long period of time is, without any other substantiation, a potentially catastrophic error in judgment”. Some assessment, instrumentation and slope stability analysis work may be required for due diligence in a full closure of the TSF. Should the Ministry of Energy and Mines require additional information or analysis as part of adjudicating such an application, SNC-Lavalin can provide a work plan and cost estimate.

5.4 Operations Manual, Emergency Preparedness Plan

This TSF does not appear to meet the definition of a major impoundment as defined in the Health, Safety and Reclamation Code for Mines in British Columbia, which can be interpreted as intended for materials stored in a slurry or liquid state. The exception is whether the facility was once declared a major impoundment by the Chief Inspector. However, it does meet the definitions for a major dam and a major dump. An Operation, Maintenance and Surveillance Manual is likely required for this TSF but SNC-Lavalin did not receive a copy if one exists. An Emergency Preparedness Plan is not required for this particular TSF due to its apparent low consequence classification. Low consequence dams do not require a specified frequency of dam safety reviews; however, the Canadian Dam Association does still recommend that the consequences of failure be reviewed periodically since the consequences may change with development occurring downstream. Such a consequence review is required under the Chief Inspector's Order.

6 CLOSURE

We trust that this report meets your requirements. Should you have any questions or comments please contact us at +1.250.426.9070.

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November 24 2014

This document represents an electronic version of the original hard copy document, sealed, signed and dated by Jeremy Zandbergen, P.Eng. and retained on file. The content of this electronically transmitted document can be confirmed by referring to the original hard copy on file.

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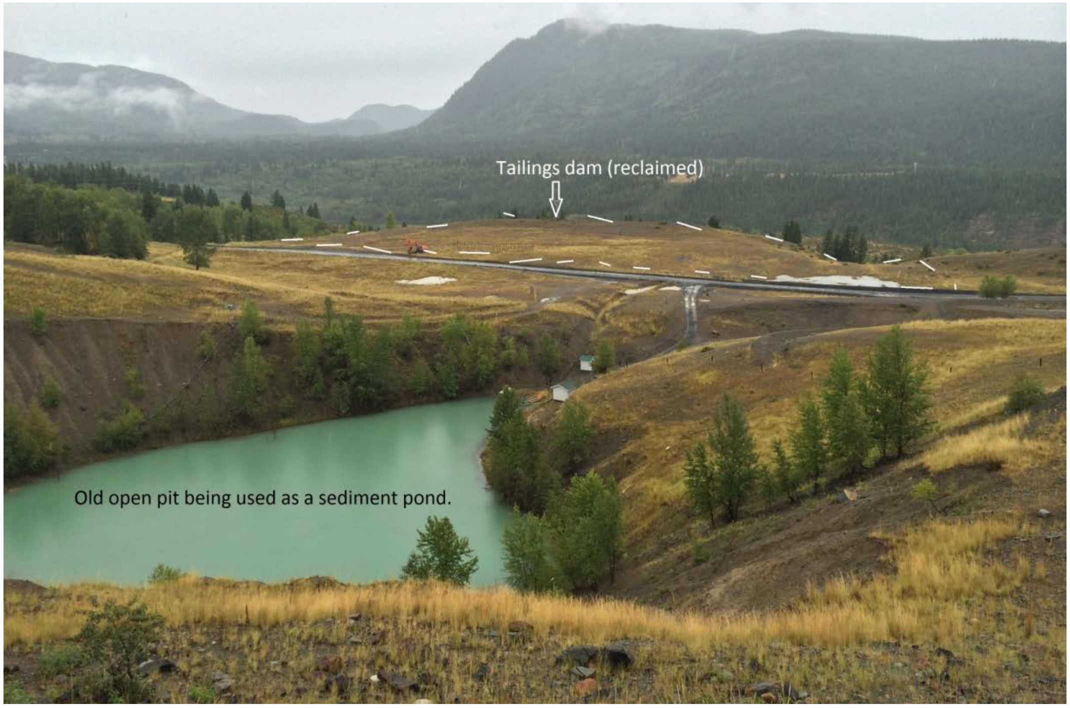
APPENDIX A

Photographs of 2014 Visual Dam Safety Inspection



Photograph 1: View to south showing the old open pit and pumphouses in the foreground and the TSF in the background. The Bull River is in the valley floor beyond the TSF.

Photograph 2: View to the east from the mine haul road to the TSF. The Bull River Road is visible in the lower right corner. The mill site is located beyond the left middle area of trees with autumn foliage.

Photograph 3: At WP 4 looking southeast toward WP 5. The dam crest is sloped uphill along its centerline and sloped back down toward the north and the former pond area.

Photograph 4: At WP 10, looking east. The downstream dam face is inclined at 29º for approximately 25 to 30 m along slope. Natural slopes below the TSF at WP 10 are 31º.

Photograph 5: At WP 11, looking east to a natural gully. The haul road linking the portal and dumps to the mill is visible in the left background and the Bull River Road is in the right background. Surficial soils were gravelly sand with some silt and cobbles. Slopes were stable.

Photograph 6: Looking southwest from WP 12 at the low point near the east abutment. The ground surface slopes down to this point and the east gully is located to the left of the photograph.

Photograph 7: At WP 14, looking west along the transition between the TSF downstream dam face and original ground. The slopes were 26 to 27º, in dry conditions.

Photograph 8: At WP 15, looking north up the downstream dam face. Some moss was present on the ground surface in this area, which was estimate to be at the dam foundation elevation. Potential very light seepage or moisture evaporation may be occurring in this area. No active seepage or vegetation such as horsetail was observed. Ground conditions downslope to the Bull River Road were dry.

Photograph 9: Slopes down to the Bull River Road at WP 15, showing the moss covered slopes in the foreground and dry terrain sloped 29º in fir and ponderosa pine forest.

Photograph 10: At WP 16, the second discrete location of surficial moss and more lush vegetation is depicted.

Photograph 11: Looking west near WP 1 at pipelines from the old open pit, under the road through a culvert and west toward Burntbridge Creek.

Photograph 12: **From WP 4 on the TSF dam crest, looking northwest to the haul road and black pipe conveying water from the old open pit pumphouse. The discharge location is at facilities in the background area, and into an old side channel of Burntbridge Creek. The culvert in the middle foreground discharges ditch water from the upslope (north) side of the haul road and its catchment is up to the background and right of the photograph.**

Photograph 13: **At WP 8, looking west toward some small ponded water areas on the soil cover surface. The weather had been rainy in recent days, and water is reported to pond in this area on a regular basis after rainfall.**

Photograph 14: **At WP 5, the dam crest high point, looking east. The TSF is generally sloped down to the north away from the dam; however, a gully was present west of the middle of the dam, draining down to the south (right). The catchment for the gully surface water is limited to a semi-circular area at its head, estimated at 1500 to 2500 m^2.**

Photograph 15: **View down the gully at WP 7. The Bull River Road is barely visible in the background. The west (right) sidewalls experience small surficial failures. The road ditch contained small volumes of washed gravels and sands, and a pullout on the road contained some dumped materials, likely originating from ditch cleanout.**

Photograph 16: **View uphill from Bull River Road to small deposit in ditch from erosion, taken during a rainfall on September 3, 2014.**

Photograph 17: **View down the gully southwest from WP 17 to the Bull River Road and small deposits in the ditch. Stockpiles of older and fresh gravels on the pullout indicate possible cleanout from previous episodes. The pullout itself may be constructed from levelled, larger events.**

Photograph 18: At WP 6 looking east across the gully with sliver failures in the west sidewall.

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