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Teck Alaska, Inc. - Red Dog Mine  
4<sup>th</sup> Quarter & Annual Report 2017  
Waste Management Permit No. 2016DB0002  
Reclamation Plan Approval F20169958  
March 1<sup>st</sup>, 2018

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## **Introduction**

This report has been prepared to fulfill the 4<sup>th</sup> quarter and annual reporting requirements of Teck Alaska Incorporated's (TAK) obligations under the State of Alaska Waste Management Permit No. 2016DB0002 and the Red Dog Mine Reclamation Plan Approval F20169958.

This report addresses mine water management, biomonitoring, waste rock management, tailings management, permafrost and groundwater monitoring, water load balance, Class III waste landfill, mining and milling activities, reclamation activities, land disturbance and wildlife interactions for the reporting period.

## **Biomonitoring Program**

### ***Annual Biomonitoring Report***

The annual biomonitoring report will be submitted with the 2018 2<sup>nd</sup> quarter report.

### ***Annual Summary of Biomonitoring Water Quality Sampling***

Analytical results of samples collected for biomonitoring water quality are attached with the electronic file, *Red Dog 2017 Analytical Results Profile I.xlsx*. Biomonitoring sampling ended for the year on October 9, 2017. Analytical samples were collected from both the Bons Creek and Mine Drainage Monitoring areas and analyzed for constituents listed in Table 2 – Profile I of the “*Monitoring Plan, Aug 2016*”.

## **Permafrost and Sub-permafrost Groundwater Monitoring**

### ***Permafrost and Subsurface Temperature Monitoring***

Piezometer and thermistor recordings were completed for the 4<sup>th</sup> quarter per the SEP requirements. The 2017 annual for the Permafrost and Groundwater Monitoring Program report is included within this report under Appendix A.

### ***Significant activities in Permafrost and Sub-permafrost Groundwater Monitoring***

Piezometer well P97-013 which is located on the Kivalina overburden stockpile is scheduled to be replaced during 2018. The existing piezometer lost nitrogen pressure at the inflator which has led to erroneous readings. A design plan for the new replacement well will be submitted to EPA Region 10 for approval prior to replacing the existing well. Well replacement updates will be included with the 2018 quarterly reports.

## **Mine Water Management**

### ***Mine water flows***

Table 1 lists mine water volumes transferred from mine areas during the reporting period. The table also includes a summation of volumes transferred for the report year. All flow monitoring stations operated normally with no problems noted for the period.

The facility ceased discharging from Outfall 001 on September 23<sup>rd</sup>. Approximately 1.89 billion gallons were discharged during the reporting period from outfall 001.

Table 1 - Water Management Volumes

	Volume in Gallons			
Mine Water Monitoring Stations	October	November	December	2017 Total
Bon's Creek Total Flow	13,080,000	14,060,000	13,680,000	182,404,000
Mine Water Sump Total Flow <sup>1</sup>	70,270,000	62,420,000	36,310,000	773,610,000
Main Dam Seepage Pumpback	29,390,000	27,220,000	25,600,000	454,410,000
Reclaim Flow to Mill	238,800,000	225,700,000	263,200,000	3,359,700,000
WTP #1 Influent from Reclaim	869,900	2,323,000	0	348,256,410
WTP #1 Influent from Mine Sump	4,061	0	20,830,000	20,834,061
WTP #1 Clarifier Sludge To Tails	0	0	0	109,157
WTP #2 Influent from Reclaim	0	0	0	2,567,070,000
WTP #2 Sludge To Tails	432,000	0	0	46,628,393
Discharge to Red Dog Creek	0	0	0	1,891,084,261
WTP #3 Influent from MWD	6,695,000	4,489,000	3,825,000	56,662,000
WTP #3 Influent from Mine Sump	0	0	0	2,984,000
WTP #3 Total Effluent	6,695,000	0	0	59,646,000
East Overburden Sump	3,352,900	622,900	380,200	14,366,700
West Overburden Sump	545,300	1,149,100	7,700	15,049,800
Main Waste ARD to Main Pit	0	0	0	2,461,300
Treated Water to Main Pit	0	0	0	0
Tailings Water Supernatant (calc.)	203,949,000	233,310,000	239,599,000	2,758,091,000

