October 9, 2014

Post-Reclamation Geotechnical Inspection

FORMER POLARIS MINE, NUNAVUT

Submitted to:
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Table of Contents

TABLES

FIGURES

APPENDIX A

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Teck Resources Ltd. (Teck) to conduct a post-reclamation geotechnical inspection of the former Polaris mine located on Little Cornwallis Island, Nunavut. The geotechnical inspection was carried out by Mr. Darrin Johnson, P.Eng., on September 2, 2014.

The decommissioned Polaris mine site is located on Little Cornwallis Island approximately 120 km northwest of Resolute, Nunavut. Figure 1 presents the general arrangement of the decommissioned former Polaris mine site (the Site).

The following areas were inspected during the 2014 geotechnical inspection:

- Subsidence Area;
- Garrow Lake Dam (Decommissioned Dam on Figure 1);
- Little Red Dog Quarry Landfill;
- Operational Landfill;
- Conveyor and Main Mine Portals; and
- Marine Foreshore (Reclaimed Shoreline on Figure 1).

The last geotechnical inspection was carried out by Golder in 2011 and current conditions were compared with conditions observed during previous post-reclamation geotechnical inspections. A summary of site conditions observed during the 2014 geotechnical inspection are presented in the following sections of this report.

2.0 SITE HISTORY

The Polaris mine was operated by Teck between 1981 and 2002 and decommissioned in 2003 and 2004. Site facilities comprised an underground mine, concentrator plant, concentrate storage shed, dock, airstrip, tailings impoundment, freshwater intake on Frustration Lake, various site access roads, a limestone quarry, a shale quarry, and support infrastructure including fuel storage, camp, warehouse, etc. Decommissioning and reclamation of the site involved demolition of all structures and excavation of all soils contaminated by metals and hydrocarbons to pre-approved risk-based concentrations. All demolition waste and contaminated soil was either placed underground or in engineered landfills. Access roads around the mine site were decommissioned by rounding the shoulders of each road, removing culverts, and re-establishing natural drainage patterns. Facilities related to the airstrip were removed during decommissioning but the landing surface remains intact and has been used during the post-reclamation monitoring period. Little Cornwallis Island airstrip (referred to as LCI by local pilots) is also used occasionally by passing airplanes for emergency landings. Teck maintained a small portable camp near Loon Lake during the post-reclamation monitoring period that was removed from the Site in September 2011.

The marine foreshore area and slope in the vicinity of the former concentrate storage shed on the west side of the island were regraded to relatively gentle slopes during decommissioning. Four portals for mine access and exploration activities have been sealed, backfilled and graded to match the surrounding slopes.

Little Red Dog Quarry, located at the northwest end of the airstrip was backfilled partially with demolition debris and metals contaminated soils and subsequently capped with rockfill. The remnant quarry walls above the level of the capping layer are benched and serve to catch ravelling material as the slopes gradually weather. Safety berms extend around the quarry perimeter, and additional safety measures in the form of a ditch and a high berm exist at the end of the airstrip. The Operational Landfill, located at the south end of the former mine facility area, was regraded and capped with rockfill during decommissioning. Thermistors were installed through the rockfill capping layer into the underlying landfilled materials at Little Red Dog Quarry and Operational Landfill. Thermistors equipped with dataloggers were used to monitor ground temperature in the Little Red Dog Quarry Landfill and Operational Landfill from 2006 through 2011. Ground temperature data previously measured by thermistors installed at the Little Red Dog Quarry Landfill and Operational Landfill indicated that permafrost has extended up through the waste into the overlying rockfill cover effectively encapsulating waste materials as designed. The thermistors remain in place but the datalogger batteries have not been changed since 2011 therefore they are no longer recording ground temperature measurements.

The Subsidence Area is located over top of former underground mine workings and experienced significant settlement during early mine operations. During decommissioning, the Subsidence Area was backfilled with non-hazardous solid waste, covered with rockfill, and regraded. No mine subsidence related surface deformation has been detected in the Subsidence Area during the post-reclamation topographic survey monitoring carried out from 2004 through 2011. Some minor thaw related settlement has been observed during post-reclamation inspections in regraded areas where frozen backfill containing ice and/or snow was used during reclamation.

The New Quarry Area was a source of shale during mine construction, operations and decommissioning. It was reclaimed by backfilling stripped materials against the quarry perimeter walls. Access roads around the site were decommissioned and culverts were removed to restore natural drainage crossings that would not require ongoing maintenance. A rockfill jetty remains at Frustration Lake that was constructed for the freshwater supply intake during operation of the mine. Freshwater pumps and piping were removed during decommissioning.

At Garrow Lake, the former tailings disposal area, the impoundment dam and wave break structure were breached during decommissioning to return water levels to pre-development levels and to eliminate structures requiring long-term monitoring and maintenance. The central part of the main dam was breached and a rip-rap lined channel was constructed.

3.0 OBJECTIVES AND LIMITATIONS OF GEOTECHNICAL INSPECTION

The primary objective of the geotechnical inspection is to visually assess the physical condition of decommissioned mine areas for evidence of slope instability, erosion or other landform instabilities that could present a safety hazard to either humans or wildlife. The inspection involved looking for visual indications of physical instability (i.e., erosion, tension cracks, slumping, etc). The stability of underground mine openings was not assessed.

