YUKON ZINC CORP.
WOLVERINE MINE



TAILINGS STORAGE FACILITY AND ON-SITE EARTH STRUCTURES 2016 INSPECTION

PREPARED FOR:

Yukon Zinc Corporation
Suite 705 - 1030 West Georgia St.
Vancouver, British Columbia
Canada, V6E 2Y3

PREPARED BY:

Knight Piésold Ltd.
Suite 1400 – 750 West Pender Street
Vancouver, BC V6C 2T8 Canada
p. +1.604.685.0543 • f. +1.604.685.0147

VA101-677/1-1
Rev 0
December 2, 2016

Knight Piésold
CONSULTING
www.knightpiesold.com

FS 64925
EMS 550121
OHS 550122

YUKON ZINC CORP.
WOLVERINE MINE

TAILINGS STORAGE FACILITY AND ON-SITE EARTH STRUCTURES
2016 INSPECTION
VA101-677/1-1

Rev	Description	Date
0	Issued in Final	December 2, 2016

Knight Piésold Ltd.
Suite 1400
750 West Pender Street
Vancouver, British Columbia Canada V6C 2T8
Telephone: (604) 685-0543
Facsimile: (604) 685-0147
www.knightpiesold.com

Knight Piésold CONSULTING

EXECUTIVE SUMMARY

The Wolverine Mine, owned by Yukon Zinc Corporation is a zinc-silver-copper-lead-gold mine located in southeast Yukon approximately 280 km east of Whitehorse and 170 km northwest of Watson Lake. The mine commenced operations in 2009 and operated at a production rate of approximately 1,700 tonnes per day. The mine ceased operations in January 2015 and is currently operating under Care and Maintenance conditions.

Tailings are stored in a fully lined Tailings Storage Facility (TSF) located south of the mill facility. The Engineer of Record (EoR) for this facility is Klohn Crippen Berger (KCB).

Yukon Zinc Corporation requested Knight Piésold (KP) complete the 2016 TSF Dam Safety Inspection (DSI) and the inspection of the on-site earth structures. A DSI is typically completed by the EoR; however Yukon Zinc retained KP to complete an independent inspection of the TSF for 2016. This independent review report should be forwarded to the EoR, with the recommendations being addressed by them to ensure they are consistent with the design and operating objectives of the TSF. The EoR was not interviewed as part of the DSI. KP is willing to assist with ongoing, independent reviews and support for the TSF, however it is recommended DSI's going forward be completed by the EoR who are intimately involved in the design of the facility.

The 2016 site inspection was completed by Les Galbraith, P.Eng. of KP. The results of the 2016 site inspection are as follows:

Tailings Storage Facility

- The TSF has a Very High dam classification according to the 2007 CDA guidelines.
- There were no construction activities in 2016.
- The TSF is accumulating water and the supernatant pond covers the entire TSF basin.
- There have been no significant changes to the dam or instrumentation monitoring records since the previous inspection. However:
  - The two inclinometers installed in the south dam are no longer functioning.
  - The five survey monuments at the south dam have not been read since January 2015.
  - The slump reported in the 2015 DSI at the north end of the TSF still exists, although the liner is still intact. The slump has resulted in a loss of the liner anchor trench and a lowering of the crest by approximately 1.5 m in this area. The progression of the slump is being monitored by site staff. Defects to the liner in this area are above the water level and the spillway invert.
- The slump is likely attributed to groundwater flow which has eroded the subsurface materials. It is recommended Yukon Zinc engage the EoR to evaluate the groundwater flow in this area and develop a plan to mitigate the on-going erosion of the slope to protect the liner from further deterioration.
- It is recommended Wolverine Mine engage the EoR to assess the instrumentation monitoring and replacement requirements.
- The Operations, Maintenance and Surveillance Manual, and the Emergency Preparedness Plan, were updated in July 2010.
- A dam with a Very High classification requires a formal Dam Safety Review (DSR) every five years as per the Canadian Dam Association guidelines. It is recommended Yukon Zinc schedule a DSR to comply with the Canadian Dam Association guidelines.

- The water balance has not been updated recently. It is recommended the water balance be updated and calibrated with measured pond volumes on a regular basis, with the results reported to the EoR.

On-Site Infrastructure

Visual observations were made of the on-site earth structures and ponds including the mill pad area and various industrial facilities. No major concerns were identified during the inspection of the on-site infrastructure.

The mine site contains numerous ditches and culverts that require regular inspections and maintenance, with repairs as needed. It is recommended the mine site staff regularly inspect site ditches and culverts and make repairs as needed.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

APPENDICES

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Wolverine Mine, owned by Yukon Zinc Corporation is a zinc-silver-copper-lead-gold mine located in southeast Yukon approximately 280 km east of Whitehorse and 170 km northwest of Watson Lake. Road access to the mine is off the Robert Campbell highway. The location of the mine is shown on Figure 1.1.

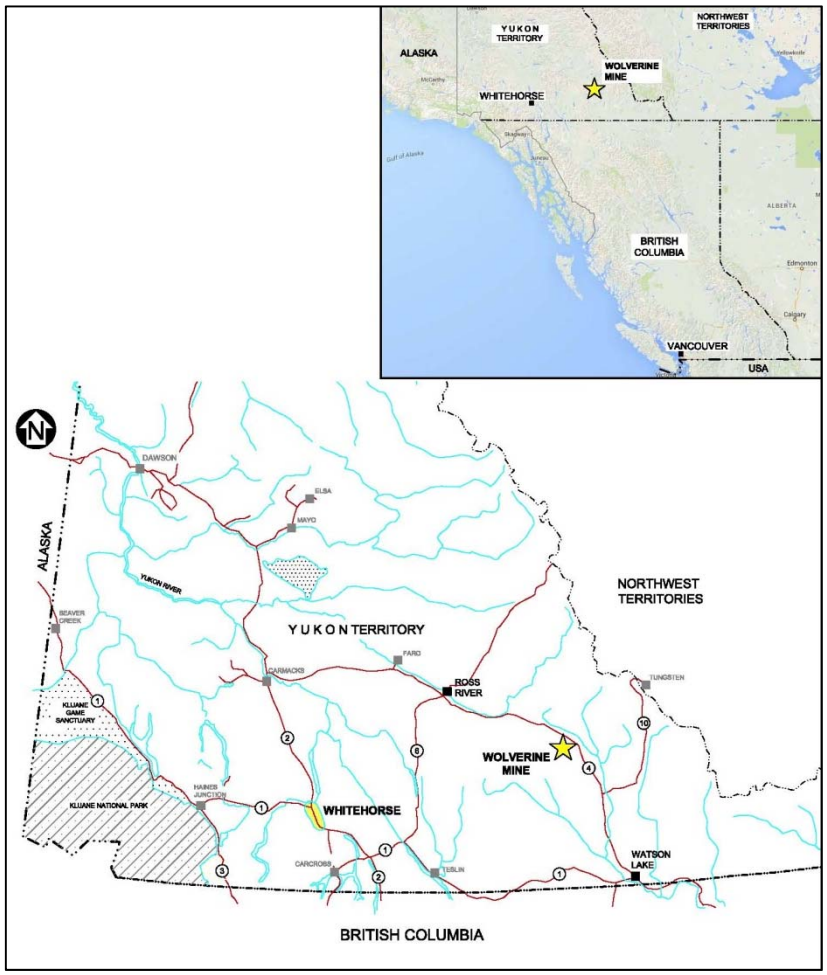


Figure 1.1 Site Location Plan

The mine commenced operations in 2009 and operated at a production rate of approximately 1,700 tonnes per day. The mine ceased operations in January 2015 and is currently operating under Care and Maintenance conditions.

Tailings were discharged as slurry into a fully lined Tailings Storage Facility (TSF) located south of the mill facility. The TSF embankment was designed and constructed as a homogeneous earthfill dam. The dam was constructed in two stages; a 19 m high starter dam constructed in 2009, with a seven meter downstream raise constructed in 2012. The ultimate height of the dam is currently 26 m

with a crest elevation of 1,313.25 m. The design of the TSF was completed by Klohn Crippen Berger Ltd. (KCB), the current Engineer of Record (EoR) for this facility.

The TSF has been accumulating water since the mine ceased operations and there is currently a full water cover on top of the tailings. The estimated volume of tailings stored in the TSF is approximately 566,000 m^3, with the estimated supernatant pond volume being approximately 452,000 m^3 (KCB 2015a). There is currently no discharge of water from the TSF.

The lined northern upstream slope of the TSF has progressively slumped over the past few years as reported in detail in the 2015 Dam Safety Inspection (DSI) completed by KCB. The slump area is approximately 75 m wide (KCB 2015b). A short term remediation plan was developed by KCB subsequent to the 2015 DSI. Observed liner damage appears to be limited to the upper section of the slope, well above the current pond elevation and above the elevation of the spillway invert.

