
Teck Alaska, Inc. - Red Dog Mine
4th Quarter & Annual Report 2016
Waste Management Permit No. 2016DB0002
Reclamation Plan Approval F20169958
February 11th, 2017

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Introduction

This report has been prepared to fulfill the 4th 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

Al Ott with the Alaska Department of Fish and Game (ADF&G) requested an extension for submitting the annual Biomonitoring Technical Report. The extension was approved by ADEC and a completed report is expected to be posted to the ADF&G website by May 15th.

Annual Summary of Biomonitoring Water Quality Sampling

Analytical results of samples collected for biomonitoring water quality are attached with the electronic file, *Red Dog Analytical Results Profile 1.xlsx*. Biomonitoring sampling ended for the year on October 17, 2016. Analytical samples were collected from both the Bons Creek and Mine Drainage Monitoring areas and analyzed for constituents listed in Table 2 – Profile 1 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 4th quarter per the SEP requirements. The 5-year report for the Long-Term Permafrost and Groundwater Monitoring Program is expected to be completed by April 2017. Once completed, the report will be submitted as Appendix A of this report and a copy will also be submitted to the EPA Region 10.

Significant activities in Permafrost and Sub-permafrost Groundwater Monitoring

No significant activities were reported.

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 with the exception of the East and West Kivalina overburden seepage collection system. The main pump back line froze during mid-November due the heat trace line failing. Extremely cold temperatures hampered repair, sump levels were monitored and if needed water pumped back near the overburden stockpile.

The facility ceased discharging from Outfall 001 on September 23rd. Approximately 1.252 billion gallons were discharged during the reporting period from outfall 001.

Table 1 - Water Management Volumes

Mine Water Monitoring Stations	Volume in Gallons			
	October	November	December	2016 Total
Bon's Creek Total Flow	11,180,000	11,100,000	9,839,000	147,108,000
Mine Water Sump Total Flow ¹	96,900,000	76,230,000	72,870,000	737,040,000
Main Dam Seepage Pumpback	28,830,000	23,840,000	21,200,000	366,800,000
Reclaim Flow to Mill	192,700,000	251,100,000	283,900,000	2,868,300,000
WTP #1 Influent from Reclaim	0	6,314,000	59,030	138,086,390
WTP #1 Influent from Mine Sump	0	0	0	0
WTP #1 Clarifier Sludge To Tails	0	0	0	471,800
WTP #2 Influent from Reclaim	0	0	0	2,222,950,000
WTP #2 Sludge Discharge To Tails	0	0	0	52,918,000
Discharge to Red Dog Creek	0	0	0	1,252,600,290
WTP #3 Influent from MWD	5,347,000	3,690,000	3,493,000	83,435,000
WTP #3 Influent from Mine Sump	0	0	1,901	2,073
WTP #3 Total Effluent	5,347,000	3,690,000	3,494,901	83,437,073
East Overburden Sump	705,000	134,000	0	12,085,000
West Overburden Sump	1,443,000	200	0	11,207,100
Main Waste ARD to Main Pit	0	0	0	1,429,113
Treated Water to Main Pit	0	0	0	0
Tailings Water Supernatant (calc.)	252,999,000	189,870,000	257,145,000	2,772,500,000

Notes: ¹ Includes Main Pit water pumped back to Tailings Storage Facility

Mine water quality

Mine water quality was analyzed for the constituents listed within Table 2 – Water Quality Profile II of the *Red Dog Mine – Monitoring Plan, August 2016*. All mine water samples were collected per the monitoring requirements for the 4th quarter without incident.

As reported in the 3rd quarter report an uncharacteristic value for lead concentration (1.99 mg/L) was reported for the Seepage Pond sample collected on September 9th, 2016. A request was made to ACZ Laboratories to re-test the original sample. Results of the retest indicated original report values were confirmed. Sample contamination is suspected since the data point was considered an outlier or significantly different from the norm.

A review of 4th quarter analytical results indicated two potential discrepancies for samples collected on 11/25/16 for the Main Pit Lake and the WTP3 influent and effluent. A request was made to ACZ Laboratories to review the sample data for alkalinity values for WTP3 for both influent and effluent as the values appear to be reversed and to review the sulfate concentration for the Main Pit Lake since the reported value was several magnitudes lower than normal. A dilution error is suspected since the Total Dissolved Solids value for the same sample did not correlate with the reduced sulfate value.

