**Appendix F 2012 TDS Management Plan Progress Report & Updated Management Plan for NPDES Permit AK-003865-2**

# 2012 TDS Management Plan Progress Report & Updated Management Plan for APDES Permit AK-003865-2

February 2013

Teck

Pursuant to Part I.A.7.f of APDES Permit AK-003865-2, Teck Alaska Incorporated (Teck) submitted a TDS Management Plan to EPA and ADEC prior to July 29, 2010. The permit requires Teck to include, by March 1st of each year, a TDS Management Plan progress report as part of the Red Dog Mine APDES Annual Water Monitoring Summary Report. The progress report/updated management plan includes information on the actions and investigative efforts undertaken prior to and during 2012 and the actions that are planned for 2013 to provide enhanced treatment for total dissolved solids (TDS) and/or TDS-source control in order to ensure that:

- Red Dog will be able to discharge treated effluent through Outfall 001 in compliance with permitted TDS limits, and;

- Treated effluent of sufficient volume will be discharged to maintain the integrity of the tailings impoundment dam.

Reducing the concentration of TDS in the Red Dog Mine tailings storage facility (TSF) is a top priority of the mine. In its original TDS Management Plan, Teck identified and selected those actions and/or investigative efforts appropriate for incorporation into the plan. The initial review identified four general categories of actions and/or investigative activities and a fifth category, "Other Opportunities", has been added in this document. The categories are:

1. Source Control (Pre-ARD Generation) – Examine potential means of reducing or preventing water infiltration into and/or oxidation of ARD generating material stockpiles

2. Source Control (Post-ARD Generation) – Examine improved TDS capture and treatment

3. Enhanced Treatment Capacity – Winterization of Water Treatment Plant 3 and/or improved utilization of Water Treatment Plant 1 and 3

4. Enhanced Treatment Technology Research

5. Other Opportunities

Results of these activities in 2012 as well as those planned for continuation or as new for 2013 are described below.

## 1. Source Control (Pre-ARD Generation)

Acid Rock Drainage (ARD) largely results from the action of microbes on sulfide minerals which results in by-production of (sulfuric) acid. The ARD process requires oxygen and water, and generally results in acidic solutions that mobilize metal ions from the host rock. Reducing or eliminating the supply of water and/or oxygen to a reactive waste rock source is a potential method to mitigate or prevent ARD generation.

### Acid rock drainage control through neutralization

Teck sponsored the AMIRA P933 project, aimed at identifying potentially feasible long-term methods to mitigate ARD. Teck's Applied Research and Technology (ART) Laboratory in Trail, British Columbia, Canada issued a report in 2012 summarizing the project findings. Certain recommendations from the report will be investigated for potential assessment at the Red Dog mine in 2013.

ART will be carrying out a test program to evaluate phosphate amendments as a long term solution to reduce ARD generation through the creation of passivating layers in the main waste stockpile (MWS). As part of the test program, ART is also investigating the neutralization capacity of select geologic material(s) from the Red Dog mine site.

Further, recycling a portion of effluent from Water Treatment Plant 3 (WTP3) to the top of the MWS will be evaluated. The effluent has a pH of 6.0-10.0 and may provide the circum-neutral conditions that the AMIRA test work has identified as critical for the passivation process.

### Reduction of Infiltration of precipitation and air into the MWS

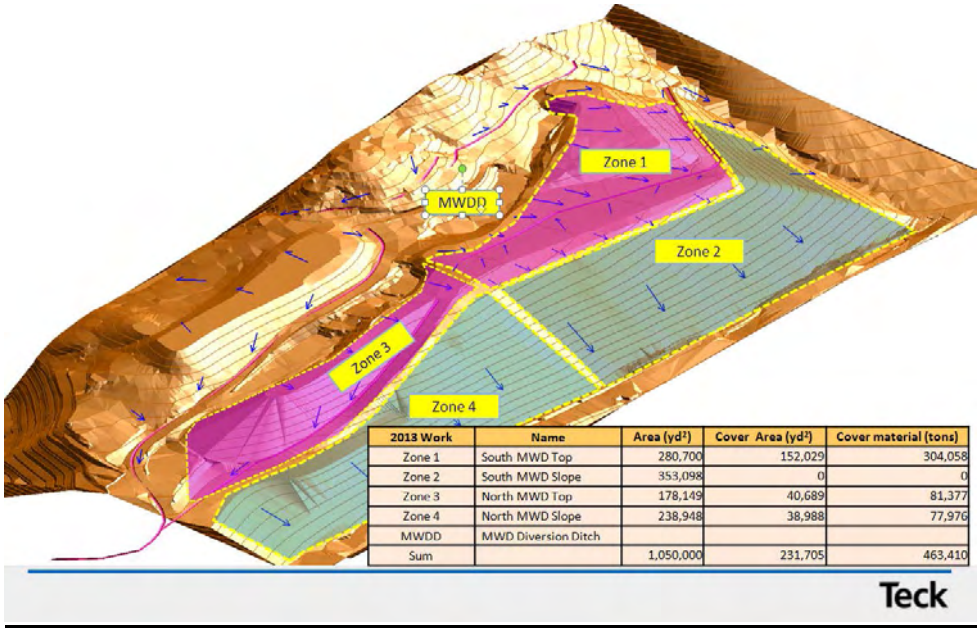
In Q4 2012, a project was initiated to reduce the infiltration of precipitation and air into the MWS. The project is comprised of re-contouring MWS for proper drainage, compacting the existing MWS material and then covering the MWS with a three-foot lift of a fine-grained cover material to decrease infiltration of precipitation and entry of atmospheric oxygen, thus reducing the oxidation of sulfidic minerals, which leads to the production of ARD.