Notes: <sup>1</sup> Includes Main Pit water pumped back to Tailings Storage Facility

### **Mine water quality**

Mine water quality charts were reviewed during the 4<sup>th</sup> quarter, during this review it was noted for both the East and West overburden sumps analytical results for dissolved copper have been omitted from testing since August 2015. It was determined the missed testing was due to the Chain of Custody (COC) forms completed after July 2015 did not list dissolved copper, thus the lab did not test this constituent. The electronic COC's have since been corrected. The missed data is not expected to have any impact from either area.

### **Mine Water Quality Trend Charts**

Mine water quality trend charts are provided in Appendixes B, C, D, and E of this report. Water quality Profile I and II ("*Monitoring Plan, Aug 2016*") constituents for the Mine Water, Mine Drainage, Bons Creek and APDES stations are illustrated for a five year period ending with the 4<sup>th</sup> quarter. Trend charts depict the Water Quality Standard (WQS) when applicable.

### **Visual Monitoring of Mine Water Management Systems**

Red Dog diversion ditches, seepage collection and treated water discharge lines were monitored during the quarter. All mine water systems operated without incident during the reporting period.

### ***Water and Load Balance***

A mine water balance computer simulation program is maintained using GoldSim software. Viewing the file requires the GoldSim 11.1 Player. An updated data file has been included with this report.

In addition a Total Dissolved Solids (TDS) load balance spreadsheet is provided for mine water areas and the Tailings Storage Facility. The spreadsheet data (flows and summary sections only) is listed in Appendix I of this report. An electronic file of the complete worksheet labeled “*Red Dog Mine 2017 Water and Mass Balance Estimates.xlsx*” is attached with the report.

The TDS load balance spreadsheet shows a negative TDS balance for the 2017 year, attributable to continuous wastewater treatment year round and a successful discharge season. The Tailings Storage Facility contained an estimated 3.337 billion gallons of free water (end of 2017) compared to 3.718 billion gallons for the previous year, a 10% reduction.

Approximately 773 million gallons was pumped from the Main Pit water to the Tailings Storage Facility during 2017. Main Pit water continues to be pumped year round to account for waste rock displacement in the pit. Main Pit water transferred to the Tailings Storage Facility accounted for the majority of TDS loading to the Tailings Storage Facility during 2017.

The Acid Rock Drainage (ARD) water collection system collected approximately 56 million gallons for 2017, slightly less than the previous year. Of this amount approximately 53 million gallons were treated in WTP1 or WTP3. The reduced volume collected was due to collection well sump being decommissioned during 2017. Options to replace the well sump or increase ARD collection capacity will be investigated during 2018.

An estimated 14,418 tonnes of TDS was removed from ARD water and 16,238 tonnes of TDS was pumped from the Main Pit to the Tailings Storage Facility during the year.

Significant reagents consumed for wastewater treatment during 2017:

- Total quantity of flocculant used in Waste Treatment Plant 2 (WTP2) and WTP1 was 99.4 metric tonnes, the majority being used in WTP2.
- Total quantity of lime used in WTP2 is not tracked individually, though the total lime used in WTP1, WTP2 and WTP3 was 10,928 metric dry tonnes.
- Total quantity of sodium sulfide used in WTP1 and WTP2 was 965.3 metric tonnes, utilized to precipitate cadmium.
- Total quantity of flocculants used in WTP3; - None
- Quantity of any other chemicals used in significant quantities in WTP2; - Gypsum 1,342.6 metric tonnes

### ***Significant activities in mine water management***

- The Main Waste Dump cover test plot construction was completed 10/23/18. A total of 15 acres of synthetic liner and cover material has been installed. Monitoring of cover performance will be ongoing over the next 18 months.

- The 2017 13 acre project was delayed 23 days due to weather. The project was completed with no significant changes to the original design plan.
- The back dam and main dam piezometers were all installed with wireless acquisition and real time monitoring capabilities.

