
2017 ANNUAL RECLAMATION REPORT for Quartz Mining License QML-0004

Name of Property: Sä Dena Hes Mine

Company Name: Sä Dena Hes Operating Company c/o Teck Resources Limited

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EXECUTIVE SUMMARY

The Annual Reclamation Report for 2017 for the Sä Dena Hes (SDH) mine site was prepared by Teck Resources Limited on behalf of Sä Dena Hes Mining Corporation, as required in accordance with Yukon Quartz Mining License QML-0004. This annual report describes the progress of closure and reclamation related activities at the Sä Dena Hes Mine in 2017.

The Sä Dena Hes (SDH) property is the site of a former lead-zinc mine that operated from 1991 to 1992. The property is located 45 km north of Watson Lake in the Yukon Territory and is owned by the Sä Dena Hes Mining Corporation which is a joint venture between Teck Resources Limited (Teck) and Pan-Pacific Metal Mining Corp., a wholly-owned subsidiary of Korea Zinc. Teck is the operator under the joint venture agreement for the site.

Permanent closure and decommissioning activities commenced in 2013 and were completed in 2015. Reclamation activities conducted at the site includes applying a simple cover, using natural glacial till materials, to most mine disturbed areas limiting the release of contaminants to the air, water and land. Surface contouring and vegetation have been completed for protection against water erosion. A revegetation program was implemented once the cover system was finished in 2015.

In 2017, post-reclamation monitoring programs included surface water, groundwater, re-vegetation monitoring, physical/geotechnical inspections, and maintenance of constructed/engineered structures. Water Use Licence QZ16-080 came into effect on January 1, 2017 and expired on March 31, 2017. Water Use Licence QZ16-051 addressing permanent closure came into effect on April 1, 2017. As such, the surface water monitoring was conducted as per Water License QZ16-080 from January – March 2017 and under Water Use License QZ16-051 issued on March 30 2017. In 2017, samples from all of the required water quality monitoring stations met the standards in licences QZ16-080 and QZ16-051 for all water quality parameters. Water quality monitoring was also conducted under the Adaptive Management Plan (AMP) as part of the new Water Licence and there were no specific performance threshold exceedances that required a response.

Revegetation monitoring was conducted and the overall survival rate was high with greater than 85% in 10 of the 14 plots.

Physical work conducted at the site was limited to maintenance of culverts along the main access road and installation of a portable bridge at 13.6km on the main access road.

Physical and environmental monitoring will continue in 2018. Additional work in 2018 includes completing a surface water-groundwater interaction study as required by Water Licence QZ16-051, and assessing a small area at the mill site that was identified to have high metal concentrations which were supposed to be covered during the closure works. Based on the assessment, it will be determined if additional mitigation measures are required (e.g., till cover or risk assessment).

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LIST OF APPENDED REPORTS

1. Sä Dena Hes – 2017 Annual Report Yukon Water Licenses QZ16-080 & QZ16-051 dated March 2018, prepared by SRK Consulting Inc.
2. Revegetation Monitoring at the Reclaimed Sä Dena Hes Mining Site, dated January 2018, prepared by Laberge Environmental Services

1.0 INTRODUCTION

The Sä Dena Hes (SDH) property is the site of a former lead-zinc mine that operated from 1991 to 1992. The property is located 45 km north of Watson Lake in the Yukon Territory and is owned by the Sä Dena Hes Mining Corporation which is a joint venture between Teck Resources Limited (Teck) and Pan-Pacific Metal Mining Corp., a wholly-owned subsidiary of Korea Zinc. Teck is the operator under the joint venture agreement for the site.

Teck submitted notice to begin “Permanent Closure” to the Ministry of Energy, Mines and Natural Gas (EMR) on February 17, 2012. The Detailed Decommissioning and Reclamation Plan (DDRP) (Teck 2012, 2013) was revised to plan for permanent closure. Permanent closure and decommissioning activities were carried out in 2014 and in 2015. A final DDRP was submitted in August 2015 (Teck, 2015) to account for amendments issued in 2014 and 2015. In 2015 Teck amended the Quartz Mining License (QML-0004), which expires on December 31, 2040. The current status of the site is Permanent Closure and Reclamation.