The project has four objectives

- ✓ The dump surface will be re-contoured to provide positive drainage into lined ditches.

- ✓ The top 8 to 10 inches of MWS material will be re-compacted to provide a better seal against infiltration of precipitation.
- ✓ A three-foot lift of a fine-grained cover material will be placed over the contoured waste rock surface to become a moisture store and release surface layer, further reducing the net infiltration of moisture and atmospheric oxygen.
- ✓ Divert surface water around the MWS by installing a series of drainage ditches.

In Q4 2012 and Q1 2013, work planned consists of re-contouring and compacting of the MWS surface and installation of diversion ditches. After spring freshet 2013, the MWS surface will be re-compacted and cover material placed on MWS top surface.




| 2013 Work | Name | Area (yd²) | Cover Area (yd²) | Cover material (tons) |
|---|---|---|---|---|
| Zone 1 | South MWD Top | 280,700 | 152,029 | 304,058 |
| Zone 2 | South MWD Slope | 353,098 | 0 | 0 |
| Zone 3 | North MWD Top | 178,149 | 40,689 | 81,377 |
| Zone 4 | North MWD Slope | 238,948 | 38,988 | 77,976 |
| MWDD | MWD Diversion Ditch | | | |
| Sum | | 1,050,000 | 231,705 | 463,410 |

## 2. Source Control (Post-ARD Generation)

ARD is currently collected through a series of five intercept wells that pump recovered ARD to a main collection tank from where it is pumped to WTP3 or WTP1 for treatment. Based on geotechnical information gathered in 2011, four new wells and a series of French drains were installed to increase collection of the ARD. Pumps and piping were installed to send water from the new wells to the main collection tank for treatment in WTP3/WTP1 or to the pit.

After a design review by Golder, three new wells with two new lines and a continuous trench along the toe of the MWS were added by the end of 2012.The changes have allowed for year round collection and treatment of ARD in WTP3/WTP1.

## Improved TDS Capture through a MWS Drainage Collection System

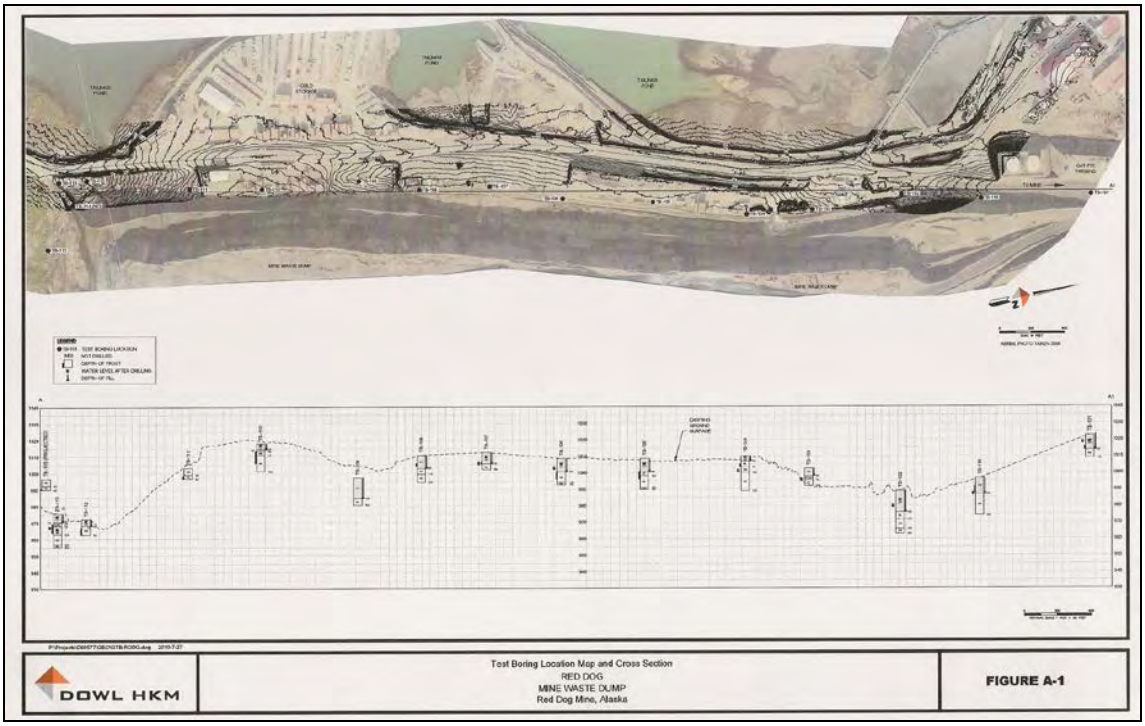
A geotechnical evaluation to determine the water flow paths emanating from the MWS was completed in 2010. This was a two phase program.