**Figure 1 - Photos of MWD Synthetic Cover Project**



Photo 1 – Looking west off MWD. Placing cover rock over the geocomposite.



Photo 2 – Looking northwest at the top of the MWD.



Photo 3 – Looking north, on upper surface of MWD. Drainage channel to the left.

## **Waste Rock Management**

### ***Quantities, placement locations and analysis of waste rock***

#### ***Results of waste rock geochemical monitoring***

Other than blast hole analyses, no additional geochemical monitoring was conducted on waste rock during the reporting period. Geochemical blast hole monitoring results are included within the *Waste Rock Production Summary* report listed in Appendix F of this report.

#### ***Visual monitoring of waste rock facilities***

Weekly waste dump inspections were conducted on both inactive and active waste rock dumps with

no adverse findings noted. Dig face inspections were carried out on waste shots to confirm waste characteristics and suitability for designated stockpile locations. All waste material was placed in suitable waste dump locations. The primary waste dump sites used during the 4<sup>th</sup> quarter were the Main Pit Dump (MPD3, MPD4, and MPD5), Oxide / Main Waste Dump (Copper Waste Dump, Landfill, and Oxide Ore Stockpile), and Cold Storage North.

A total of 515,239 tonnes of waste rock were hauled from the Aqqaluk pit and a total of 873,052 tonnes of waste rock were hauled from Qanaiyaq pit.

### **Main Pit Dump Area**

For the fourth quarter of 2017 a total of 1,185,048 tonnes were hauled to the Main Pit Dump area.

- 5,018 tonnes of Ikalukrok “Other Waste” were hauled to MPD3.
- 180,331 tonnes of Ikalukrok and Siksikpuk “Most Reactive Waste” were hauled to MPD4.
- 535,557 tonnes of Ikalukrok and mixed “Other Waste” were hauled to MPD4.
- 80,933 tonnes of Ikalukrok and Siksikpuk “Most Reactive Waste” were hauled to MPD5.
- 383,209 tonnes of Ikalukrok, Kivalina, and mixed “Other Waste” were hauled to MPD5.

### **Oxide / Main Waste Dump Area**

For the fourth quarter of 2017 a total of 170,767 tonnes were hauled to the Oxide / Main Waste Dump (MWD). The Copper Waste Dump was recently added on the northern edge of the MWD.

- 7,020 tonnes of Ikalukrok and Siksikpuk “Most Reactive Waste” were hauled to the Copper Waste Dump (CWD) storage area, which is a new dumping location located on the Main Waste Stockpile Area.
- 10,753 tonnes of Ikalukrok “Other Waste” were hauled to CWD.
- 2,280 tonnes of mixed “Most Reactive Waste” were hauled to the Landfill (LAN). 3,999 tonnes of Ikalukrok “Other Waste” were hauled to LAN. 52,751 tonnes of Ikalukrok and Siksikpuk “Most Reactive Waste” were hauled to the Oxide Ore Stockpile (OXO). 93,964 tonnes of Ikalukrok, Kivalina, and mixed “Other Waste” were hauled to OXO.

### **Cold Storage North**

For the fourth quarter of 2017 a total of 2,785 tonnes of Ikalukrok and mixed “Most Reactive Waste” was hauled to the Cold Storage North waste dump (CSN).

### **Portable Crusher / Stemming Rock**

For the fourth quarter, 3,974 tonnes of Ikalukrok “Most Reactive Waste” and 25,717 tonnes of Ikalukrok “Other Waste” were hauled to the Portable Crusher – which was placed near MPD4 during 2017. This material is used for projects and in-pit stemming use for blasting.



Weekly visual inspections of waste rock facilities were conducted by the Senior Geotechnical Engineer or their trained designee. No incidents or findings were noted for the reporting period.

Dig face inspections were carried out on waste shots to confirm waste characteristics and suitability for designated stockpile locations. All waste material was placed in suitable waste storage stockpiles.

### **Cover Material at Main Waste Stockpile**

No cover material was stockpiled for the period. Table 2 lists amount of cover material stockpiled onsite.

