

Myra Falls Mine Tailings Facility Field Review Report

Date of Field Review:	July 2019 (see below)	Date of Memo:	27 September 2019
File No.:	NX14001B1	Client:	Nyrstar Myra Falls Ltd.
Engineer:	Dan Hughes-Games, P.Eng.	To:	Keith Watson, P.Eng.
With:	n/a	Cc:	
Weather:	Sunny, seasonably warm, daytime highs in the upper 20s – all three dates in question.		

Summary

- The Old TDF and Lynx TDF facilities were reviewed by Wood.
- Action Items:
 1. Reduce the water level in Lynx TDF to the maximum Normal Operating Water Level of 355.0 m and maintain this condition.
 2. Remove windrows on the Old TDF Seismic Upgrade Berm and considering permanently closing the route to traffic (windrow was removed prior to 29 July).
 3. Specific actions relative to the Superpond and Polishing Ponds are not given here; however, as noted below some deficiencies were noted. These deficiencies should be considered in work being carried out to address the regulatory compliance plan.

The Old TDF and Lynx TDF are reviewed by Wood Environment & Infrastructure (Wood) on a monthly basis as part of the engineering reconnaissance of the tailings facilities. Wood notes conditions in and around the facilities during the reviews, with emphasis on water management, dam stability, and seepage conditions.

This inspection was carried out on 22, 23, and 29 July 2019. The scope of inspection included Superpond and the Polishing Ponds. These structures should be inspected again in the wet season, preferably during passage of a significant rainfall event, in order to review their function under more demanding conditions.

Old TDF

- The Old TDF is free of significant ponded water. The surface of the APA is desiccating in the summer weather.
- Tailings are being removed from the apex of the APA for use in Lynx TDF construction. Nyrstar indicated the intent is to replace the excavated materials with filter cake.
- The APA Decants and spillway culverts are clear. There is no flow due to the dry summer conditions.
- The Surge Pond water level is at the decant sill elevation, as per design intent. The water is relatively clear with the submerged buttress in the east end of the pond clearly visible.
- Grading activities on the Old TDF Seismic Upgrade Berm have created a windrow along the haul route (22 July). The windrow is up to about 0.4 m high and would pond significant water. The road surface has been carved down several centimetres below the adjacent surface. Given the sensitivity of the area to drainage and ponding of water, and the design intent that it shed runoff, Wood recommends regrading to remove these windrows (completed prior to 29 July) and then permanently closing the Upgrade Berm as a haul route/road. Vehicle access should be for maintenance of the area only, with the exception of access to the helicopter area near 0+700. Consideration could be given to accessing the helicopter area from the OEB via the side of the Operations Spillway or by a new designated route constructed down the 6H:1V slope.



- The wet well springs at Pump House 4 are flowing at an estimated 0.5 L/s. The pump house springs (located about 50 m up slope on the abutment contact) are not flowing.
- Scotch broom infestation has been removed from the Surge Pond fuse plug. Monitor the area for further sprouting and/or regrowth.

Lynx TDF

- Pumping has been moved from the east abutment to the west abutment, in order to move it away from the future tailings beach. The pumps discharge in the mill ditching system.
- A new staff gauge has been established at the new pumping area. The gauge is a freeboard gauge and is numbered from top-down. 2.00 m on the gauge is surveyed as 355.77 m, therefore the maximum normal operating water level is 2.77 m on the gauge.
- Water level in the evening of 22 July was about 1.85 m on the gauge = $355.77 + (2.00 - 1.85) = 355.92$ m.
- Water level in the afternoon of 23 July was about 2.01 m on the gauge, 355.78 m.
- Water level in the afternoon of 29 July was about 2.40 m on the gauge, 355.37 m. Water clarity at the pumping area was very turbid below 4 cm depth. At this water elevation, most of the impoundment has dredgate exposed at the surface. Pumping to 355.00 m elevation may require improvements to the pump area to limit sediment ingress. Lower portions of the gauge are difficult to read due to sediment deposited on the face.
- The sinkhole is visible in a location and size consistent with recent observations (all dates noted above).
- Work is underway to place a platform for the upstream beach. Fill placement is resulting in significant displacement of dredgate, and a mud wave approximately 50-100 m wide. There are indications of upwelling groundwater in response to consolidation at the toe of the fill.
- Cracking is present roughly parallel to the dam crest in the vicinity of Plane E to Plane F, 1.5-3.0 m from the upstream crest, adjacent to the work area below. The cracks are discontinuous and open up to about 1 cm, without significant apparent vertical offset. The cracking is interpreted as primarily horizontal strain resulting from consolidation settlement of the toe of the embankment due to the placement of fill at the toe. Construction staff are reviewing the cracks multiple times daily to check for signs of changing conditions.
- Construction on the downstream side continues. The working bench is about half way up the dam across the south arm and part of the west arm.
- Seepage or surface runoff were not observed on the downstream side of the embankment.
- Low flows at the Lynx Springs Drain.