Phase I had four objectives

- ✓ Determine nature and material properties of the overburden
- ✓ Determine depth and nature of weathered/fresh bedrock
- ✓ Determine depth to groundwater
- ✓ Locate discrete low resistivity (high conductivity) 2D and 3D pathways that could reflect metal-rich water migrating from the MWS to the tailings impoundment.

The data required to meet the first three objectives was obtained by drilling a series of 15 holes along the base of the MWS using a hollow stem auger. In each of the holes the overburden material was logged, and the condition of the bedrock was determined. In the eight holes that encountered groundwater, the groundwater elevation was measured.

Figure1: DOWL HKM Auger Hole Location Map




To gather the data needed to meet the fourth objective, two different electro-magnetic (EM) surveys were conducted. A RESOLVE Airborne EM Survey was

conducted to locate discrete low resistivity (high conductivity) 3D pathways of metals-rich water flowing/draining into the tailings impoundment. The airborne survey was followed up by a ground based Dipole-Dipole Array and Wenner Array survey. The results of the surveys are presented in the figures below.

Figure 2: RESOLVE Airborne EM Survey – Differential Resistivity (320 MASL)

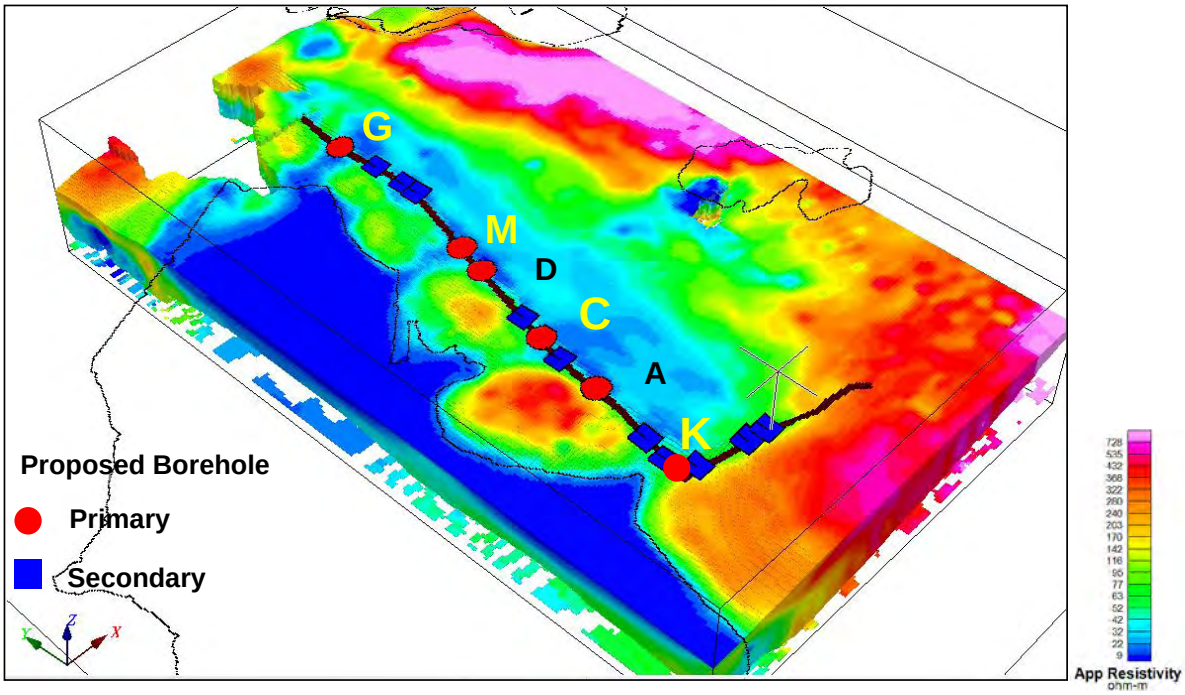
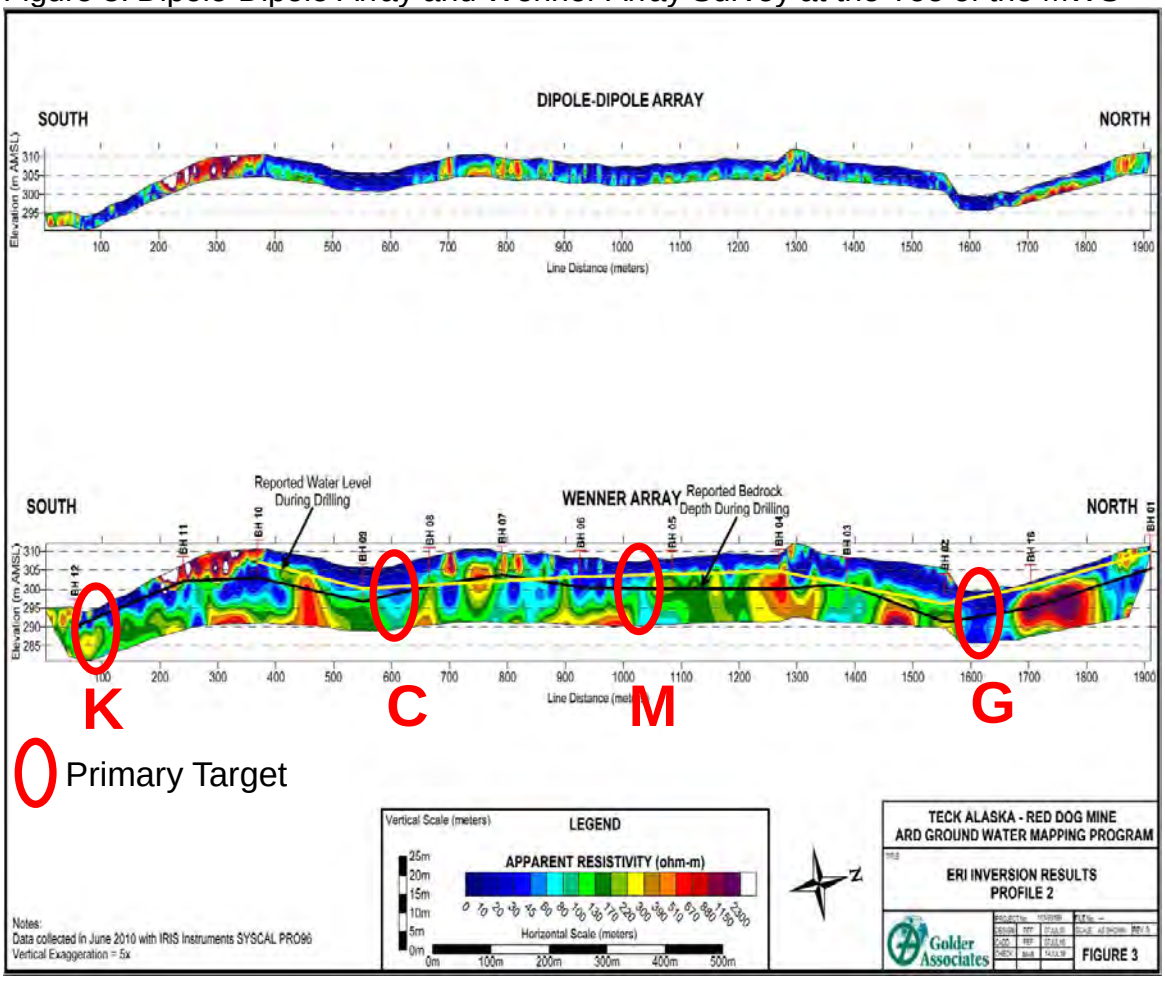


Figure 3: Dipole-Dipole Array and Wenner Array Survey at the Toe of the MWS




The objective of Phase II was to determine the target locations for intercept wells based on the results of the geophysical surveys. Wells were installed at locations G, M, C, and K. Pumps were installed in wells at locations G and M. Initial test work resulted in a non-sustained water draw. A system design evaluation is currently ongoing to re-assess well size diameter, recharge rates and optimal pumping capacity. Additional testing was undertaken during the 2011 field season.