Appendix A includes a series of annotated photographs taken during the 2014 geotechnical inspection. Photograph locations were recorded using a hand-held Global Positioning System (GPS) and are shown in plan on Figure 1. A summary of inspection photographs and approximate Northing and Easting coordinates are listed in Table 1. Conditions observed during the 2014 inspection were compared to previous annual inspections to identify if any changes have occurred that may indicate instability or a potential safety hazard.

4.0 GEOTECHNICAL INSPECTION OBSERVATIONS

In general, the conditions observed during the September 2014 geotechnical inspection of the former Polaris mine site have not changed significantly from previous post-reclamation geotechnical inspections. The following sections provide a summary of conditions observed during the September 2014 geotechnical inspection by area.

4.1 Subsidence Area

There were no significant visual changes to the mine subsidence area observed during the September 2014 geotechnical inspection compared to previous post-reclamation inspections. No features were observed in the subsidence area during the September 2014 inspection that present a significant risk to either humans or wildlife. Photographs 1 through 80 document subsidence area conditions observed during the September 2014 geotechnical inspection.

Most of the photographs taken in the subsidence area during the 2014 inspection are of vent/backfill raises that extend to surface. The raise bores are about 1.5 m in diameter and were used to either provide ventilation to the underground mine or deliver rock backfill to mine stopes. Vent/backfill raises have been observed during previous inspections and were not considered a risk to either humans or wildlife so only a few photographs had been taken to document typical conditions. However, the 2014 inspection attempted to photograph and GPS locate all of the vent/backfill raises in the vicinity of the subsidence area for future reference. Most of the vent/raise locations have corrugated steel pipe (CSP) extending slightly above ground surface. This is considered to be the result of near surface thaw settlement of backfill around and inside the CSP. It is assumed that CSP sections were used as casing through the active thaw layer in overburden down to either permafrost or bedrock. It is possible that frost jacking could be pushing the CSP out of the ground at some of the raise locations. However, it is considered more likely that frozen backfill, that may have contained ice and snow, placed around the CSP and down the raise is settling as a result of seasonal thaw. In fact, the CSP sections may have extended above ground surface when they were initially installed during mine operations. The depth of settlement inside the CSP at most raise locations is less than 0.3 m. There are four locations with substantial thaw settlement adjacent to the raise resulting in exposed CSP up to 1 m high (see Photos 31,37,56,59). There is ponded water in some of these thaw settlement depressions beside vent/backfill raises. Previous inspections had observed thaw settlement beside some of the vent/backfill raises, which were assumed to be unchanged since the mine site was decommissioned. However, it appears that the depth of settlement around and inside the CSP at some raise locations may be increasing over time. Even if there has been some post-reclamation settlement at the vent/backfill raises, it is important to note that this settlement is considered to be a result of seasonal thaw of backfill and not related to underground mine subsidence. There are three vent/backfill raise locations with internal settlement (i.e., inside the CSP) more than 0.3 m deep that could potentially pose a risk to either humans or wildlife (see Photos 25, 32, and 57).

As noted above, much of the subsidence area was backfilled and regraded with frozen rockfill that may have contained ice and snow. Some of the photographs illustrate typical surficial settlement in the subsidence area likely caused by thaw of frozen backfilled material. Again, the observed settlement is not considered to be a result of underground mine related subsidence. The thaw settlement areas have gentle slopes that do not present a risk to either humans or wildlife. Some of these thaw settlement areas have associated tension cracks around the perimeter. There are some longer tension cracks in the subsidence area (see Photos 70 and 71) that have been observed during previous post-reclamation inspections (i.e., are not new) and were previously noted as being related to historic larger-scale subsidence in the area. These previously observed longer tension cracks are well weathered with internal erosion that has self-armoured confirming that they are not new. There are also similar previously observed tension cracks that run along the road at the east side of the subsidence area. However, these tension cracks are considered to be related to thaw creep of the gentle slope that extends from the road embankment down to towards the adjacent New Quarry. The road embankment and regraded slope is constructed of rockfill and is considered to be stable.

During the current and previous post-reclamation inspections there has been an area with ponded water in the centre of subsidence area (Photos 74 through 76) indicating that permafrost is preventing drainage of surface water from the depression. The shallow ponded water freezes solid each winter and does not interfere with maintaining permafrost conditions in the subsidence area. Because of the climate and depth of permafrost at Polaris, a very large and deep body of water is required to create a talik (i.e., thawed zone) through the permafrost.

4.2 Little Red Dog Quarry Landfill

No protruding waste, tension cracks or settlement depressions were observed on the Little Red Dog Quarry Landfill cover during the September 2014 inspection. Photographs 81 through 88 document the condition of the Little Red Dog Quarry Landfill cover during the September 2014 inspection.

4.3 Garrow Lake Dam and Creek Channel

Photographs 89 through 94 illustrate the condition of the breached Garrow Lake Dam and creek channel. Minor thaw settlement on the dam breach slopes appear to be unchanged during post-reclamation geotechnical inspections. Rip-rap at the base of the breach slopes appears to be in good condition and is effectively protecting the breach slopes from channel erosion.