Table 2 - Cover Material Amount

Cover Stockpile Location	Tonnes Hauled per Month			Total Tonnes Report Period	Tonnes Stockpiled
	Oct	Nov	Dec		
Ramp to Nowhere (RNC)	0	0	0	0	1,390,625
Oxide 2 Cover Dump (OX2)	0	0	0	0	39,694
Oxide Cover Dump (OCD)	0	0	0	0	27,880
North Oxide (NOX)	0	0	0	0	553,245
South Oxide Top Soil (SOT)	0	0	0	0	81,094
				0	2,092,538

### **Significant activities in waste rock management**

No significant activities reported for the 4<sup>th</sup> quarter.

### **Tailings Management**

#### **Quantities and analysis of tailings**

Table 3 depicts the dry tonnes of tailings generated and the average lead, zinc and iron concentrations in the tailings solids for the 4<sup>th</sup> quarter and summation and average concentrations for the 2017 report year.

Table 3 - Tailings Generated

Month	Dry Tonnes Tailings	Analysis		
		% Pb	% Zn	% Fe
Oct	269,309	2.1	3.2	7.1
Nov	205,840	2.5	3.0	8.2
Dec	244,923	2.9	3.1	8.1
Annual sum/avg.	3,070,336	2.2	2.9	7.6

### **Tailings Storage Facility and Main Pit Dump water elevation**

Table 4 depicts the surveyed Tailings Storage Facility and Main Pit water levels during the reporting period. The current dam permits allow for a crest elevation of 986 feet amsl or 981 amsl freeboard. The Tailings Storage Facility water level for the 4<sup>th</sup> quarter was maintained below the freeboard limit. The Main Pit Dump was maintained below an elevation of 850 feet amsl.

Table 4 - Tailings Storage Facility and Main Pit water elevations

Tailings Storage Facility Elevation			Main Pit Dump		
Survey Date	TSF Feet MSL	Comment	Survey Date	MPL Feet MSL	Comment
Date	Elevation	Comment	Date	Elevation	Comment
10/6/2017	970.17	Weekly H2O	10/6/2017	840.23	Weekly H2O
10/11/2017	970.19	Weekly H2O	10/11/2017	840.29	Weekly H2O
10/18/2017	970.18	Weekly H2O	10/18/2017	840.54	Weekly H2O
10/25/2017	971.07	16* lt wind	10/25/2017	841.40	16* lt wind
11/1/2017	971.17	H2O Weekly	11/1/2017	842.09	H2O Weekly
11/8/2017	971.17	Due to snow, access to the tailings pond was blocked.	11/8/2017	841.96	Weekly H2O
11/14/2017	971.38	Weekly H2O	11/14/2017	841.91	Partially Frozen Weekly H2O
11/25/2017	972.16	Weekly H2O	11/25/2017	841.75	
11/30/2017	971.85	Weekly H2O	12/6/2017	838.87	
12/6/2017	972.10	Weekly H2O	12/14/2017	838.87	
12/14/2017	972.29	Weekly H2O	12/21/2017	N/A	Storm -unable to acquire
12/21/2017	N/A	Storm -unable to acquire.	12/30/2017	839.98	Ice
12/27/2017	972.65	ice			