1.2 SCOPE OF REPORT

Yukon Zinc Corporation requested Knight Piésold (KP) complete the 2016 DSI of the TSF and the inspection of the on-site earth structures. A DSI is typically completed by the EoR; however Yukon Zinc was interested in obtaining an independent inspection of the TSF for 2016. The site inspection was completed by Les Galbraith, P.Eng. of KP, who visited the site from August 29 to September 1, 2016. This report presents the results of the TSF DSI and the inspection of the on-site earth structures. Photographs from the 2016 inspection are included in Appendix C. Any recommendations presented in this report should be discussed with KCB, the EoR for the Wolverine Mine TSF.

2 – TAILINGS STORAGE FACILITY

2.1 GENERAL

The TSF embankment was designed and constructed as a homogeneous earthfill dam using the downstream construction method. The embankment is located at the south and west sides of the TSF. The embankment is at its highest at the south end where it is approximately 26 m high. The north and east sides of the TSF were cut into existing slopes. The impoundment is fully lined with linear low density polyethylene (LLDPE) geomembrane; the Stage 1 construction used 40-mil LLDPE and the Stage 2 embankment raise used 60-mil LLDPE (KCB 2009). LLDPE liners are susceptible to degradation from Ultra Violet exposure. It is recommended Yukon Zinc engage the EoR develop a plan to cover the LLDPE to ensure the integrity of the liner in the event of a prolonged Care and Maintenance period. The LLDPE liner is anchored into trenches located along the crest of the TSF.

The reclaim barge is located at the south end of the TSF. There are currently no tailings beaches as water covers the entire basin. Installed instrumentation includes inclinometers, vibrating wire piezometers, and survey monuments. The TSF has an emergency spillway located in natural ground at the northwest end of the TSF. A plan and section of the TSF are included in Appendix A.

A liner underdrain was installed during the Stage 1 construction to prevent uplift pressures on the liner in the TFS basin. The liner underdrain was extended during the Stage 2 construction program with the upstream end being located at the north end of the TSF adjacent to the assess road. The liner underdrain was considered to be redundant once tailings and/or water were discharged into the basin to offset potential uplift forces.

A seepage recovery pond is located at the south end of the TSF. The seepage recovery pond is adjacent to the mine access road which provides containment along the west side.

2.2 DAM CLASSIFICATION

The dam classification was previously evaluated using the Canadian Dam Association Guidelines (CDA 2007). The dam classification is determined by evaluating the potential incremental losses (loss of life, environmental and cultural values, and infrastructure and economics) as shown in Table 2.1.

Table 2.1 Dam Classification

Dam Class	Population at risk [2]	Incremental losses		
		Loss of life [3]	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 important 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 critical 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 critical 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)

The dam classification is selected based on the “most severe” incremental loss for the different categories following a hypothetical dam breach. A dam breach analyses was completed for the Wolverine TSF to aid in the selection of the appropriate dam classification. The dam classification for the Wolverine TSF was selected as Very High (KCB 2015a). It is recommended the Dam Classification be reviewed in the next Dam Safety Review.

2.3 MINIMUM DESIGN EARTHQUAKE AND FLOOD

The Canadian Dam Association (CDA) issued a technical bulletin in 2014 titled Application of Dam Safety Guidelines to Mining Dams. The suggested Annual Exceedance Probabilities (AEPs) for the flood and earthquake design were presented for dams considered to be in the operations and Closure Phases. The AEPs for dams in the Operations Phase are similar to values previously referenced by the CDA for all dams. The Passive Closure Phase was added as it was recognized mining dams, especially tailings dams, have a significantly longer life than water dams and therefore higher AEPs would be more appropriate for the structures in the long term. The Wolverine TSF is currently considered to be in the Operational Phase. The suggested AEPs for the Wolverine TSF with a Very High dam classification are shown on Table 2.2.

Table 2.2 Suggested Design Flood and Earthquake Levels

Dam Class	Annual Exceedance Probability	
	Floods	Earthquakes
Low	1/100	1/100
Significant	Between 1/100 and 1/1,000	Between 1/100 and 1/1,000
High	1/3 between 1/1,000 and PMF	1/2,475
Very high	2/3 between 1/1,000 and PMF	1/2 between 1/2,475 and 1/10,000 or MCE
Extreme	PMF	1/10,000 or MCE

NOTES:

1. Acronyms: PMF, probable maximum flood; AEP, annual exceedance probability; MCE, maximum credible earthquake.

The Design Earthquake and Design Flood events for the TSF are as follows:

- Design Flood 2/3 between 1/1,000 and PMF
- Design Earthquake 1/2 between 1/2,475 and 1/10,000 or MCE

The TSF has been designed to safely route the 1:10,000 year return event through the current spillway. The TSF has the capacity to store the 1:200 year return event during operations without discharge of water (KCB 2015a). The design earthquake for the TSF is the 1:10,000 year return event. The Peak Ground Acceleration (PGA) for this event is 0.22g (KCB 2015a). The design flood and earthquake return period events both exceed the CDA recommended minimum AEP's for a dam with a Very High classification.

3 – 2016 INSPECTION

3.1 GENERAL

The site inspection was completed by Les Galbraith, P.Eng. of KP on August 30 and 31, 2016. The weather at the time of the inspection consisted of overcast skies. Support was provided during the inspection by Kevin Unrau, Site Supervisor.

3.2 2016 SITE ACTIVITIES

There have been no construction activities at the TSF in 2016. Site activities have been limited to instrumentation monitoring and routine maintenance.

3.3 TAILINGS STORAGE FACILITY

3.3.1 Tailings Embankment

No signs of deformation were identified on the TSF embankment. The embankment slopes were approximately planar and there was no evidence of cracking, bulging or slumping in the embankment fill materials (with the exception of the upstream slope at the north end of the TSF which is discussed below). Vegetation (grass) is starting to grow on the downstream slopes. Small erosion channels were observed on the downstream slope of the embankments although they are considered to be minor at this time.

The embankment crest appeared to be relatively level although ponding from precipitation was observed in low spots or ruts at a few locations. Grading of the embankment crest would alleviate ponding. There was no evidence of animal burrowing.

The north end of the TSF has slumped as reported in previous DSIs. The slump has resulted in a loss of the liner anchor trench and a lowering of the crest by approximately 1.5 m (KCB 2015a). A short-term remediation plan was presented by KCB in August 2015 (KCB 2015b) which included covering the crest in this area with LLDPE liner material to prevent surface water from entering the tension cracks. The covering liner was in place during the 2016 inspection.

3.3.2 Supernatant Pond

The TSF supernatant pond covers the entire TSF basin. The pond elevation is at approximately 1308 m. The pond is deepest at the south end where it is approximately 18 m deep according to the bathymetric survey completed in 2016.

3.3.3 Stage 2 Dam Emergency Spillway

The spillway channel is located on the northwest side of the TSF and was constructed in natural ground. The spillway channel is lined with riprap. No water has been discharged through the spillway. The spillway appeared to be in good condition.

3.3.4 Freeboard

The TSF design provides storage for the 200 year wet month plus snowmelt. The design also includes a freeboard allowance of 1.5 m on top of the peak water elevation resulting from routing the

1:10,000 year event through the spillway. It is recommended a maximum operating level be established for the supernatant pond to ensure there is sufficient freeboard to comply with the design storage objectives.

3.3.5 LLDPE Geomembrane Liner

The TSF is fully lined with a LLDPE liner. The TSF inspection included walking around the crest and visually inspecting the liner for obvious defects. No liner defects were observed during the inspection outside of the slumped area. Diagonal lines/bulges are evident along the east side of the TSF which may indicate differential stress on the liner resulting from creeping subgrade materials.

The liner at the north end of the TSF where the slump is occurring (discussions with mine staff indicate the slope has continued to progress based on a 2016 survey of this area) was inspected to the water line using a safety rope and harness. Although the bedding material beneath the liner has slumped in this area, the liner appears to be in good condition, with the exception of a few defects near the top of the slope which have been previously reported. The welds appeared to be intact. There was loose debris on the liner in this area which should be removed as discussed with Kevin Unrau. The slumped area is shown on Figure 3.1.

Figure 3.1 Slump at North End of TSF

The slump is likely attributed to groundwater flow eroding the subsurface materials. The 2015 DSI reported a number of seeps were observed along the impoundment slope during construction (this was a cut slope) indicating this is an area of groundwater flow/discharge. Ditch A, which routes runoff around the north side of the TSF, was lined with a LLDPE geomembrane to reduce groundwater infiltration; however, the upstream Stilling Basin which drains into Ditch A is unlined and is likely a source of groundwater inflow towards the TSF. It is recommended Yukon Zinc engage KCB to evaluate the groundwater flow in this area and develop a plan to mitigate the on-going erosion of the slope.