A revised report is expected by ACZ Laboratories, based on the report, data will be amended if necessary. An update will be provided in the 1st quarter report for 2017.

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 4th quarter. Trend charts depict the 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.

Visual monitoring of the dams was completed per the requirements in each dams Operation and Maintenance Manual. A review of completed daily inspections indicated some daily inspections could not be located, though most were completed for the period.

Two findings were noted with the weekly inspection reports for both the Back Dam and Red Dog Mine Water Diversion Dam. A new employee not yet trained on completing the weekly dam inspections had noted the two separate findings which were later determined to be insignificant.

Water and Load Balance

A mine water balance computer simulation program is maintained using GoldSim software. A recent update was made to the model and is reflected in the attached player file. Viewing the file requires the GoldSim 11.1 Player.

A tailings water basin load balance spreadsheet is provided for mine water areas. The spreadsheet data (flows and summary sections only) is listed in Appendix of this report. An electronic file of the complete worksheet labeled *"Red Dog Mine 2016 Water and Mass Balance Estimates.xlsx"* is attached with the report.

The tailings basin water and load balance spreadsheet shows a negative water balance for the 2016 year. The reduced water volume is attributable a successful discharge season, 95% of theoretical discharge record. The Tailings Storage Facility contained an estimated 3,718 million gallons of free water (end of 2016) compared to 4,169 million gallons for the previous year, 11% reduction or 451 million gallons and 100 million gallon reduction for the Main Pit Lake.

Approximately 737 million gallons were pumped from the Main Pit Lake to the Tailings Storage Facility during 2016. Main Pit Lake water continues to be pumped year round to account for waste rock displacement in the pit. Main Pit Lake water transferred to the Tailings Storage Facility accounted for the majority of TDS loading to the Tailings Storage Facility. TDS concentration within the Tailings Storage Facility continued a downward trend in concentration for the 2016 year.

Collection and treatment of the Main Waste Dump Acid Rock Drainage (ARD) water was similar to last year with approximately 82 million gallons collected, of this 98% was treated in WTP1 and WTP3. Red Dog expects TDS concentration the Tailings Storage Facility will continue to decline for the 2017 year.

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

ARD Capture and Treatment Highlights for 2016:

- Collected 82 million gallons and treated 80.6 million gallons of ARD water in WTP1 and WTP3, remaining 1.4 million gallons diverted to Main Pit Lake.
- Intercepted 50.7% with the ARD water wells.
- ARD was treated daily, year round in either WTP1 or WTP3.
- 87% ARD well/sump availability

Reagents Consumed for Water Treatment for 2016:

- Total quantity of flocculant used in Waste Treatment Plant 2 (WTP2) and WTP1 was 99 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 9,728 metric dry tonnes.
- Total quantity of sodium sulfide used in WTP1 and WTP2 was 131.7 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 920 metric tonnes

Significant activities in mine water management

A two acre geosynthetic cover test on the southern limit of the west facing slope and top deck of the main waste dump was completed mid-October. The cover test was installed with no deviations from the submitted work plan design. Monitoring for stability of the cover rock material placed above the geosynthetic will be measured after snow melt and continue throughout the year. Infiltration performance will be evaluated during snow melt and continue throughout the year.

An additional 13 acre geosynthetic cover test is proposed for the 2017 year. The purpose of the larger test to gain a more thorough understanding of constructability and costs. The test will incorporate similar geosynthetic materials (double textured LLDPE, woven geonet) as utilized for the two acre test. Two feet of uncompacted waste rock cover will be placed over the geosynthetic. No moisture instrumentation will be utilized for the test. Figure 1 depicts the location of the 13 acre geosynthetic layout.



Photo 1 - Two acre test, Looking south, near south end of MWD. Placing double textured LLDPE on MWD surface.



Photo 2 - Two acre test, MWD toe, west face looking east, final placement of drainage mat over LLDPE, prior to placing 2 feet of cover rock on top.