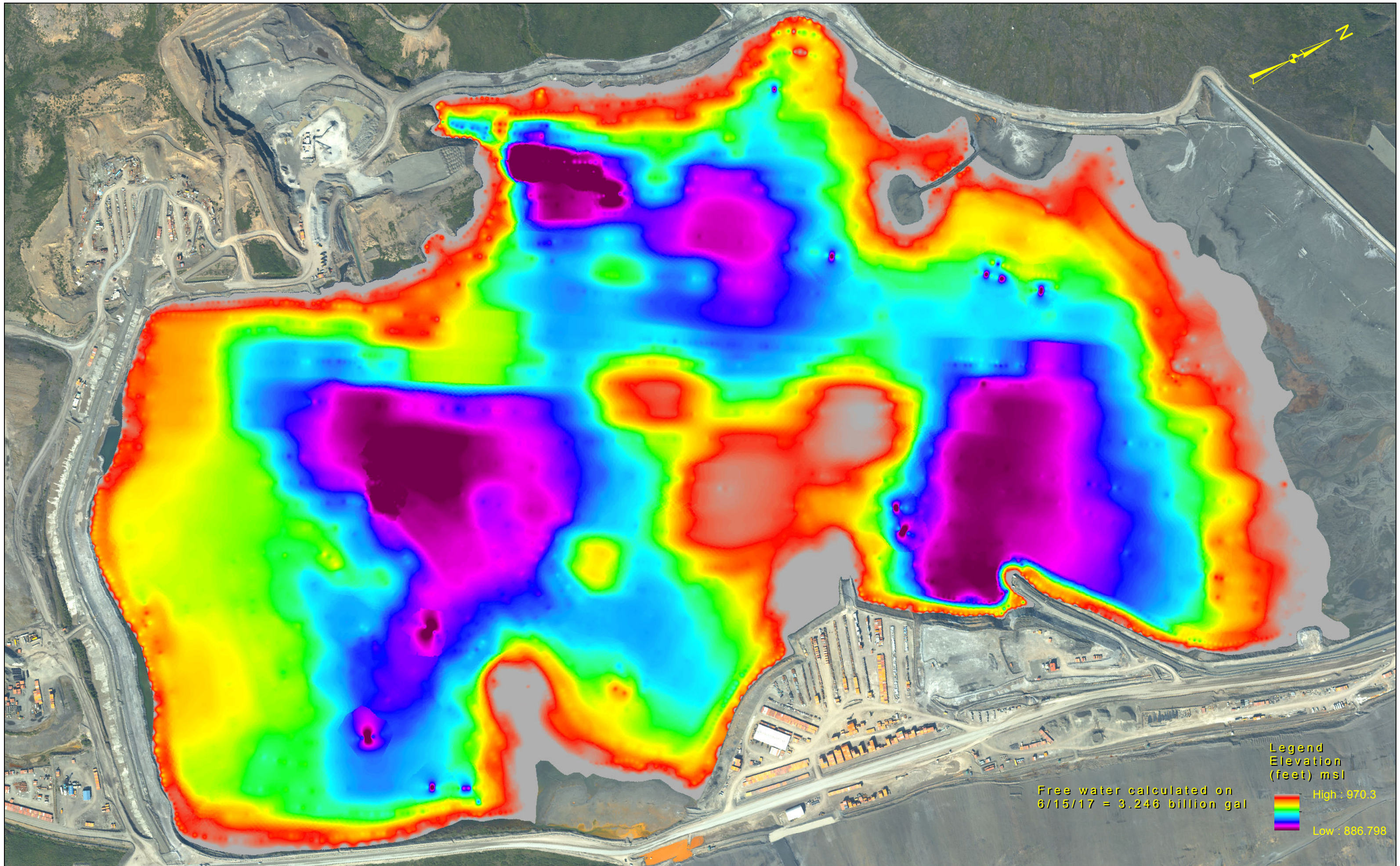
### **Visual monitoring of tailings facilities**

Visual monitoring inspections of the tailings storage facilities were completed during the 4<sup>th</sup> quarter. All systems operated as designed with no findings.