In 2012 additional testing was completed to determine flow rates and loading at different elevations within the bedrock. Also, the pump and pipeline system was refurbished. A series of interconnecting drain ditches has been established along the MWS toe, and the pumping system draws from these ditches.

In 2013 efforts will concentrate on additional containment/capture measures with a goal of increasing capture and treatment of ARD.

## 3. Enhanced Treatment Capacity

Red Dog is committed to increasing the capture of ARD from the main MWS before it enters the TSF. Capturing and separately treating this water has been demonstrated to be the most cost effective method to reduce the TDS load in the TSF. It also provides process benefits as a lower TDS recycle water will reduce pipe scaling, thus improving availability and grade/recovery performance.

### Enhanced Utilization of Water Treatment Plant 1 and 3 (WTP1 and WTP3) and Winterization of Water Treatment Plant 3.

Lime-high density sludge (HDS) treatment of the MWS-stream in WTP1 has proven successful in dramatically lowering the high TDS concentrations of this source.

Certain improvements to the MWS-stream recovery/treatment system were completed to allow reliable winter operation. Further improvements to winterization will continue through 2013.

Water Treatment Plant 1 (WTP1) was successfully utilized to treat the MWS-stream from October 2012 and continuing through present.

The scoping-level engineering work for winterization of WTP3 was not completed in 2012. In light of the successful conversion of WTP1 to a facility capable of year-round MWS-stream treatment, the potential need for winterization of WTP3 was deferred until 2014.

## 4. Enhanced Treatment Technology Research

### Reverse Osmosis Bench Study

In Q2 2012, Red Dog Mine commissioned a water treatment company to conduct a bench scale prefeasibility study to treat a sample of reclaimed TSF water using membrane technology. The technology demonstrated potential although there were concerns over certain operational parameters of the testing and so a second bench test was commissioned in Q4 2012.

The second bench test parameters were better defined to address the issues identified in the initial test. Lime was used as a pretreatment step and the water temperature was maintained to better simulate actual Red Dog conditions. Results of the second bench study were encouraging and Teck plans to continue evaluating membrane technology alternatives in 2013 through bench and pilot studies.

## 5. Other Opportunities

Mining in the Main pit was completed in Q1 2012. A significant opportunity was identified to accelerate TDS reduction in the TSF by pumping ARD – generated in excess of what can currently be treated – into the Main pit. The current plan is to fill and/or allow the pit surface water level to reach 840' above mean sea level (AMSL), after which the pit water will be pumped to the ARD treatment system. In 2012, 6.6 million gallons of ARD was diverted to the North Main pit, thus removing this TDS load to the TSF.

An element of TDS reduction is the diluting impact of spring freshet and summer precipitation flowing into the TSF. This impact is proportionately increased as the TSF water volume is decreased and to maximize this, 387 million gallons of treated water was pumped to the Main pit in 2012 (rather than to the TSF). This also helped ensure the TSF water level did not encroach into the TSF dam freeboard limit (TSF water level was 963.5' AMSL by 2012 year end). Red Dog plans to continue pumping ARD and excess discharge-treatment water in the Main pit in 2013.

### ARD Diversion to the North Main Pit

Treatment of ARD in WTP3 is limited by lime mixing capacity during the spring and early summer. Lime demand is high during spring melt period as lime is used to treat reclaimed TSF water for discharge purposes. Hence, all of the collected ARD cannot be treated. Historically, ARD that could not be treated in WTP3 overflowed to the TSF, thus increasing its TDS load.

A pumping system was installed in 2012 to divert any collected, untreated ARD to the North Main pit. In 2012, 6.6 million gallons of untreated ARD was sent to the North Main pit, reducing the TDS load in the TSF significantly. It is planned to continue diverting any ARD beyond the treatment capacity to the Main pit in 2013.

### Treated Water in the South Main Pit

2012 was a challenging year for water management at Red Dog mine. Due to a number of unusual factors, the water storage onsite increased by 1.7 billion gallons and the TDS load increased in the TSF.

A major contributing factor to the increase in stored water on the site is that Red Dog experienced what may have been a 1000-year precipitation event in August during which 15" of rain were received during the month. Average precipitation for

August is approximately 4.7”.  Beyond the abnormal precipitation event, Red Dog received 28.8” of rain from July through October.  Average precipitation in this time period is approximately 11.9”.

Other contributing factors included operational and structural issues with WTP2 and an increase in selenium concentrations above the discharge permit limits, which ultimately led to the decision to cease discharge until all these issues could be resolved.