The objectives of the decommissioning and reclamation plan are to ensure the:

- Protection of public health and safety;
- Implementation of environmental protection measures that minimize adverse environment impacts;
- Ensuring land use commensurate with surrounding lands;
- Post closure monitoring of the site to assess effectiveness of closure measures for the long term.

Reclamation activities conducted at the site includes applying a simple cover, using natural glacial till materials, to most mine disturbed areas limiting the release of contaminants to the air, water and land. Surface contouring and vegetation have been completed for protection against water erosion. A revegetation program was implemented once the cover system was finished in 2015.

The Yukon Water Board regulates water management of the mine site. Water Use Licence QZ16-080 came into effect on January 1, 2017 and expired on March 31, 2017. Water Use Licence QZ16-051 addressing permanent closure came into effect on April 1, 2017.

2.0 2017 DECOMMISSIONING AND RECLAMATION ACTIVITIES

The QML and Water Use Licence both require post-reclamation environmental monitoring, physical/geotechnical inspections, and maintenance of constructed/engineered structures to be completed under the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP) and Adaptive Management Plan (AMP). When the new Water Use Licence QZ16-051 was issued, it required an update to the EMSRP and AMP to the Yukon Water Board. The EMSRP (Teck, 2017) and AMP (Alexco, 2017) were updated in 2017 to reflect comments and revisions received during the Water Licence renewal application process and were submitted to Yukon Water Board and EMR on June 29, 2017. During the monitoring in 2017, there were errors in

the AMP threshold values identified by SRK, as such the AMP was revised in February 2018 (Alexco, 2018) and submitted to the Water Board and EMR (Teck, 2018).

The following summarizes the activities with details further discussed within the subsequent sections:

- Surface Water and Groundwater Quality Monitoring
 - Monthly/quarterly water sampling was conducted January to March conducted using helicopter/snowmobiles in the winter months as per Water Licence Use QZ16-080.
 - Bi-monthly/quarterly surface water and groundwater monitoring and sampling was conducted from April to December conducted using helicopter/snowmobiles in the winter months and an all-terrain vehicle in the snow free months as per the 2017 Water Use Licence QZ16-051.
- Aquatic Resources Monitoring
 - The Environmental Effects Monitoring program under QZ16-051 is required to begin in 2018 and must be carried out every two years during the low flow period in August or September.
- Terrestrial Monitoring
 - The 2017 re-vegetation assessment was completed in July to assess the 2015 site planting program.
- Physical/geotechnical inspections
 - Spring and fall routine site inspection of physical/geotechnical features was completed by Teck and the site care taker.
 - The annual 2017 Dam Safety Inspection (DSI) was completed by the engineer of record in July.
 - Survey completed on the North Dam settlement gauges in July.
- Maintenance of constructed/engineered structures or access road
 - Main culvert at 13.6km on the main access road collapsed and was replaced with a portable 100 ton bridge.
 - All large vegetation on the downstream face of the north dam was removed.

3.0 2018 DECOMMISSIONING AND RECLAMATION ACTIVITIES

There are no planned physical activities in 2018 other than monitoring the newly reclaimed areas and completing maintenance of any areas that may be identified following freshet.

The post closure monitoring as outlined in the EMSRP and AMP will be conducted as per the Water Licence issued in April 2017. This includes completing a surface water-groundwater interaction study which is required to be completed by March 2019 as per Water Licence QZ16-051.

In addition, a small area at the mill site was identified to contain high metal concentrations which were supposed to be covered during the closure works. As such, additional assessment will be conducted to determine if additional mitigation measures are required (e.g., till cover or risk assessment). Based on the observation of nearby healthy plant growth, it is suspected that this area is relatively small (1 to 2 ha).

4.0 EFFECTIVENESS OF THE REMEDIATION MEASURES

All the physical remediation and revegetation activities were completed in 2015 as such it is too early to determine the effectiveness of the remediation measures conducted. It is anticipated that the EMSRP will assist in determining the effectiveness of the remediation measures in the next five years.

5.0 MAP SHOWING THE STATUS OF ALL DECOMMISSIONING AND RECLAMATION ACTIVITIES

All the physical remediation and revegetation activities were completed in 2015. In the 2015 Annual Report, several drawings were included within the AMEC 2015 As-built report. Due to the limited physical work and revegetation completed in 2016/2017 there are no updated maps included within this report.