### **Significant activities in tailings management**

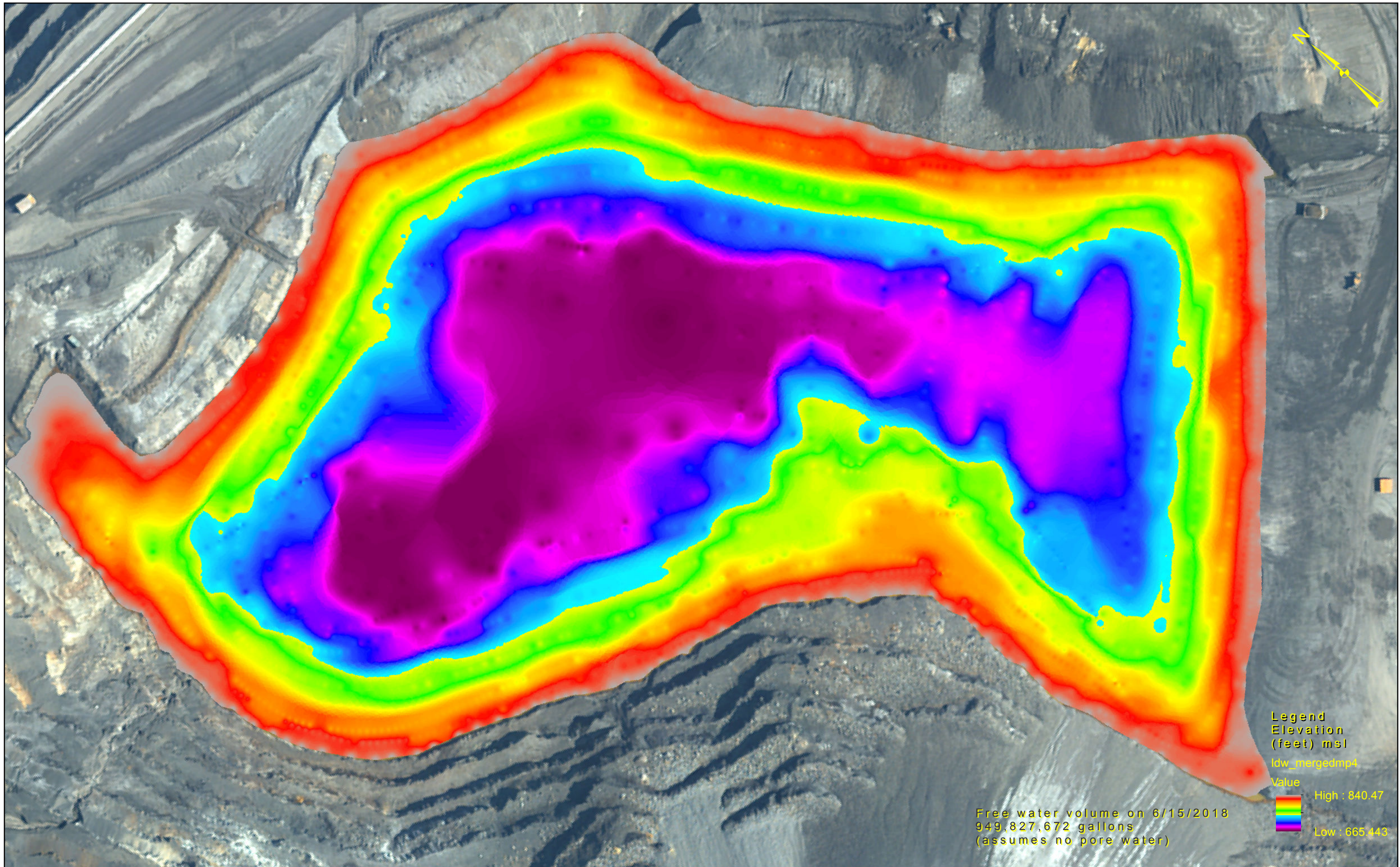
Tailings were deposited several areas of the Tailings Storage Facility during the 4<sup>th</sup> quarter, mainly along the west and northwest portions of the Tailings Storage Facility.

Bathymetry surveys were completed June 15, 2017 for both the Tailings Storage Facility and the Main Pit. A bathymetry map for each area was generated and depicted in Figures 2 and 3.



Legend  
 Elevation  
 (feet) msl  
 High : 970.3  
 Low : 886.798

Free water calculated on  
 6/15/17 = 3.246 billion gal



Legend  
 Elevation  
 (feet) msl  
 ldw\_mergedmp4  
 Value  
 High : 840.47  
 Low : 665.443

Free water volume on 6/15/2018  
 949,827,672 gallons  
 (assumes no pore water)

### **Class III Municipal Solid Waste Landfill**

Visual inspections were conducted at the landfill and random inspections conducted on bins of refuse waste prior to being hauled to the landfill. No incidents were reported during the 4<sup>th</sup> quarter.

#### ***Landfill Use Plan***

For the 2018 year, refuse will continue to be placed on the existing 2017 lift while working toward the northern end of the cell. It is expected during the spring of 2018 a new lift will be started where refuse will be placed at the southern end and progress in a northerly direction.