3.3.6 Liner Underdrains

The liner underdrain system was installed to manage seepage during the construction program, specifically to reduce the potential uplift forces on the liner system prior to there being water and/or tailings stored in the impoundment. The upstream inlet to the liner undrains is located adjacent to the crest at the north end of the TSF near the slump area. The outlet is located downstream of the seepage collection pond berm. There was no surface water flowing into the underdrain inlet. The outlet flows are discharged into a riprap lined channel/basin prior to discharge to the environment. A V-notch weir has been added to the discharge location since the 2015 DSI. It is recommended the discharge flows be measured at regular intervals and reported to the EoR to monitor fluctuations and/or increases in the groundwater flows.

3.4 SEEPAGE COLLECTION POND

The Seepage Collection Pond is located at the south end of the TSF. It was constructed to provide a contingency measure to collect potential seepage from the TSF. The pond also collects runoff from the TSF embankment slope and direct precipitation on the Seepage Collection Pond. The Seepage Collection Pond is contained on the west side by the site access road which appeared to be in good condition. Surface drainage from the pond is via two culverts installed on the west side of the pond. The pond level was below the culvert inverts at the time of the inspection.

3.5 DIVERSION DITCHES A AND B

Surface water is routed around the TSF via Diversion Ditches A and B. Diversion Ditch A routes water from the north end of the TSF to the west side of the TSF. Diversion Ditch B collects surface runoff from the east side of the TSF and discharges to the south of the TSF.

The north end of Diversion Ditch A is located at the southern end of the Stilling Basin located between the Waste Rock Pad and the TSF. Ditch A is mostly lined with HDPE, with the exception of the ditch near the culvert at the northwest end of the TSF. The ditch has minor sediment buildup in places but this is not impeding the ditch flow.

The northern inlet to Ditch A is at the south end of the stilling basin. Although the ditch is lined, the stilling basin is not. There is the potential for water from the stilling basin to flow under the lined ditch towards the TSF (in the direction of the slump). This may be a contributing factor to the deterioration of the fill material at the TSF slump area. Consideration should be given to reducing potential seepage flow in this area.

Ditch B is located on the eastern side of the TSF. Ditch B is an unlined ditch. The ditch was dry at the time of the inspection and no potential blockages were observed in the ditch.

3.6 TSF INSTRUMENTATION AND MONITORING

3.6.1 Piezometers

There are currently five working piezometers installed at the south embankment. Three of the piezometers were installed in the embankment fill material (approximately 2 m above the foundation elevation) and two piezometers were installed in the embankment foundation material (approximately 2 m below the foundation elevation). Piezometer PZ-10-1 is no longer functioning. It is recommended Yukon Zinc engage the EoR evaluate the need to replace lost instrumentation. The time plots for the piezometers are included in Appendix B.

The foundation piezometers (PZ10-03F and PZ10-04F) are showing regular seasonal trends with rising pore pressures being measured during the spring and summer followed by a lowering of the pore pressures in the winter months. The pore pressures measured in the foundation piezometers are below the trigger levels.

The piezometers installed in the embankment fill materials (PZ-10-02D, PZ-10-03D, and PZ-10-04D) are also showing seasonal trends although the seasonal fluctuations in PZ-10-2D and PZ-10-03D are less pronounced as compared to PZ-10-04D. The pore pressures measured in the embankment fill materials are below the trigger levels.

3.6.2 Inclinometers

There are currently two inclinometers installed at the south end of the TSF. The inclinometers were installed downstream of the Stage 1 dam during the Stage 1 construction program. The location of the inclinometers was within the Stage 2 dam footprint resulting in the need to extend the casing through the Stage 2 embankment fill material. Access to the inclinometers is approximately midway up the downstream embankment slope. Both inclinometers have been damaged, are no longer functioning and are likely not repairable. It is recommended Yukon Zinc discuss the requirement for maintaining functioning inclinometers with KCB and develop a replacement plan if required, or alternative method for measuring potential slope deformations.

3.6.3 Survey Monuments

There are five survey monuments installed along the embankment crest. The survey monuments were measured monthly until January 2015 but have not been measured since. It is recommended the measurement of the survey monuments be re-started and a regular schedule be developed especially in lieu of the damaged inclinometers.

3.7 DAM SAFETY REVIEW

A dam with a Very High classification requires a formal Dam Safety Review (DSR) every five years as per the Canadian Dam Association guidelines. It is not known if a DSR has been completed for the Wolverine TSF. It is recommended the Yukon Zinc schedule a DSR to comply with the Canadian Dam Association guidelines.

3.8 OTHER INFRASTRUCTURE

The tailings discharge and reclaim pipeline are located on the west side of the TSF. The pipelines are located on the crest adjacent to the liner. The pipelines are not being operated and do not present a stability concern for the TSF.

The reclaim barge is located at the south end of the TSF. The barge is accessed via a floating walkway sitting on pontoons. A conveyor belt has been placed under the pontoons which are located on the upstream slope to protect the liner. The liner was visually inspected from the crest and there did not appear to be any visible damage to the liner where it is in contact with the pontoons.

3.9 WASTE ROCK PAD

The waste rock pad is located approximately 100 m north of the TSF. A small pond is located at the south end of the waste rock pad. Water from the pond is routed to the TSF directly through a 4-inch pipe or through the passive treatment area.

The 2015 inspection report indicated this material was being removed with plans for complete removal. The mine is now operating under Care and Maintenance and the mine should update the plan and schedule for removal of this material.

3.10 OPERATIONS, MAINTANCE AND SURVEILLANVE MANUAL AND EMERGENCY PREPARDNESS PLAN

The Operations, Maintance and Surveillanve (OMS) Manual was last updated on July 2010. The OMS and Emergency Prepardness Plan (EPP) were not reviewed as part of the inspection. It is recommended Wolverine Mine review these documents and update as required.

4 – ON-SITE EARTH STRUCTURES

Visual observations were made of the on-site earth structures and ponds including the mill pad area and various industrial facilities (fuel tank area, water treatment sumps, cut and fill slopes, collection ditches, camp area, waste rock and ore storage areas, and the land treatment facility). The visual inspections were compared with the photographs included in the 2015 DSI report to evaluate whether there were obvious changes since the previous inspection. The results of the inspection are as follows:

- Mill building – The slope downstream of the mill building appeared to be in good condition. The erosion channel identified during the 2015 inspection has been repaired.
- The sinkhole at the manhole at the MSE – The sinkhole identified during the 2015 inspection has been repaired.
- Site Ponds – The site ponds consist of Sump 2, Sump 5, the Sewage Effluent Pond, and the Ore Stockpile Area Runoff Collection Sump. All of these ponds are lined with a geomembrane. The ponds liners appeared to be in good condition with no obvious defects observed.
- Ditch 1 – Ditch 1 is located on the eastern side of the Mill Building. Ditch 1 is unlined. A tension crack approximately 20 m long was observed on the crest of the downstream berm for Ditch 1. This was documented in the 2015 DSI report. The tension crack still exists, although there was no other sign of distress observed for this slope.
- Ditches 3 and 4 are located on the western side of the Mill Pad. Ditches 3 and 4 are lined with a geomembrane. There are areas of sediment deposition within these ditches which will require periodic maintenance to keep clean. The liner is not properly anchored in areas, as mentioned in the 2015 DSI report. It is recommended the mine develop a regular inspection schedule for the site ditches and maintain or repair as required.
- Camp Pad – Erosion gullies from the Camp Pad have previously been observed and repaired.
- MSE Wall – The MSE wall was inspected and no signs of deformation or bulging were observed. Small tension cracks were observed on the downstream side of the road above the MSE wall which will require monitoring.
- Waste Rock and Ore Storage Facility – The Waste Rock and Ore Storage Facility is located south of the Camp Pad. The crest of the Waste Rock and Ore Storage Facility was inspected and no signs of instability (tension cracking, slumping, etc.) were observed.
- The slopes behind the Vent Raise and Underground Mine Office, the Propane Tank Pad, and the Truck Shop were inspected from the base of the slope. No signs of slope instability were observed and the slopes appeared to be similar to the 2015 DSI photographic record.
- Site Culverts – There are numerous culverts at the mine site, most of which are in need of maintenance or repair. It is recommended the mine develop a regular inspection schedule for the culverts and maintain or repair as required.

The presence of large erosions gullies on some slopes can be an indication that upstream surface runoff is not being managed properly. A number of the previously reported erosion gullies have been repaired, however, ongoing monitoring of the repaired erosion gullies is recommended as this is likely the preferred pathway for storm water runoff which may result in ongoing erosion in some areas.

5 – TSF WATER BALANCE

A water balance spreadsheet was included in the 2015 DSI Report. The water balance has apparently not been updated. The mine site is currently storing the majority of the site runoff in the TSF. The total stored volume is a function of the site runoff and the water which is treated and discharged to the environment. It is recommended the water balance be updated and calibrated with measured pond volumes on a regular basis, with regular updates to the EoR. The water balance update should include a stochastic analysis to evaluate the potential impacts climate variability may have on the storage requirements (and predicted water quality) for the mine site.