6.0 INSPECTION OF ENGINEERED STRUCTURES

The 2017 geotechnical inspection of the structures and features associated with the Tailings Management Area at SDH was completed by SRK on July 25, 2017. The inspection report *Sä Dena Hes Mine, Yukon Territory 2017 Dam Safety Inspection, dated December 2017* was submitted to EMR on December 20, 2017.

The report presents SRK's observations of the following structures and features, identifies any deficiencies and provides recommendations where appropriate:

- The North Dam;
- The decommissioned North Creek Dyke and Second Crossing;
- The relocated Camp Creek Channel;
- The North Channel and South Channel;
- The Sediment Retaining Structure (SRS);
- The Burnick Portals (1200 and 1300) and Waste Rock Dumps;
- The Jewelbox and Main Zone Waste Rock Dump and Portal areas.

The South and Reclaim Dams including the tailings were decommissioned in 2014. The Camp Creek Diversion and Exit Chute were decommissioned in 2015. The North Creek Dyke and spillway including a second crossing culvert system on North Creek downstream below the dyke were decommissioned in 2015.

The North Dam remains as an earthen embankment that retains the stored tailings. A variable depth till cover was placed over the tailings in 2014 as a growth medium and to control the migration of windblown tailings. No resloping of the downstream dam face was needed.

The SRS is an approximately 5 m high berm that was formed during the decommissioning and removal of the South Dam. The berm was designed to retain sediment in runoff from the till tailings cover and incorporates a riprap lined spillway. The spillway has capacity for the 1 in 1000-year flood event.

The Burnick 1200 and 1300 Portals were capped in 2015 with locally available waste rock and graded with a gently sloped face to provide long term stability. The crests of the associated waste rock dumps were recontoured to provide added stability. No resloping of the downstream face of the dumps was required.

The 2017 Dam Safety Inspection Deficiencies:

- 2017-01 Remove beaver dam at inlet to channel, North Creek Cannel – Removed July 27, 2017
- 2017-02 Pipe Weir at MW-02, reconstruct weir –Reconstructed on July 27, 2017

7.0 RESULTS OF STUDIES AND MONITORING PROGRAMS

7.1. Water Licence Monitoring

The water quality standards and monitoring requirements are managed under Water License QZ16-080 effective from January – March 2017 and Water Licence QZ16-051 Effective Date April 1, 2017 with the expiry date of December 31, 2040.

The licence describes the water quality monitoring program for post closure monitoring, which is the applicable program for the current status of the SDH (Permanent Closure and Reclamation). The water quality program outlines the sampling sites, frequency and required water quality parameters.

As required by License QZ16-080, water quality data was reported monthly from January to March 2017, and under Licence QZ16-051, water quality data is reported quarterly to the Yukon Territory Water Board. The 2017 monitoring results are discussed in the report prepared by SRK Consulting entitled *Să Dena Hes – 2017 Annual Report Yukon Water Licences QZ16-080 and QZ16-051 dated March 2018* (SRK, 2018). The report is included as Attachment 1.

In summary, samples from all of the required water quality monitoring stations met the receiving water quality standards in both licences. Surface and groundwater water quality monitoring conducted under the AMP are also included in the water licence monitoring requirements. The AMP describes a means of interpreting data to indicate if water quality is changing from conditions observed over the past 20 years. The plan also describes when and how changes in water quality require a response. In 2017, there were no AMP specific performance threshold exceedances that required a response. Results are discussed in SRK, 2018.

The Environmental Effects Monitoring under Water Licence QZ16-051 is scheduled to begin in 2018.

7.2. Vegetation Monitoring

In 2015, a total 27,000 plugs were planted of *Salix alaxensis*, *S. bebbiana*, *S. barclayi*, *S. planifolia* and *Populus balsamifera* were installed in several discrete areas throughout the reclaim, south pond, north pond and mill areas. The remaining open areas of these sites were planted with approximately 70,000 alder (*Alnus viridis crispa*) plugs. The alder were planted at a much lower density than the other tree species.