Photo 3 - Two acre test, aerial of cover construction

Figure 1 - Proposed 13 Acre Geosynthetic Cover Test Layout



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 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.

The primary waste storage sites have been the Main Pit Dump (MPD2, MPD3, and MPD5), Main Waste Dump (landfill and Oxide East) and a small amount of production waste material was used for road construction in the pit. A total of 956,633 tonnes of waste rock was hauled from the Aqqaluk pit and a total of 768,365 tonnes of waste rock hauled from Qanaiyaq pit.

Main Pit Stockpile Area

For the fourth quarter of 2016 a total of 1,719,734 tonnes were hauled to the Main Pit Stockpile Area. The following list the rock type and disposition:

- 80 tonnes of mixed rock “Most Reactive Waste” were hauled to MPD2.
- 69,232 tonnes of Siksikpuk and Ikalukrok “Most Reactive Waste” were hauled to MPD3.
- 333,461 tonnes of Siksikpuk, Ikalukrok, mixed rock, and Kivalina “Other Waste” were hauled to MPD3.
- 360,001 tonnes of Siksikpuk and Ikalukrok “Most Reactive Waste” were hauled to MPD5.
- 956,960 tonnes of Siksikpuk, Ikalukrok, and mixed rock “Other Waste” were hauled to MPD5.

Oxide/Main Waste Stockpile Area

For the fourth quarter of 2016 a total of 3,088 tonnes were hauled to the Oxide/Main Waste Stockpile Area. Break down as follows:

- 1,877 tonnes of Ikalukrok “Other Waste” were hauled to Oxide East (OXE).
- 1,211 tonnes of Siksikpuk “Most Reactive Waste” were hauled to the landfill (LAN).
-

Haul Road Maintenance

A total 2,176 tonnes of Siksikpuk “Other Waste” was used for road maintenance within the pit area.

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	481,522
South Oxide Top Soil (SOT)	0	0	0	0	81,094
				0	2,020,815

Significant activities in waste rock management

Approximately 25% of the southern end of the existing oxide stockpile was stripped of the cover rock and oxide ore from Qanaiyaq pit was placed on the stripped area for potential future use.

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.

Table 3 - Tailings Generated

Month	Dry Tonnes Tailings	Analysis		
		% Pb	% Zn	% Fe
Oct	146,987	1.3	2.9	6.9
Nov	205,014	1.3	3.2	6.3
Dec	269,559	1.2	2.9	4.9
Annual sum/avg.	2,827,500	1.9	3.1	6.6

Tailings Storage Facility and Main Pit Dump water elevation

Table 4 lists the surveyed Tailings Storage Facility and Main Pit Lake 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 4th quarter was maintained below the freeboard limit. The Main Pit Dump is maintained below an elevation of 850 feet amsl.

Table 4 - Tailings Storage Facility and Main Pit Lake 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
10/6/2016	968.66	Weekly H2O Survey	10/6/2016	841.40	Weekly H2O Survey
10/13/2016	968.95	34* Sunny no Wind,	10/13/2016	841.32	34* Sunny no Wind,
10/20/2016	968.97	Weekly H2O Survey. Taken on ice.	10/20/2016	841.29	Weekly H2O Survey
10/29/2016	969.57	Weekly H2O Survey. High wind, majority of pond iced over. Measurement taken at barge, may be inaccurate.	10/29/2016	841.80	Weekly H2O Survey
11/3/2016	969.55	32* Partly Cloudy ICE shot	11/3/2016	841.80	32* Partly Cloudy Ice Forming
11/10/2016	969.79	Weekly H2O Survey (Taken on ice)	11/10/2016	841.82	Weekly H2O Survey
11/18/2016	970.12	Weekly H2O Survey. Measurement taken on ice.	11/18/2016	842.00	Weekly H2O Survey. Measurement taken on ice.
11/25/2016	970.15	0* Clear, Cold breeze, fully frozen	11/25/2016	841.86	1* Clear w/ light wind, frozen edges of discharge pond
12/1/2016	970.24	Measurement taken on ice.	12/1/2016	841.85	Measurement taken along frozen edges of discharge pond
12/8/2016	970.55	Measurement taken on ice.	12/8/2016	841.31	Measurement taken on ice.
12/15/2016	970.75	22* Cloudy 10mph wind and rising, Ice	12/15/2016	841.18	22* Cloudy 10mph wind and rising, measured off a rock in the water
12/22/2016	970.89	Weekly H2O	12/22/2016	840.82	Weekly H2O

Visual monitoring of tailings facilities

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

Significant activities in tailings management

Tailings were deposited within several areas of the Tailings Storage Facility during the 4th quarter – the main dam wing wall, west of cold storage area and south of cold storage area.