6 – SUMMARY AND RECOMMENDATIONS

6.1 GENERAL

The Wolverine Mine, owned by Yukon Zinc Corporation is a zinc-silver-copper-lead-gold mine located in southeast Yukon approximately 280 km east of Whitehorse and 170 km northwest of Watson Lake. The mine commenced operations in 2009 and operated at a production rate of approximately 1,700 tonnes per day. The mine ceased operations in January 2015 and is currently operating under Care and Maintenance conditions. Tailings were discharged as slurry into a fully lined Tailings Storage Facility (TSF) located south of the mill facility. The design of the TSF was completed by Klohn Crippen Berger Ltd. (KCB), the current Engineer of Record (EoR) for this facility.

Yukon Zinc Corporation requested Knight Piésold (KP) complete the 2016 DSI of the TSF and the inspection of the on-site earth structures as a third party reviewer. The site inspection was completed by Les Galbraith, P.Eng. of KP. The results of the 2016 site inspection are as follows:

6.2 TAILINGS STORAGE FACILITY

- The TSF has a Very High dam classification.
- The design flood and earthquake return period events for the TSF both exceed the CDA recommended minimum values for a dam with a Very High classification.
- There were no construction activities in 2016.
- No signs of deformation were identified on the TSF embankment. The embankment slopes were approximately planar and there was no evidence of cracking, bulging or slumping in the embankment fill materials (with the exception of the slump area at the north end of the TSF.
- The section of the upstream slope at the north end of the TSF has slumped as reported in previous DSIs. The slump has resulted in a loss of the liner anchor trench and a lowering of the crest by approximately 1.5 m in this area. The progression of the slump is being monitored by site staff. Defects to the liner in this area are above the water level and the spillway invert. All loose debris on the liner surface should be removed.
- The crest at the slumped area was covered with HDPE liner in 2015 to reduce runoff inflows to the tension cracks.
- The slump is likely attributed to groundwater flow which has eroded the subsurface materials. It is recommended Yukon Zinc engage the EoR to evaluate the groundwater flow in this area and develop a plan to monitor and mitigate the on-going erosion of the slope.
- Groundwater flows in this area are likely reporting to the liner underdrain. It is recommended these flows be measured and reported to the EoR on a regular basis.
- A possible contributor to groundwater flows is the Stilling Basin, which is an unlined basin upstream of the slumped area. It is recommended this be evaluated by KCB.
- There are five working piezometers at the south TSF dam. There are no concerns with the piezometric readings. Piezometer PZ-10-1 is no longer functioning. It is recommended Yukon Zinc engage the EoR evaluate the need to replace lost instrumentation.
- There are two inclinometers installed at the south TSF dam. None are currently working. It is recommended Yukon Zinc engage KCB to assess the ongoing inclinometer monitoring requirements.

- There are five survey monuments located at the TSF south dam. These have not been read since January 2015. It is recommended these be monitored and reported to the EoR on a regular basis, especially in-lieu of the inclinometers not working.
- The OMS and EPP have not been updated since July 2010. It is recommended Wolverine Mine review these documents and update as required.
- The water balance has not been updated recently. It is recommended the water balance be updated and calibrated with measured pond volumes on a regular basis, with regular updates to the EoR. The water balance update should include a stochastic analysis to evaluate the potential impacts climate variability may have on the storage requirements (and predicted water quality) for the mine site.
- A dam with a Very High classification requires a formal Dam Safety Review (DSR) every five years as per the Canadian Dam Association guidelines. It is recommended Yukon Zinc schedule a DSR to be completed as per the schedule outlined in the Canadian Dam Association guidelines.

6.3 ON-SITE INFRASTRUCTURE

Visual observations were made of the on-site earth structures and ponds including the mill pad area and various industrial facilities. No major concerns were identified during the inspection of the on-site infrastructure.

The mine site contains numerous ditches and culverts that require regular inspections and maintenance, with repairs as needed. It is recommended the mine site staff regularly inspect site ditches and culverts and make repairs as needed.

7 – REFERENCES

Canadian Dam Safety Guidelines, 2007

Klohn Crippen Berger, March 2009. *Wolverine Project – Tailings and Infrastructure Design and Construction Plan, Version 2009-02*.

Klohn Crippen Berger, August 11, 2015a. *Wolverine Mine – 2015 Annual Inspection of TSF and On-Site Earth Structures.*

Klohn Crippen Berger, August 26, 2015b. *Wolverine Mine – 2015 Annual Inspection – Short Term remediation for Slump along TSF North Wall*.

8 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared: Dec 2/16

Les Galbraith, P.Eng.
Specialist Engineer | Associate

Reviewed:

Bruno Borntraeger, P.Eng.
Specialist Geotechnical Engineer | Associate

Approval that this document adheres to Knight Piésold Quality Systems: BB

APPENDIX A

KCB SITE DRAWINGS

(Pages A-1 to A-3)

TAILINGS PIPELINE
NEW STILLING BASIN
UNDERDRAIN INTAKE BASIN
WASTE ROCK STORAGE AREA (WRS)
DITCH A (LINED)
DITCH B
SLUMP LOCATION (SEE NOTE 3)
AIR STRIP
TENSION CRACK AND SIGN OF DISTRESS IN NORTH WALL
SOUTHEAST BORROW
NORTHEAST WASTE PILE
TAILINGS BEACH
RECLAIM BARGE
℄ SEEPAGE COLLECTION V-DITCH
DIVERSION DITCH B CULVERT
CULVERT
PUMP HOUSE
SM14-05
SM14-02
SM14-03
PZ10-02
PZ10-03
GO CREEK
STAGE 2 SPILLWAY
STILLING BASIN
WEST DAM
RECLAIM PIPELINE
SOUTH DAM
IN10-01
PZ10-01
PZ10-04
SM14-03
IN10-02
SM14-04
SOUTHEAST WASTE PILE
DIVERSION DITCH A CULVERT
DAM CREST EL ~1313.5m, 6m WIDTH
MINE ACCESS ROAD TO ROBERT CAMPBELL HWY
℄ SEEPAGE COLLECTION V-DITCH
STILLING BASIN
SEEPAGE COLLECTION BASIN
℄ SEEPAGE DAM SPILLWAY
SEEPAGE DAM
UNDERDRAIN OUTLETS
6809500N
6809000 N
6808500N
6808000N
443000 E
441500E
442000E
442500E
0 200 m

LEGEND

- PIEZOMETER
- INCLINOMETER
- SURVEY MONUMENT
- DITCH (LINED)
- DITCH (UNLINED)

NOTES:

1. NOT ALL CULVERTS HAVE BEEN SHOWN.
2. ALL ELEVATIONS IN METRES.
3. LOCATION OF THE SLUMP WAS TAKEN BY HANDHELD GPS UNIT.
4. TSF AS-BUILT PROVIDED BY YZC SEPT. 2012.