Diversion Ditches

- Low flow in the LLDD.
- The LLDD debris basin and net are clear of alluvium or debris.
- Significant and wide-spread delamination are present between shingles of the LLDD concrete cloth liner in many areas. The LLDD should be subjected to a thorough condition assessment and repair program before the wet season flows commence. The LLDD is a critical structure and these repairs must not be deferred.
- Alder reach waterfalls are dry.

Waste Dumps

- Waste dumps were not reviewed.

Superpond

- The downstream side of the embankment is near angle of repose in several areas. There are no indications of active instability in those areas. Future upgrades should include reconstruction of the downstream slope at stable slope angles.
- The downstream side of the embankment has coniferous trees growing in some areas. These trees are currently unlikely to adversely affect dam performance; however, if they were to become fully mature there could be some potential concern about root penetration.

- The corrugated steel pipe culverts between the secondary sump weir box on the upstream side and the secondary outlet sump on the downstream side are in poor condition. The inlets are badly corroded and partially blocked by rockfill. Two of the three culverts have HDPE pipes routed through them, a practice which should be abolished when the culverts are intended for water conveyance. Corrugated steel piping should not be used for conveyance of waters which are potentially corrosive to steel.
- The secondary outlet sump on the downstream side has been undermined during overtopping events. The slope below the sump is eroded and rests near the angle of repose. This configuration is not robust relative to the intended function. Future upgrades should consider a more robust sump.
- A variety of unknown and partially abandoned piping is present in both the upstream and downstream sides of the embankment. Some lines appear to penetrate the embankment. Disused lines should be removed or filled with grout.
- The HDPE liner is generally in good condition, but has several significant tears above the normal water level on the south side, and a number of minor tears or punctures elsewhere. Liner repairs should be undertaken.
- This inspection did not include condition review or testing of control structures/valves/etc. This equipment must be tested at least once per year as part of the annual dam safety inspection. Schedule this testing for the wet-season inspection.

Polishing Ponds

- The polishing pond embankments were reviewed for indications of instability. No obvious cracks, sags, or seepage were noted.
- All pond levels are below their indicated minimum freeboard markings.
- Pond 2A is partially dredged, with cut lines from the dredge clearly visible. The other ponds appeared to be more thoroughly dredged.
- Decant structures are in generally poor condition. They are timber structures and most show at least some signs of rot or damage. Internal bracing or loose boards may interfere with conveyance of peak flows. Control of water levels via stop logs (as intended) is not currently possible at several of the decants.
- The condition of the conveyance culverts could not be assessed. Some of the conveyance pipes appear to be HDPE while others appear to be corrugated steel pipe. The use of metal pipes should be reviewed relative to potential corrosion. Future upgrades should consider potential corrosion as a key design constraint.
- The diversion ditch on the slope above the ponds was reviewed. The ditch appears to be cut in large, open-graded talus. The sides of the ditch are oversteepened relative to the natural angle of repose. Rocks in the ditch were moss-covered, and there were shrubs and trees growing on the ditch and retaining embankment. Apart from ravelling there were no indications of major instability. The ditch does not appear to have conducted significant flows of water and given the substrate material it is unlikely that it ever would. The ditch should not be relied upon for water conveyance; however, any study considering inflows from the hillside should consider high infiltration rates and the influence of infiltrated runoff on valley-bottom aquifer levels.

The recommendations herein are based on Wood's observation of surface conditions at the time of the field review and are subject to revision upon the availability of new information.