Bathymetry surveys were completed for both the Tailings Storage Facility and the Main Pit Lake and are depicted in Figures 2 and 3. The main dam and wing wall beaches were “built up” upstream of the causeway with tailings during the summer months using sub-aerial deposition.

Figure 2 - Tailings Storage Facility Bathymetry Map

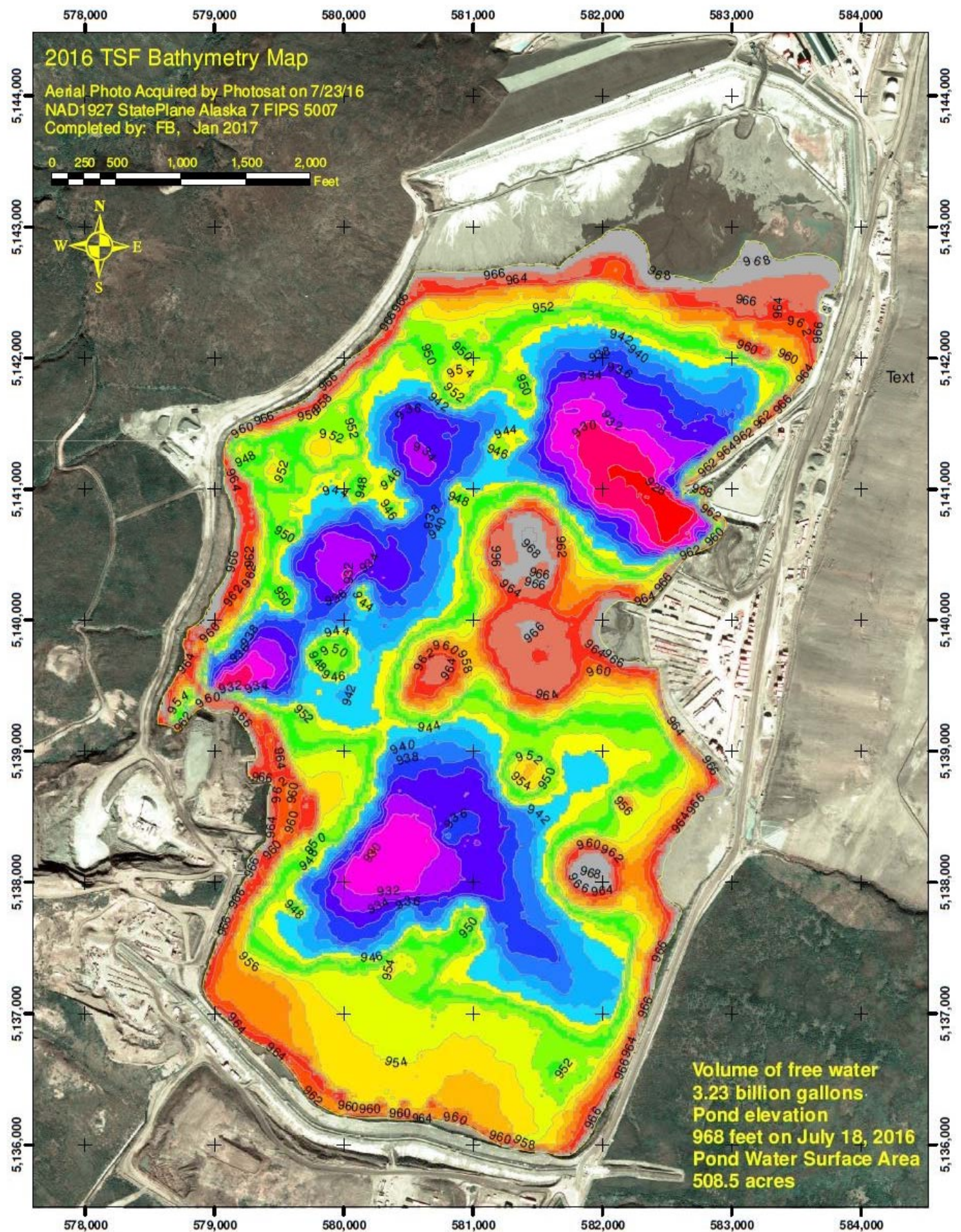