CLIENT: Yukon Zinc CORPORATION

Klohn Crippen Berger

PROJECT: WOLVERINE MINE 2015 ANNUAL INSPECTION

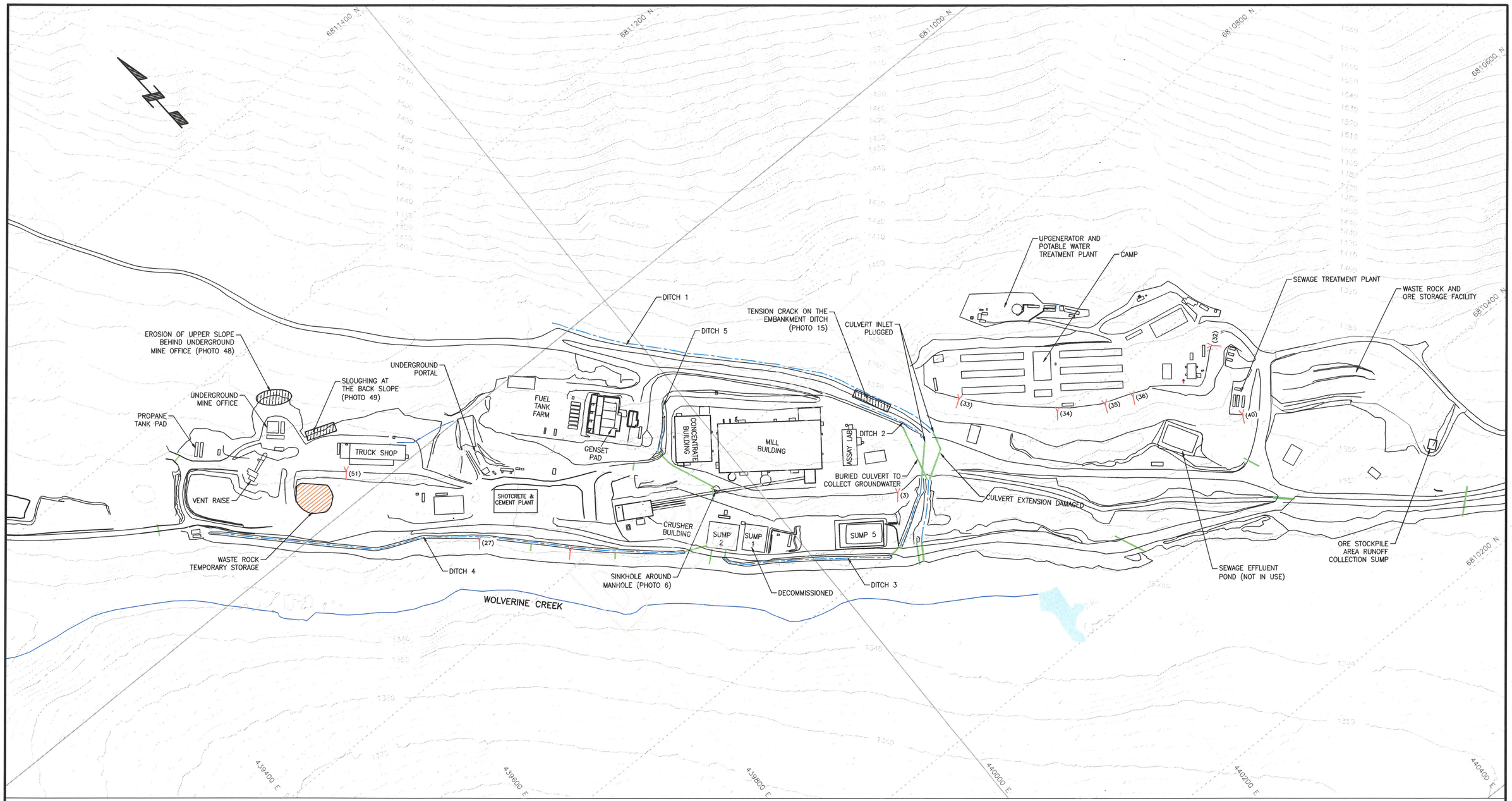
TITLE: SITE PLAN
TAILINGS STORAGE FACILITY (TSF)

SCALE	PROJECT NO.	FIG. NO.
AS SHOWN	M09234A11	1

CANCEL PRINTS BEARING PREVIOUS REVISION

KCB-DWG-TL

Time: 13:30:55
Date: 7/27/2015
Scale: 1:1(PS)
Drawing File: Z:\M\VCR\M09234A11-YZC-Wolverine Annual Inspec\400 Drawings\Fig 1 - Plan.dwg (dhu)



SCALE 0 100 m

LEGEND

- CULVERT
- DITCH ℄
- Y (51) EROSION GULLEY (PHOTO NUMBER)

NOTES:

1. THE SITE PLAN WAS PROVIDED BY YZC.
2. PHOTOS ARE PROVIDED IN APPENDIX II.
3. EROSION LOCATION SHOWN ARE APPROXMATE TAKEN BY HANDHELD GPS UNIT.

CLIENT: Yukon Zinc Corporation

Klohn Crippen Berger

PROJECT: WOLVERINE MINE 2015 ANNUAL INSPECTION

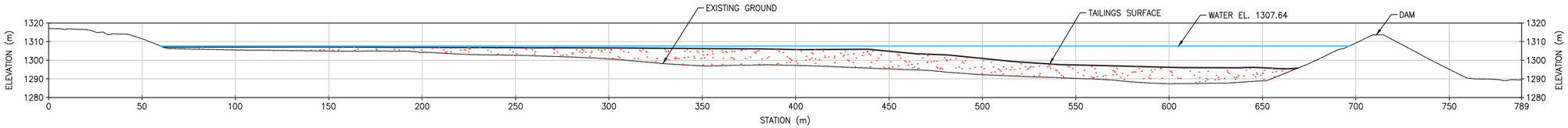
TITLE: SITE PLAN ON-SITE EARTH STRUCTURES

SCALE	PROJECT NO.	FIG. NO.
AS SHOWN	M09234A11	2

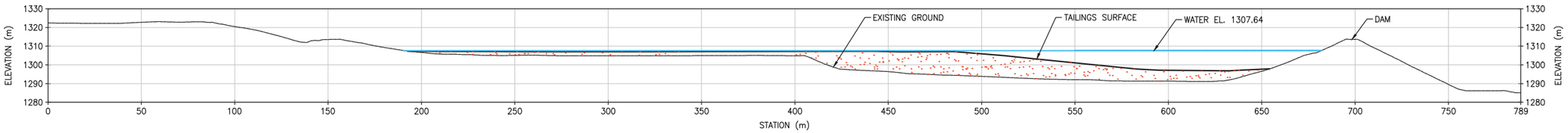
CANCEL PRINTS BEARING PREVIOUS REVISION

KCB-DWG-D-L

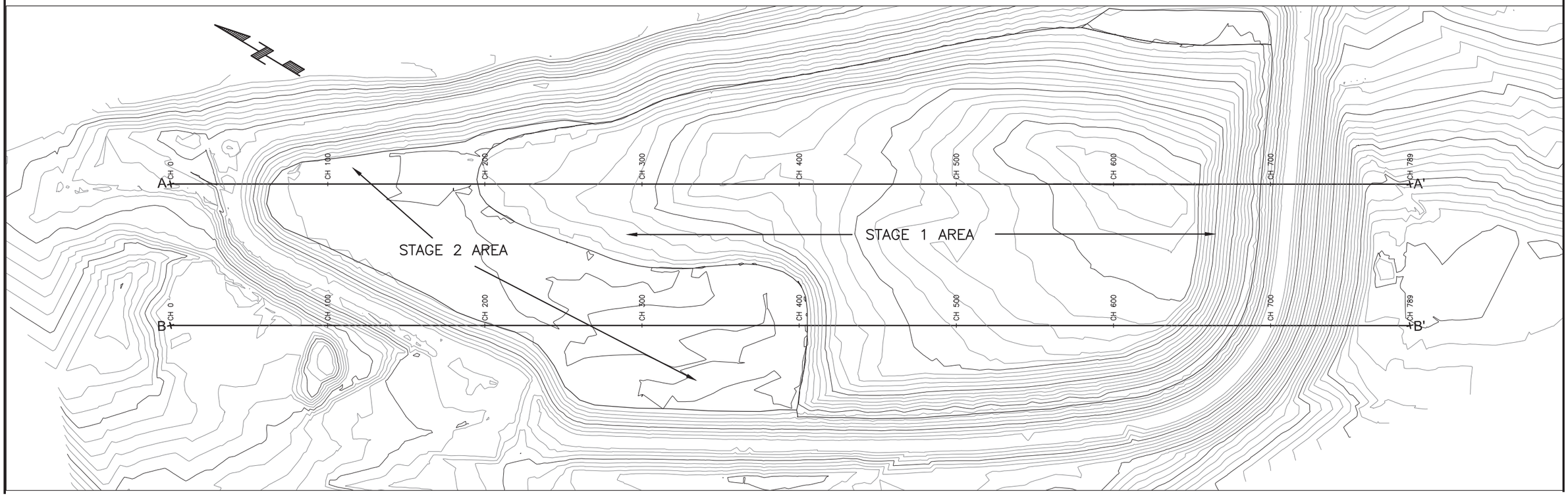
Time: 14:11:44
Date: 7/27/2015
Scale: 1:2(PS)
Drawing File: Z:\M\VCR\M09234A11-YZC-Wolverine Annual Inspec\400 Drawings\Fig 2 - Surface As Built June 2013.dwg (dhu)



SECTION A – A'



SECTION B – B'