A waste management consultant was retained during the 4<sup>th</sup> quarter which will assist with enhancing Red Dogs recycling opportunities. The consultant is expected to be onsite for at least twelve months with the main goal of establishing a much more robust recycling program.

#### ***Quantities of inert solid waste for the reporting year***

The quantity of inert solid waste (cover rock not included) placed in the landfill for 2017 was calculated at 15,962 cubic yards of uncompacted waste.

#### ***Significant activities in solid waste landfill***

No significant activities occurred at the solid waste mine landfill during this reporting period.

### **Mining and Milling Activities**

#### ***Mining quantities***

Table 5 lists the tonnes of ore hauled to the mill stockpile each month during the reporting period. This does not include marginal ore which was placed within the Marginal Ore Stockpile.

Table 5 - Ore Mined

Date	Ore Mined, tonnes
Oct	336,633
Nov	226,271
Dec	371,680
Annual	4,014,895

#### ***Milling Quantities***

Table 6 lists the tonnes of ore processed through the mill facilities each month during the reporting period.

Table 6 - Ore Processed through Mill

Date	Ore Milled, tonnes
Oct	394,233
Nov	282,301
Dec	348,474
Annual	4,269,909

### ***Significant activities in mining and milling***

There were no significant activities in mining and milling during the quarter.

## **Reclamation**

### **Reclamation Activities**

#### ***Area Disturbed and Reclaimed***

Table 7 depicts new disturbed acreage for 2017. A map of the new (2017) and total disturbance areas is shown in Figure 5 – Red Dog Mine 2017 Disturbance. No areas were reclaimed during the reporting period. Any top soil recovered from newly disturbed areas was stockpiled for future use.

Table 7 - Area Disturbed in 2017

2017 Disturbance Area	Acres
Aqqaluk exploration sites	3.9
PAC dump expansion	1.2
Airport paving project material site	5.2
Total	10.3

#### ***Reclamation Research***

Peter Johnson from Alaska Department of Environmental Resources (ADNR) was retained by Red Dog to initiate a new vegetation study on the Main Waste Dump. The study area comprises 6 small test plots located on the upper surface of the Main Waste Dump. The study involves variations of grass seed mixture, forbs, mulch application and fertilizer types and rates. The study commenced during June 2017 and will continue for the next several years.

#### ***Reclamation Monitoring***

No monitoring was completed for the reporting year.

#### ***Significant reclamation activities***

No reclamation activities took place during the 2017 reporting year.

## **Dust**

#### ***Dust monitoring activities***

The 2017 Risk Management Plan Annual Report is not yet completed. The report should be finalized by the 2<sup>nd</sup> quarter of 2017. A final report will be submitted when complete as Appendix J.