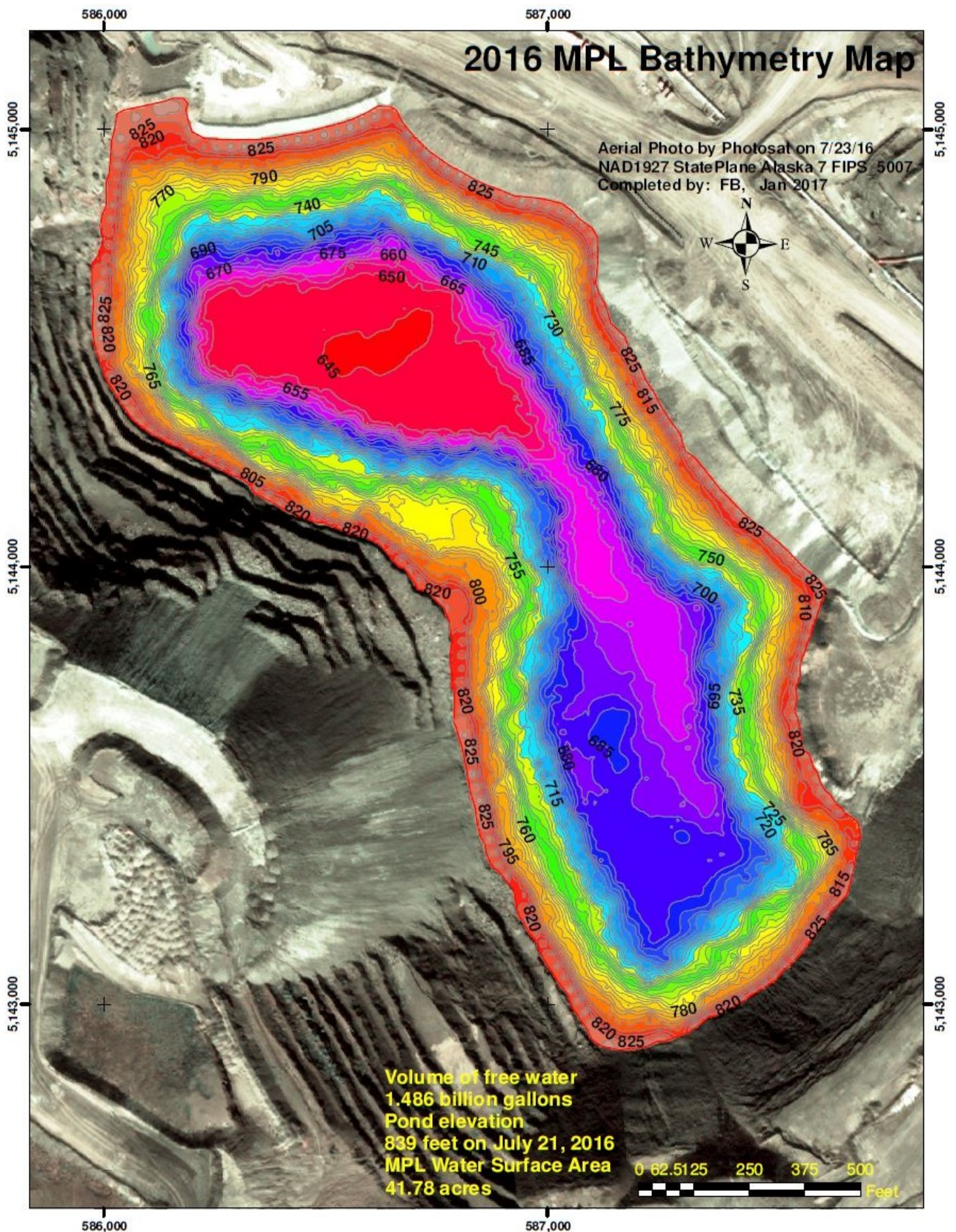


Figure 3 - Main Pit Lake Bathymetry Map



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. One incident was reported in November and involved food waste being placed in an open top dumpster staged near the mill facility. The food waste (wrappers, plates) was removed prior to the dumpster being transferred to the landfill.