LEGEND

SATURATED TAILINGS

NOTE

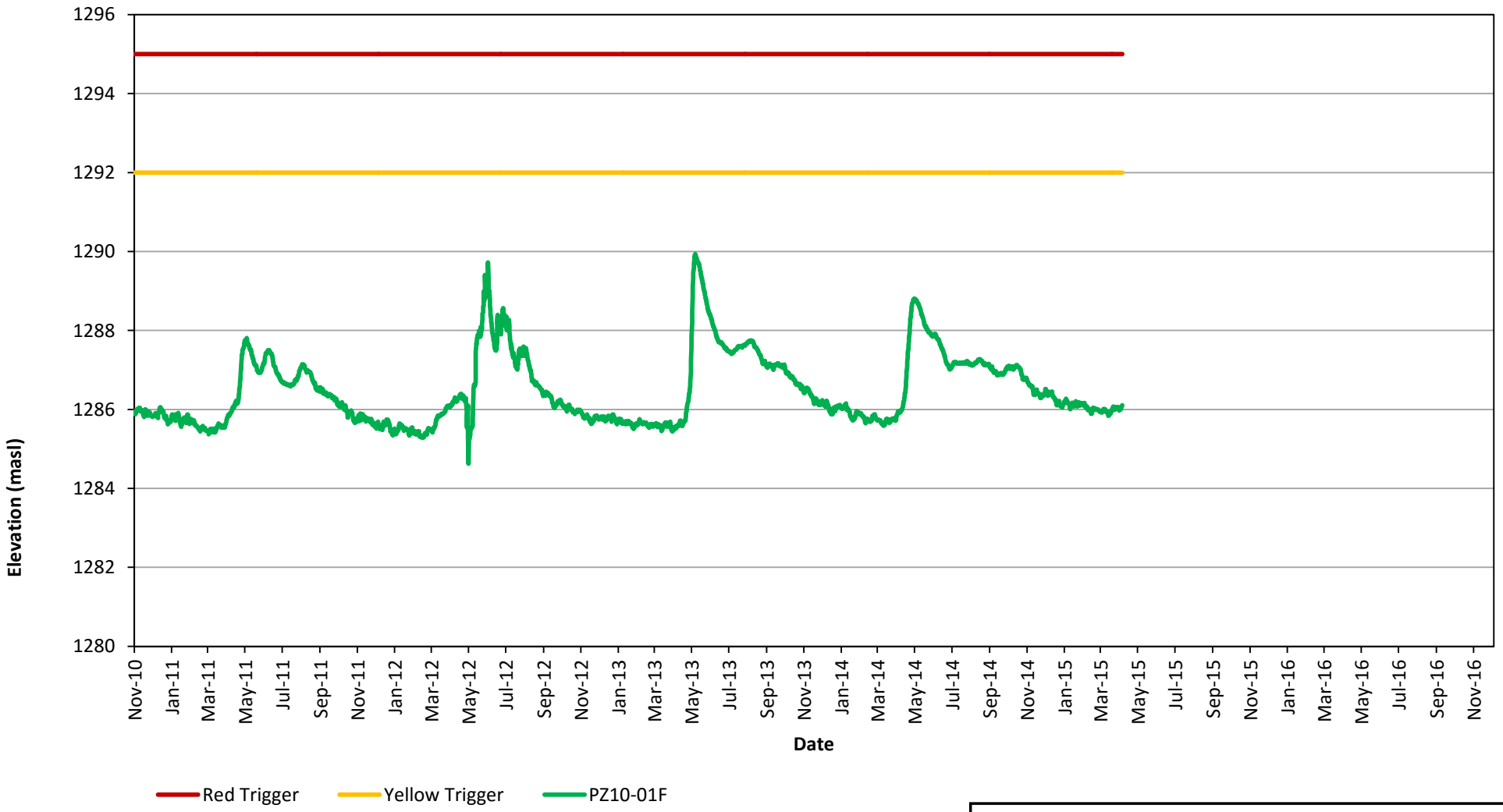
1. BATHYMETRIC SURVEY PROVIDED BY YUKON ZINC CORPORATION, COMPLETED MAY 24, 2015.

Time: 08:26:23
Date: 6/19/2015
Scale: 1:2(PS)
Drawing File: Z:\M\VCR\M09234A10-LRX-Wolverine Closure Options\400 Drawings\Fig 1 – Plan and Profile.dwg (dhu)

APPENDIX B

INSTRUMENTATION

(Pages B-1 to B-4)



Notes: Triggel levels defined by Klohn Crippen Berger

YUKON ZINC CORPORATION

WOLVERINE MINE

TAILINGS STORAGE FACILITY
2016 INSPECTION
VIBRATING WIRE PIEZOMETER PZ-10-01

Knight Piésold CONSULTING

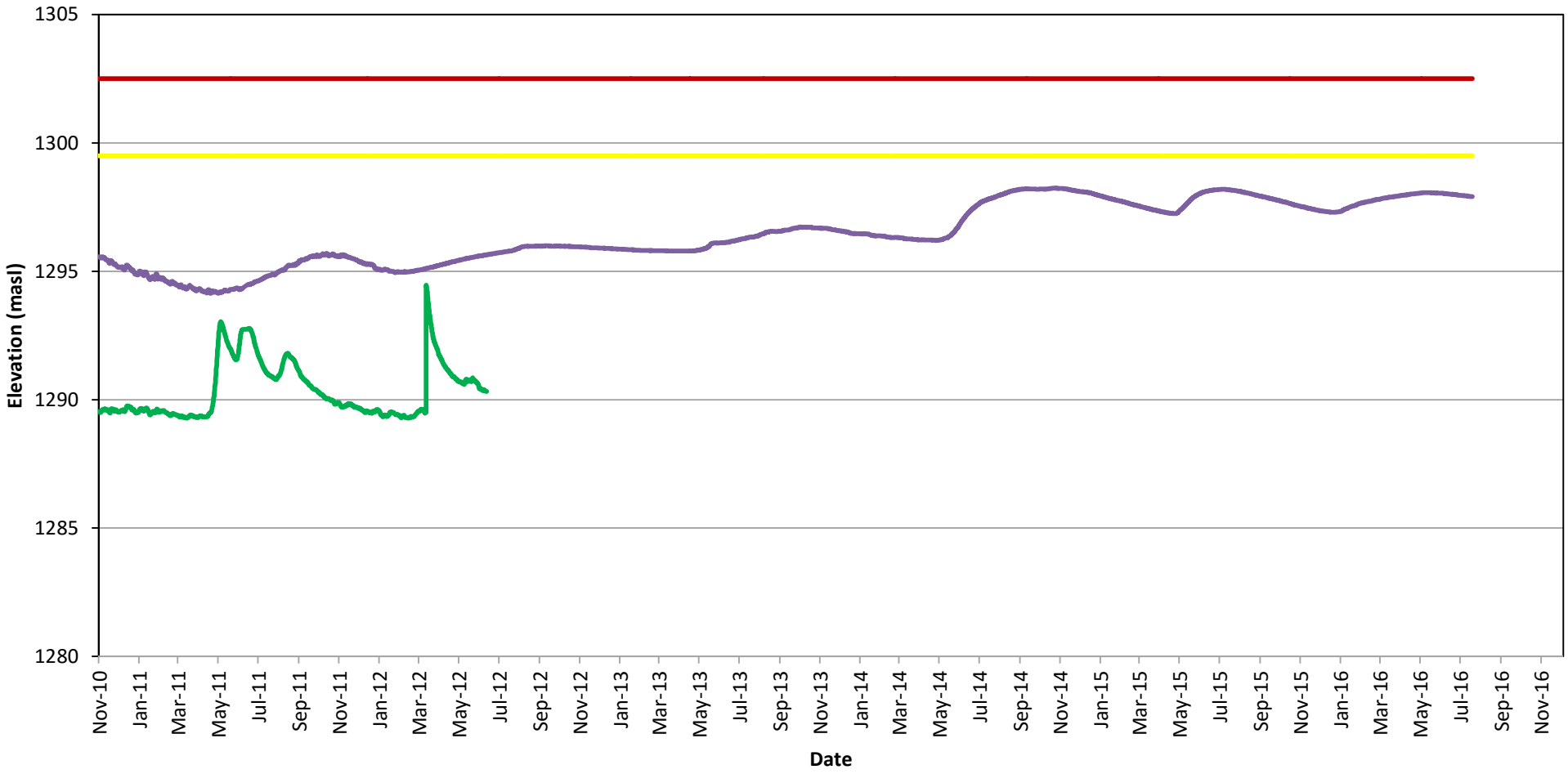
P/A NO. VA101-677-01

REF NO. 1

FIGURE B1

REV 0

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	10NOV'16	ISSUED WITH REPORT	LJG	BB	BB



Notes: Triggel levels defined by Klohn Crippen Berger

0	10NOV'16	ISSUED WITH REPORT	LJG	BB	BB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