This report has been prepared for the exclusive use of Nyrstar Myra Falls for specific application to the area described within this report. Any use which a third party makes of this report or any reliance on or decisions made based on it are the responsibility of such third parties. Wood accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

Myra Falls Mine Tailings Facility Field Review Report

Date of Field Review:	17 September 2019	Date of Memo:	27 September 2019
File No.:	NX14001B1	Client:	Nyrstar Myra Falls Ltd.
Engineer:	Dan Hughes-Games, P.Eng.	To:	Keith Watson, P.Eng.
With:	Dixie Ann Simon, P.Eng. Bryan Woods, P.Eng.	Cc:	
Weather:	Showers changing to rain, heavy at times. Temperatures between 10-20°		

Summary

- The Old TDF and Lynx TDF facilities were reviewed by Wood.
- Action Items:
 1. Monitor cracking along the upstream slope of Lynx TDF.
 2. Inspect LLDD repairs during/after high flows.
 3. Spread the cake piles at the apex of the APA into the adjacent excavations if practical (if weather allows).

The Old TDF and Lynx TDF are reviewed by Wood Environment & Infrastructure (Wood) on a monthly basis as part of the engineering reconnaissance of the tailings facilities. Wood notes conditions in and around the facilities during the reviews, with emphasis on water management, dam stability, and seepage conditions.

Old TDF

- The APA has normal water levels, with flow along the APA Berm into the east and west decants.
- The water level in the Old TDF decant is near the elevation of the tailing surface.
- The APA west decant is flowing at moderate rates, with turbid, sediment-laden water.
- The Surge Pond water level is just above the decant sill, per design. The water is red in colour and the surface appeared relatively clear. Water discharging through the decant tower is relatively clear.
- Fill has been advanced from the laydown area in the west end of the APA across one of the significant gullies. Gullies should be filled with tailings materials to reduce the potential for formation of preferential seepage pathways during closure. Details to provide groundwater cut-off will need to be provided during the cover detailed design phase. Alternately, exhume the fill from the gully and fill it with tailings.
- Tailings cake remains piled at the apex of the APA, adjacent to the excavation that was created during the summer for a source of Lynx TDF construction materials. The cake piles should be spread into the excavations if practical.
- The APA Operations Spillway inlet area has been the subject of piping erosion in the past. The area is currently free of indications of continued piping erosion – prior interim repairs appear to be performing.
- The East Strip has a shallow depth of ponded water, controlled by the spillway culvert inlets and by a fan of material deposited from the backfill plant overflow lines.
- The DDS and East Strip groundwater boils area are not flowing.
- The LLDD subdrain at the APA east abutment is flowing at about 0.5 L/s, consistent with past observations. It flowed at similar rates all summer, suggesting LLDD leakage is responsible for the source of the flow (as opposed to hillside groundwater sources).



Lynx TDF

- Water level is as low as practically attainable, with dredgate slimes exposed across most of the impoundment surface.
- Sinkhole is visible. The location and size are consistent with prior observations since April 2019.
- Paste tailings deposition near the southeast corner continues. The tailings are displacing dredging slimes; however, there are islands and strips of dredgate trapped between deposition lobes.
- Cracking is present along the upstream crest, between about 2-3 m from the edge, primarily from Plane E to the east. The cracks were intermittent and open up to about 5 cm, with similar displacement across the. The cracks are thought to be likely due to consolidation settlement but should be monitored.
- Some ponding of water is present at the toe of the south arm in Panel 13 area. The area should be drained by pumping, as in past years.
-

Diversion Ditches

- LLDD is flowing at moderate levels.
- LLDD debris basin and net are clear of debris.
- Repairs have been made to the LLDD punctures and delaminations. Moderate flows preclude thorough inspection to see if all issues have been addressed. Repaired areas should be monitored for performance relative to high flows.

Waste Dumps

- Waste dumps were not reviewed.

The recommendations herein are based on Wood's observation of surface conditions at the time of the field review and are subject to revision upon the availability of new information.

This report has been prepared for the exclusive use of Nyrstar Myra Falls for specific application to the area described within this report. Any use which a third party makes of this report or any reliance on or decisions made based on it are the responsibility of such third parties. Wood accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.



Photo 5: Flow through the Surge Pond decant inlet. Note the clarity of the water relative to Photo 3. The Surge Pond appears to be settling tailings solids as intended. The current level of sediment in the pond and the future need for dredging should be evaluated.



Photo 6: Panorama of Lynx TDF from the 10L East portal. Water level is at the achievable minimum, with dredgate exposed across most of the surface. The sinkhole is visible with size and location consistent with prior observations.



Photo 7: Crack on Lynx TDF Dam upstream crest near Plane E. The crack has apparent opening up to about 5 cm and has an apparent vertical offset of similar magnitude. This crack should be monitored for further development.



Photo 8: Voids found along the continuation of the alignment of the crack shown in Photo 7.