Revegetation monitoring was conducted in 2017 by Laberge Environmental Services. The detailed results of the monitoring are included in the attached report entitled *“Revegetation Monitoring at the Reclaimed Sä Dena Hes Mining Site, 2017”* dated January 2018 (Laberge, 2018). In summary, fourteen permanent tree monitoring plots were established and monitored from July 25th to July 27th. Overall the survival rate was high with greater than 85% in 10 of the 14 plots.

In 2015, grass was hand seeded at an application rate of 44 kg/ha, in various areas throughout the mine site. A low elevation seed mix was used on the reclaimed roads and the lower borrow pit. A high elevation seed mix was used at the Burnick and Jewel Box waste rock zones. Seven grass monitoring plots were established. Overall the grass growth was gradually increasing in all plots since the assessment in 2017.



Photograph 1: Grass growing in seeded area

Soil chemistry data was also completed as part of the revegetation monitoring by Laberge. The soil data indicates that currently the plots have nutrient poor soils which is not unexpected given the material used for capping. High concentrations of some metals were also documented at the Burnick and Mill plots which was previously identified during the closure and reclamation of the site. Based on the ecological and human health risk assessments, mitigation and risk controls were put in place (e.g., cover systems and/or limited site access). However, to ensure that the metal concentrations were consistent with the risk assessment completed, Teck retained Azimuth Consulting Group to review the soil exceedances and assumptions used in the risk assessments. The results are discussed in Laberge, 2018, attached. In summary the metals are consistent with the assumptions used in the risk assessment with the exception of one area at the mill site which has soil concentrations consistent with pre-closure conditions and was intended to be covered with 20 cm of till. As such, additional assessment is required in 2018 to determine if additional

mitigation measures are required (e.g., till cover or risk assessment). Based on the observation of nearby healthy plant growth, it is suspected that this area is relatively small (1 to 2 ha).

8.0 INVASIVE PLANTS

Similar to 2016, the most common invasive species was Hawksbeard (*Leucantbenum vulgara*) and was generally found sporadically along the road sides within the study area. The population in these areas have not expanded since documented in 2016. In 2017 two individual white sweetclover plants (*Melilotus alba*) were identified near the boneyard site. These were immediately removed from site and disposed appropriately.

9.0 SPILLS AND ACCIDENTS

There were no reportable spills or accidents in 2017.

10.0 WILDLIFE INCIDENTS AND OTHER ACCIDENTS

There were no direct wildlife incidents or other accidents reported in 2017 other than notable activity of beavers plugging road culverts along the main access road and North Creek Cannel.

11.0 SITE IMPROVEMENTS TO ADDRESS SEDIMENT AND EROSION

There were no signs of major erosion in any the capped areas in 2017. Some minor erosion has occurred in areas where surface water is collecting and forming into small streams. The capping material contains a component of larger stones that are self-armorng the small steams and reducing the overall erosion. The small streams will be reassessed in 2018 to determine if any remedial action is required.

12.0 CLOSING

I trust this reports meets the requirements under Part 5, Section 11.4 of QML-0004. Please contact Gerry Murdoch at 250-427-8408 gerry.murdoch@teck.com if you have any questions regarding this report.



Gerry Murdoch
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Teck Legacy Properties

13.0 REFERENCES

Alexco. (2017). *Sa Dena Hes Mine - Post-Reclamation Adaptive Management Plan, dated June 28, 2017.*

Alexco. (2018). *Sa Dena Hes Mine - Post-Reclamation Adaptive Management Plan, dated February 12, 2018.*

Laberge. (2018). *Revegetation Monitoring at the Reclaimed Sä Dena Hes Mining Site, 2017.*

SRK. (2018). *Sä Dena Hes – 2017 Annual Report Yukon Water Licences QZ16-080 and QZ16-051 dated March 2018.*

Teck. (2017). *Sa Dena Hes Mine – Environmental Monitoring, Surveillance and Reporting Plan, June 28, 2017.*

Teck. (2018). *Water Licence #QZ16-051 – Sa Dena Hes Mine – Submission of Revised Adaptive Management Plan, dated March 7, 2018.*

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1. Sä Dena Hes – 2017 Annual Report Yukon Water Licenses QZ16-080 & QZ16-051 dated March 2018, prepared by SRK Consulting Inc.
 2. Revegetation Monitoring at the Reclaimed Sä Dena Hes Mining Site, 2017 dated January 2018, prepared by Laberge Environmental Services
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