YUKON ZINC CORPORATION

WOLVERINE MINE

TAILINGS STORAGE FACILITY
2016 INSPECTION
VIBRATING WIRE PIEZOMETER PZ-10-02

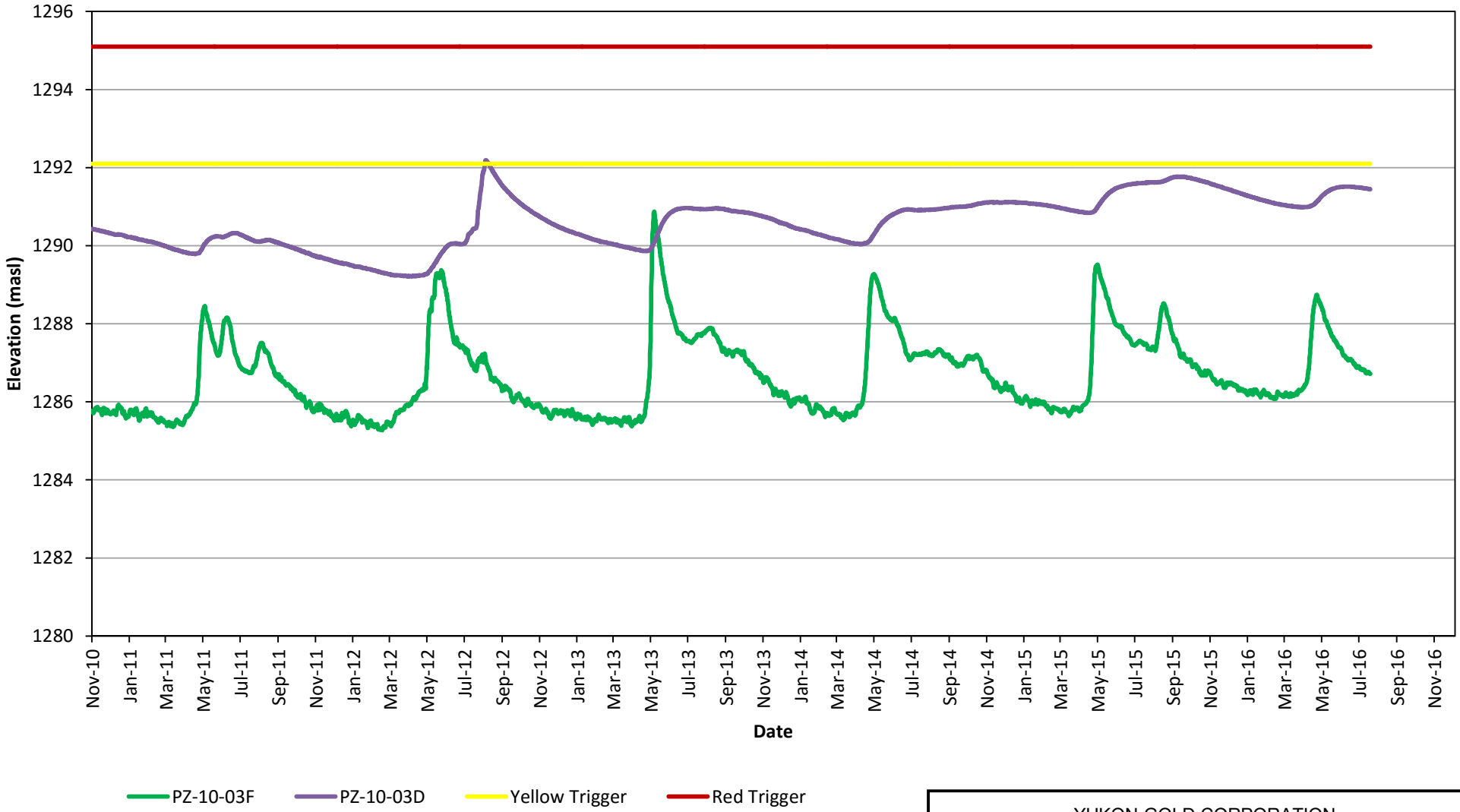
Knight Piésold CONSULTING

P/A NO. VA101-677/1

REF NO. 1

FIGURE B2

REV 0



Notes: Triggel levels defined by Klohn Crippen Berger

0	10NOV'16	ISSUED WITH REPORT	LJG	BB	BB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

YUKON GOLD CORPORATION

WOLVERINE MINE

TAILINGS STORAGE FACILITY
2016 ANNUAL INSPECTION
VIBRATING WIRE PIEZOMETER PZ-10-03

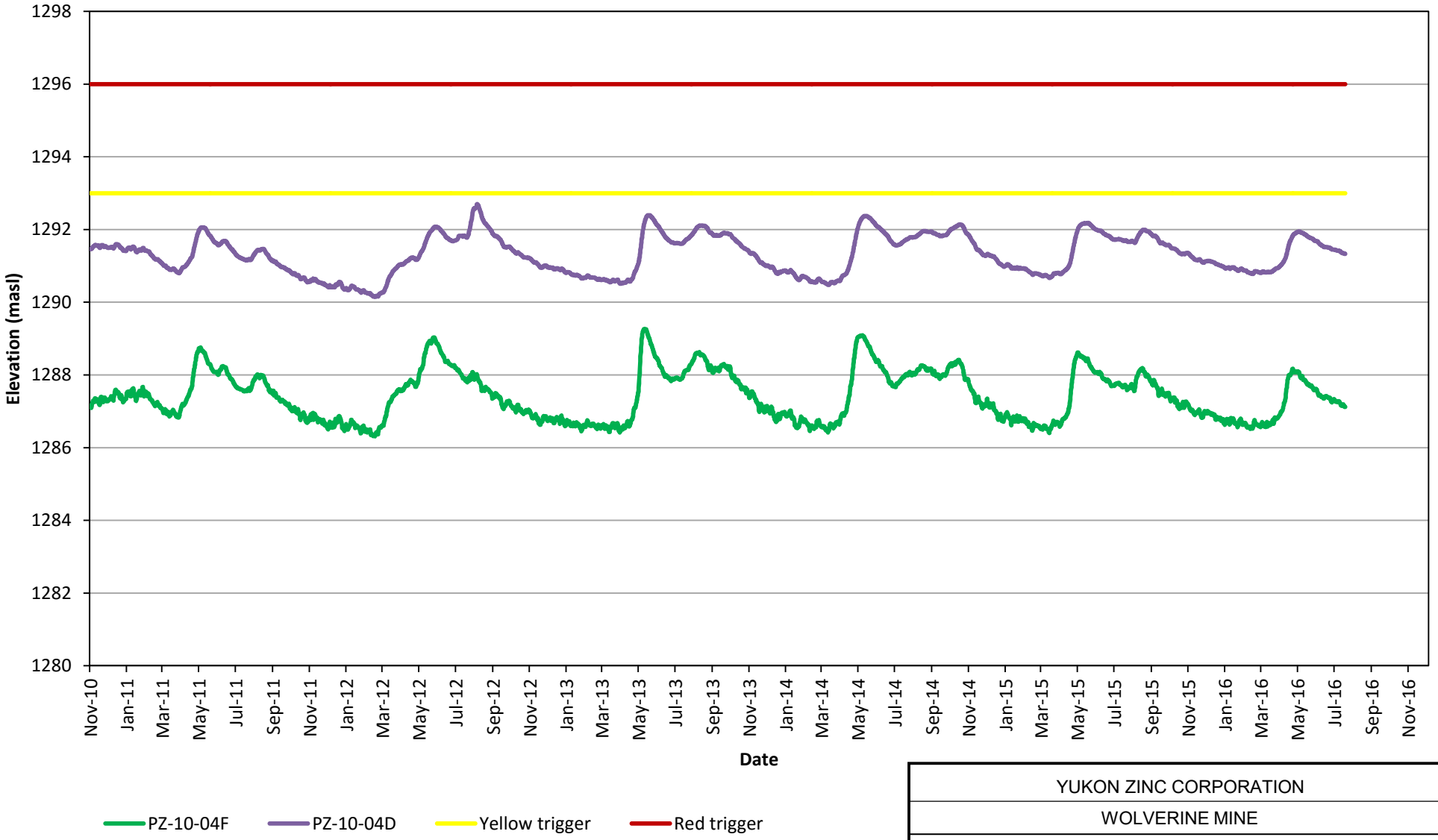
Knight Piésold CONSULTING

P/A NO. VA101-677/1

REF NO. 1

FIGURE B3

REV 0



Notes: Triggel levels defined by Klohn Crippen Berger

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	10NOV'16	ISSUED WITH REPORT	LJG	BB	BB

YUKON ZINC CORPORATION

WOLVERINE MINE

TAILINGS STORAGE FACILITY
2016 INSPECTION
VIBRATING WIRE PIEZOMETER PZ-10-04

Knight Piésold CONSULTING

P/A NO. VA101-677/1

REF NO. 1

FIGURE B4

REV 0

APPENDIX C

PHOTOGRAPHS FROM 2016 SITE INSPECTION

(Pages C-1 to C-29)

PHOTO 1 – TSF South Embankment – Looking west. Piezometer readout box in foreground.

PHOTO 2 – TSF South Embankment – Looking east.

PHOTO 3 – TSF South Embankment – Reclaim barge.

PHOTO 4 – TSF South Embankment – Downstream slope.