Corrective action involved team meetings with contractors which discussed proper management of food waste onsite since it was thought the food waste originated from temporary contractors onsite at the time.

Monthly landfill inspections were conducted at the landfill site, no findings were recorded.

Landfill Use Plan

During the latter part of the 2016 year the entire cell was graded and compacted using additional rock material from the western slope wall side. For the 2017 year, refuse will be placed starting in the southern most end of the cell creating a new lift. Based on historical volumes the 2017 lift is expected to cover half of the existing dump cell. The 2016 and 2017 Landfill Use Plans are depicted in Figure 4.

Quantities of inert solid waste for the reporting year

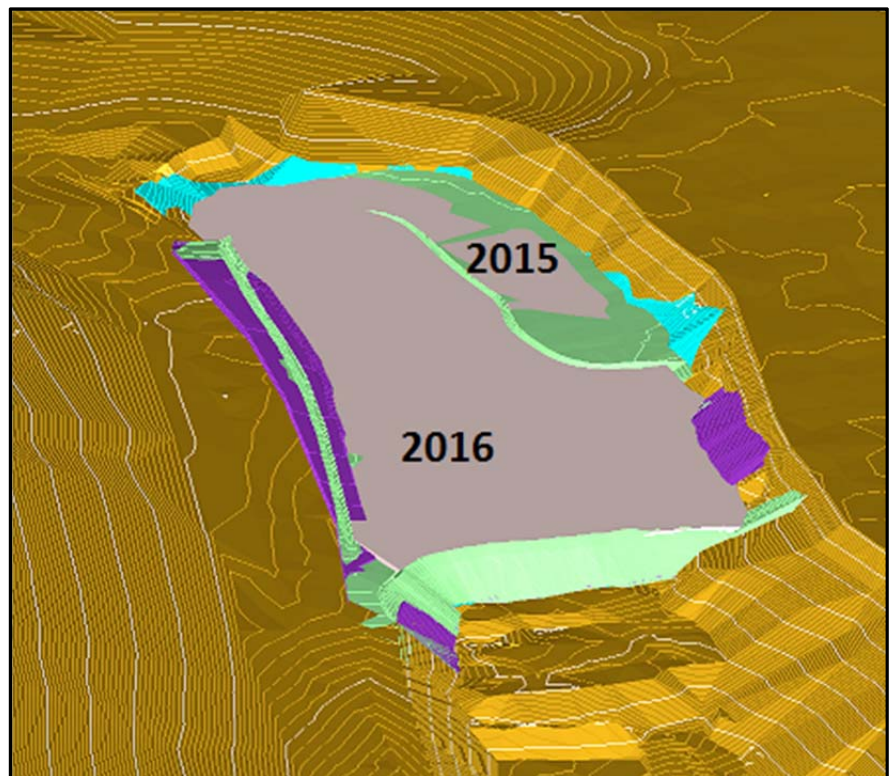
The quantity of inert solid waste (includes cover rock) placed in the landfill for 2016 was calculated at 17,558 cubic yards of material.