## **Wildlife**

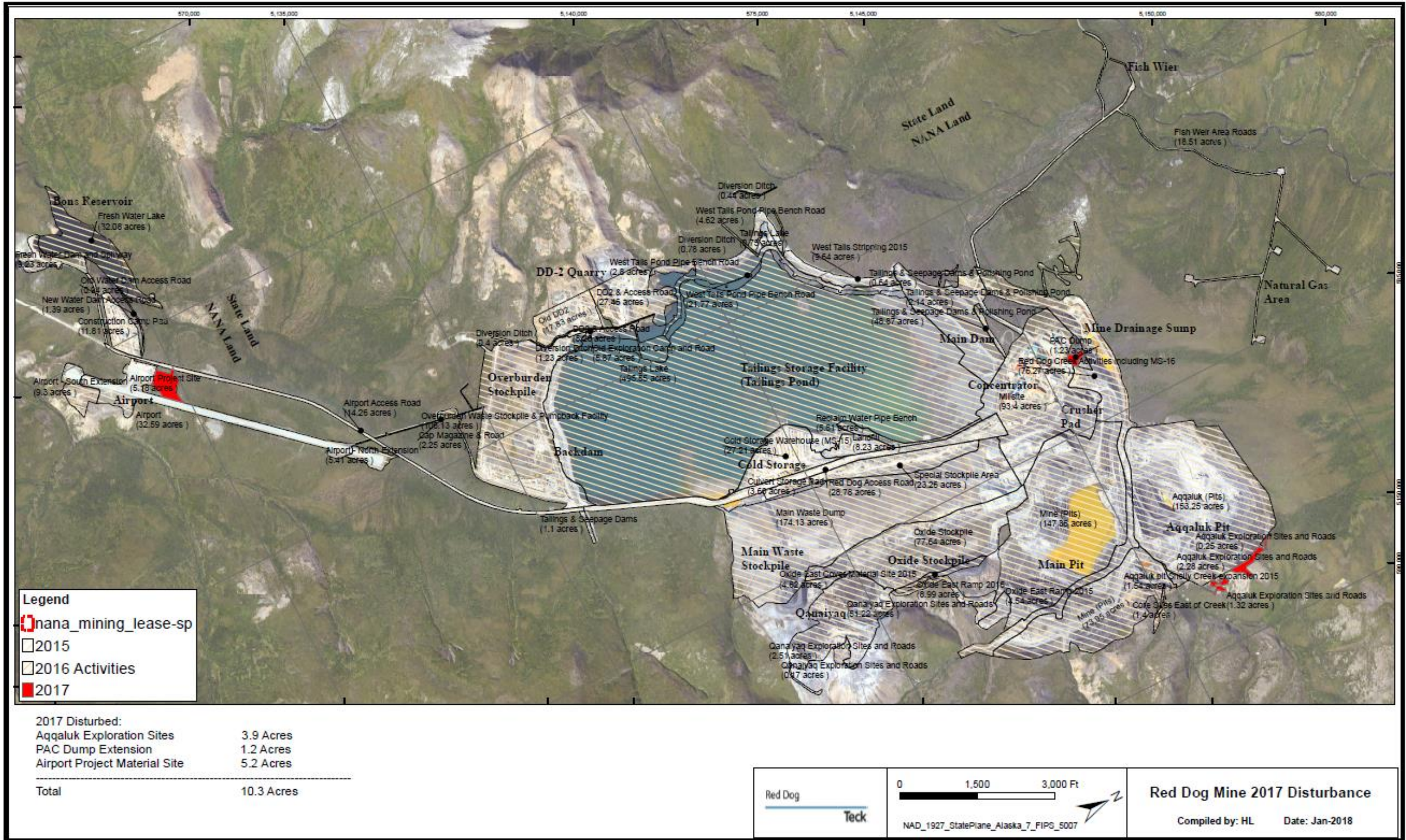
#### ***Wildlife interactions***

No wildlife interactions occurred during this 4<sup>th</sup> quarter reporting period.

## **Financial Assurance**

TAK increased the reclamation bond for Reclamation Plan Approval (F20169958) by \$4,466,800 to account for inflation based on the Anchorage Consumer price Index (CPI). The total bond amount is \$562,816,800. The adequacy of the bond is sufficient for current operations and conditions.

Figure 4 - Land Disturbance Map



**2018 Mine Plan**

A 2018 Mine Plan is included with the annual report and listed within *Appendix H: Red Dog One Year Mine Plan 2018*. References to grades have been redacted from the document to conform to with fiscal regulations.

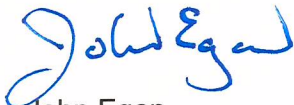
The majority of the ore to be mined for the 2018 year is anticipated to come from the Aqqaluk pit with remaining amount of ore coming from the Qanaiyaq Pit.

**Closing**

Please accept this report as required under the State of Alaska Waste Management Permit No. 2016DB0002 and Reclamation Plan Approval F20169958. If there are any questions, please contact Frank Bendrick at (907) 754-5138 or myself at (907) 754-5272.

Based on information and belief formed after reasonable inquiry, I certify that the statements and information in and attached to this document are true, accurate and complete.

Sincerely,  
Teck Alaska Incorporated



John Egan  
Acting General Manager

cc: Tim Pilon, ADEC, Fairbanks;  
Marie Steele, ADNR, Anchorage  
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