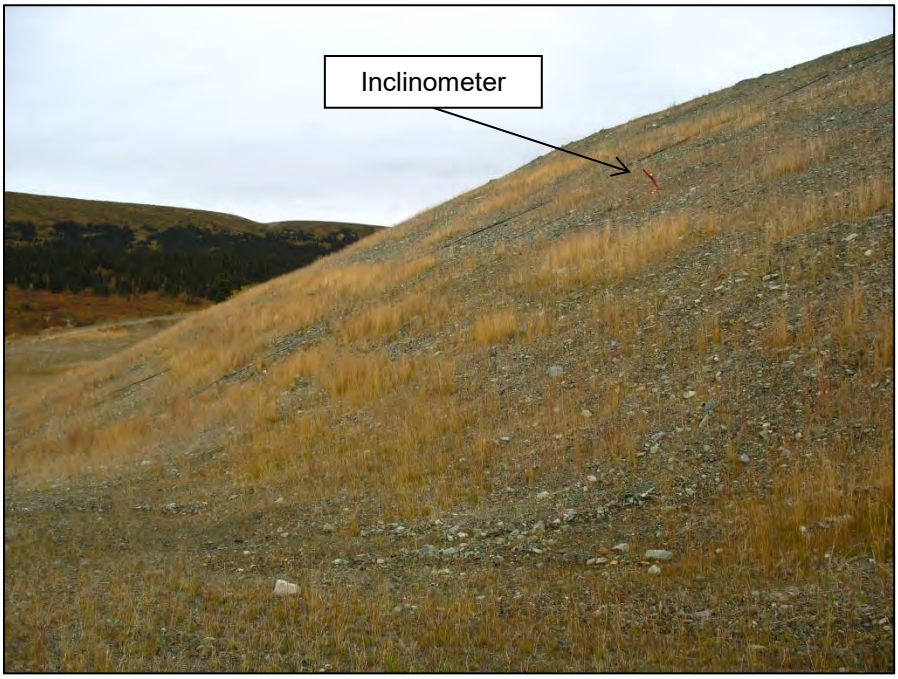


PHOTO 5 – TSF South Embankment – Downstream slope.

PHOTO 6 – TSF South Embankment – Damaged inclinometer – no longer functioning.

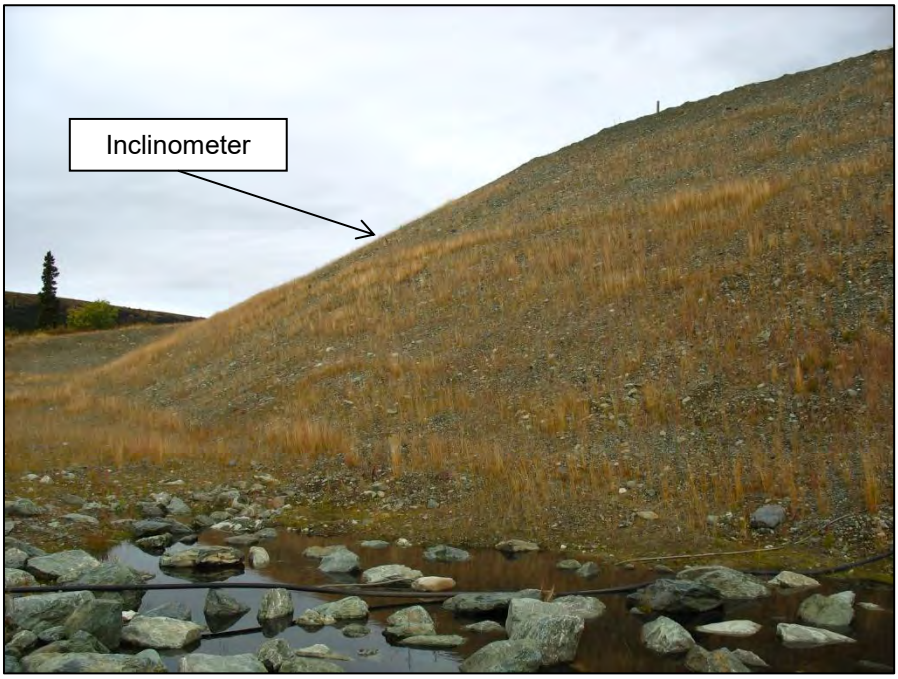


PHOTO 7 – TSF South Embankment – Downstream slope

PHOTO 8 – TSF South Embankment – Pipe stuck in inclinometer – no longer functioning.

PHOTO 9 – TSF South Embankment – Upstream slope.

PHOTO 10 – TSF West Embankment – Ponding on crest

PHOTO 11 – West Side of TSF – Upstream slope.

PHOTO 12 – TSF West Embankment crest looking south. Ponded water at toe.

PHOTO 13 – TSF upstream slope near spillway.

PHOTO 14 – North TSF Upstream Slope – Slump area.

PHOTO 15 – North TSF Upstream Slope – Slump area.

PHOTO 16 – TSF slump area – Liner damage

PHOTO 17 – TSF slump area cover material.

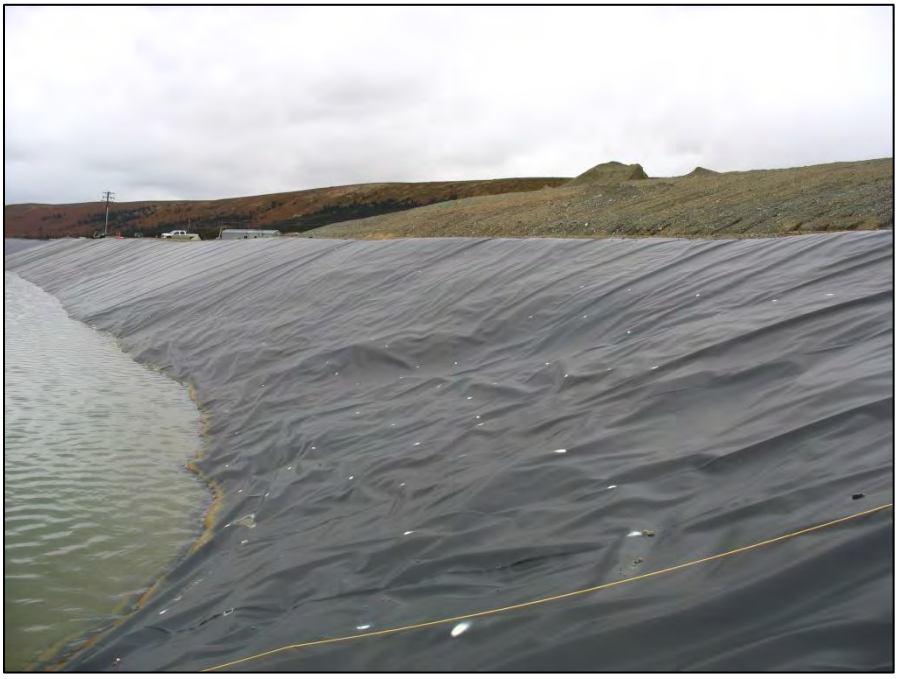


PHOTO 18 – TSF slump area – Deformation of underlying fill material.

PHOTO 19 – West Side of TSF – Looking east

PHOTO 20 – East side of TSF - Looking south.

PHOTO 21 – TSF spillway channel looking downstream.

PHOTO 22 – TSF spillway looking west.

PHOTO 23 – TSF Seepage Collection Pond.

PHOTO 24 – TSF Underdrain Discharge Area at west side of the Seepage Collection Pond.

PHOTO 25 – TSF Seepage Collection Pond looking west towards culverts.

PHOTO 26 – Ditch A at north side of TSF – Looking west.

PHOTO 27 – Ditch A at north side of TSF – Looking north towards Stilling Basin.

PHOTO 28 – Ditch B on east side of TSF - Looking south.

PHOTO 29 – Ditch B on east side of TSF - Looking north.

PHOTO 30 – Stilling Basin and upstream end of Ditch A.

PHOTO 31 – Stilling Basin and upstream end of Ditch A. Stilling Basin unlined.

PHOTO 32 – Passive treatment area north of TSF.

PHOTO 33 – Small collection area downstream of the Waste Rock Storage Area.

PHOTO 34 – Passive treatment area north of TSF.

PHOTO 35 – SE borrow

PHOTO 36 – SE waste pile

PHOTO 37 – NW waste pile

PHOTO 38 – NW waste pile erosion gullies

PHOTO 39 – MSE Wall

PHOTO 40 – MSE Wall

PHOTO 41 – Manhole upstream of MSE Wall

PHOTO 42 – Downstream Slope of the Genset Pad

PHOTO 43 – Sump 1

PHOTO 44 – Sump 2

PHOTO 45 – Sump 5

PHOTO 46 – Ditch 1 – Tension crack in berm fill material.

PHOTO 47 – Ditch 1 – Minor debris in ditch bottom.

PHOTO 48 – Ditch 1 culvert

PHOTO 49 – Drainage from Mill Pad.

PHOTO 50 – Ditch 4

PHOTO 51 – Ditch 5

PHOTO 52 – Camp Pad with repaired erosion gully

PHOTO 53 – Sewage Effluent Pond

PHOTO 54 – Waste Rock and Ore Storage Facility

PHOTO 55 – Waste Rock and Ore Storage Facility runoff collection sump

PHOTO 56 – Slope behind Vent Raise and Underground Office

PHOTO 57 – Slope upstream of MSE Wall – Small tension cracks observed on downstream site of access road.

PHOTO 58 – East slope of lined TSF. Note diagonal lines on the liner which may be an indicator of liner stress.