Figure 4 - Landfill Development and Use Plans

Inert Solid Waste Landfill – Main Waste Dump

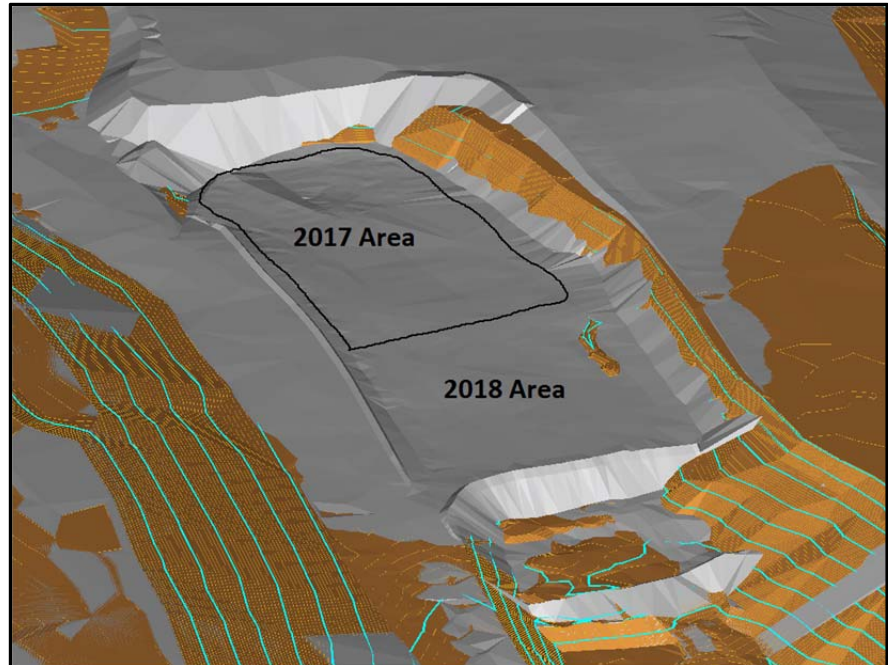
2015 Fill Area
Volume 14,407 cubic yards

2016 Fill Area
Volume 17,558 cubic yards



Expected Development Use Plan for 2017

Expected 2017 fill volume is
estimated at 15,000 cubic
yards



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	397,968
Nov	437,676
Dec	385,955
Annual	4,399,216

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	399,098
Nov	292,558
Dec	379,550
Annual	4,220,156

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 lists newly disturbed acres for 2016. A map of the disturbance areas is shown in Figure 5 – Red Dog Mine 2016 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 2016

2016 Disturbance Area	Acres
Qanaiyaq Exploration Sites	2.68
Aqqaluk Pit Shelly Creek Extension	8.0
Oxide East Ramp	9.0
Tailings & Seepage Dams	2.14
Red Dog Creek Activities	1.01
Total	22.83

Reclamation Research

No reclamation research was completed during the 2016 reporting year.

Reclamation Monitoring

No monitoring was completed for the reporting year.

Significant reclamation activities

No reclamation activities took place during the 2016 reporting year.

Dust

Dust monitoring activities

The 2016 Risk Management Plan Annual Report is not yet completed. The report should be finalized by the 2nd quarter of 2016. A final report will be submitted when complete as Appendix J.

Wildlife

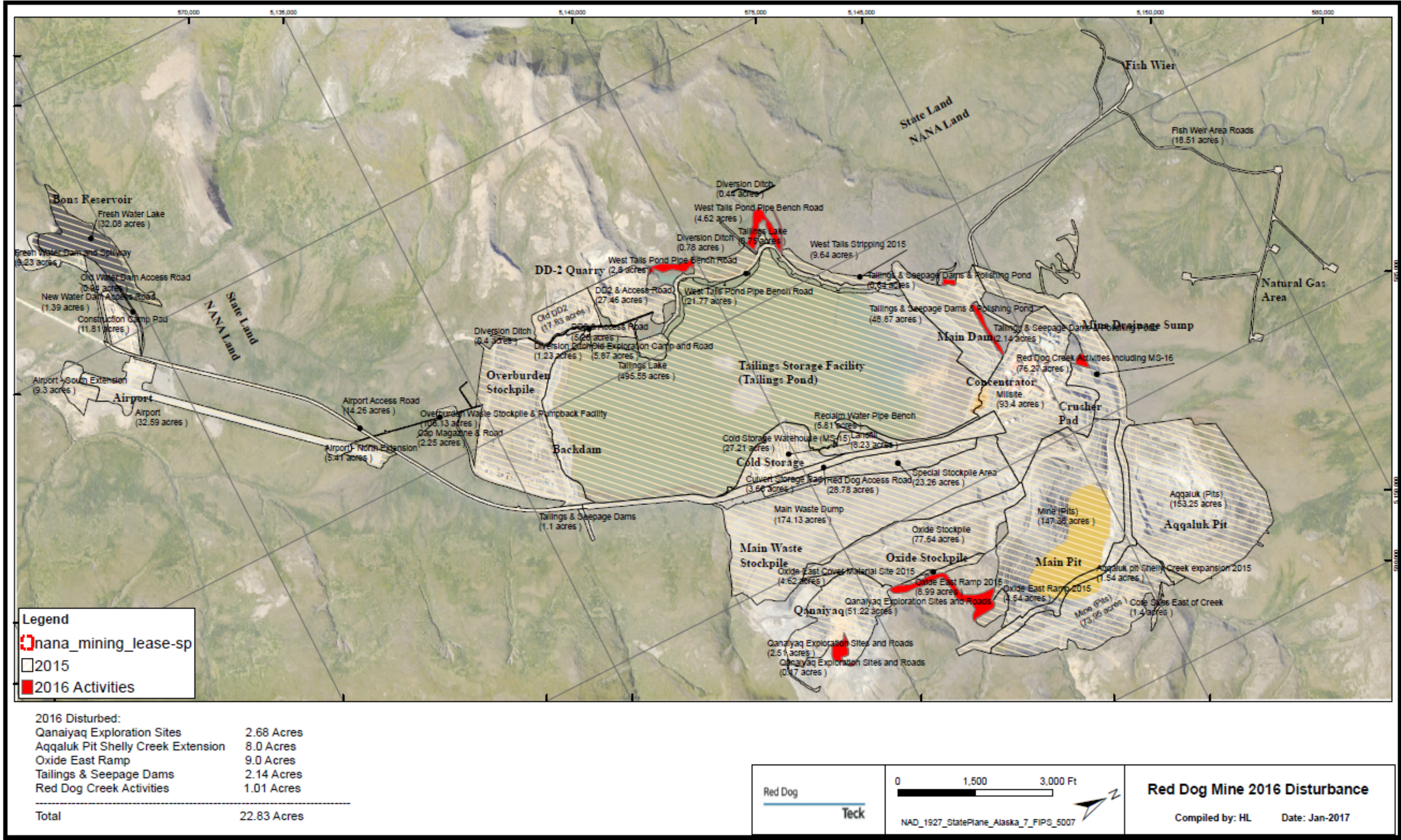
Wildlife interactions

No wildlife interactions occurred during this 4th quarter reporting period. No major wildlife incidents were reported during the 2016 reporting year.

Financial Assurance

TAK recently increased the reclamation bond for Reclamation Plan Approval (F20169958). The bond will be adjusted annually to account for inflation based on the Anchorage Consumer price Index (CPI). Annual adjustment will be submitted by September 28 of each year. The adequacy of the bond is sufficient for current operations and conditions.

Figure 5 - Land Disturbance Map



2017 Mine Plan

A 2017 Mine Plan has not been finalized and will be submitted as *Appendix H: Red Dog One Year Mine Plan 2017*. References to grades have been redacted from the document to conform to with fiscal regulations.

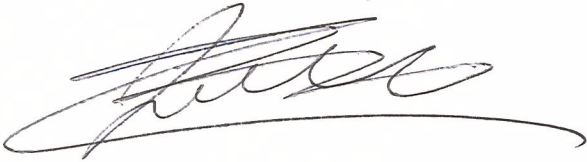
The majority of the ore to be mined for the 2017 year is anticipated to come from the Aqqaluk pit with minor amounts of ore coming from the Qanaiyaq Pit.

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) 754-5127.

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

A handwritten signature in black ink, appearing to read 'Henri Letient', with a long horizontal flourish extending to the right.

Henri Letient, P. Eng.
General Manager

cc: Tim Pilon, ADEC, Fairbanks;
Marty Lentz, ADNR, Anchorage
Brent Martellaro, ADNR, Fairbanks
Wayne Hall, Red Dog Mine
Robert Napier, Red Dog Mine

DNR.Water.Reports
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