4.4 Operational Landfill

Photographs 95 through 108 illustrate conditions observed at the Operational Landfill during the September 2014 inspection. No indications of slope instability or exposed waste were observed. No tension cracks or settlement depressions were observed on the landfill crest. No indications of erosion or slope instability were observed on the landfill slopes.

4.5 Marine Foreshore

The slopes adjacent to the former dock structure were observed to be stable. No active erosion features discharging sediment were observed in the foreshore area during the September 2014 inspection. Photographs 109 and 110 document a wooden pile observed in the water at the South end of the marine foreshore area. Photograph 114 documents the typical condition at the North end of marine foreshore area during the September 2014 inspection. Thaw settlement and the formation of gravel bars in response to ocean wave and ice action has been observed along the shoreline during previous post-reclamation inspections.

4.6 Mine Portals

The Polaris Mine was an underground mining operation. There were four portals used to access the mine and/or to convey ore out of the mine. During mine decommissioning, the portals were sealed and covered with rockfill to prevent access to the underground mine workings. During the September 2014 inspection only the Main Portal and Conveyor Portal were visited. During previous post-reclamation inspections the North and Exploration portals were observed to have backfilled slopes that were stable.

The Conveyor Portal slope was observed to be in good condition during the September 2014 inspection (see Photograph 111). Most of the backfilled slope in front of the Main Portal was snow covered during the September 2014 inspection (see Photograph 112). The slope in front of the Main Portal had been regraded and flattened in 2009 to repair a slope failure. Photograph 113 is a close-up of some new minor slumping above the Main Portal slope.

5.0 DISCUSSION AND QUALITATIVE RISK ASSESSMENT

The following sections discuss the post-reclamation condition of each area inspected in September 2014 and if there are any potential safety risks to either humans or wildlife.

5.1 Operational Landfill and Little Red Dog Quarry Landfill

No protruding waste, erosion, slope instability or significant settlement was observed at either the Operational Landfill or the Little Red Dog Quarry Landfill during the September 2014 inspection. The batteries in the landfill thermistor dataloggers had not been changed since 2011 and therefore were not downloaded during the September 2014 inspection. Ground temperature data measured from 2006 through 2011 at the Little Red Dog Quarry Landfill and Operational Landfill previously indicated that permafrost had extended up through the waste into the overlying rockfill cover effectively encapsulating waste materials as designed. Observed conditions at the two landfills do not present a safety risk to either humans or wildlife.

5.2 Garrow Lake Dam and Creek Channel

The breached Garrow Lake Dam and creek channel were unchanged from previous post-reclamation geotechnical inspections. Rip-rap at the base of the breach slopes appears to be in good condition and is effectively protecting the breach slopes from channel erosion. Observed conditions at the breached dam and creek channel do not present a safety risk to either humans or wildlife.

5.3 Marine Foreshore Area

The slopes adjacent to the former dock structure were observed to be stable and no active erosion features discharging sediment were observed in the foreshore area during the September 2014 inspection. Minor thaw settlement and the formation of gravel bars in response to ocean wave and ice action have been observed during previous post-reclamation inspections. Observed conditions at the reclaimed shoreline area do not present a safety risk to either humans or wildlife.

5.4 Mine Portals

The Conveyor Portal and Main Portal were inspected during the September 2014 inspection. Although the North Portal and Exploration Portal were not inspected in September 2014, they both have relatively flat backfilled slopes that were observed to be stable throughout the 7 year post-reclamation monitoring period. The slope in front of the Conveyor Portal was observed to be stable during the September 2014 inspection. There was a small slump above the Main Portal slope that was repaired in 2009 but the overall slope appeared to be stable. The slope that is slumping above the Main Portal is steeper than the lower section where additional material was pushed to flatten the slope in 2009. This upper section of slope is supported by the lower, flatter slope which would prevent a large scale slope failure exposing the sealed Main Portal. Minor thaw related slumping of the steeper upper slope above the Main Portal should be expected to continue until a stable slope is achieved.

Observed conditions at the portals inspected in September 2014 are not considered to present a safety risk to either humans or wildlife.

5.5 Subsidence Area

There were no significant visual changes in the subsidence area from previous post-reclamation inspections. During site reclamation, much of the subsidence area was backfilled and regraded with frozen rockfill that may have contained ice and snow. Post-reclamation settlement that has been observed in the subsidence area is considered to be thaw related and not a result of underground mine related subsidence. Thaw settlement in the subsidence area has gentle slopes that do not present a risk to either humans or wildlife. Some of these thaw settlement areas have associated tension cracks around the perimeter. There are some longer tension cracks in the subsidence area that have been observed during previous post-reclamation inspections and may be related to historic larger-scale subsidence in the area. During the current and previous post-reclamation inspections there has been an area with ponded water in the centre of subsidence area indicating that permafrost is preventing drainage of surface water from the depression. The shallow ponded water freezes solid each winter and therefore does not interfere with maintaining permafrost conditions in the area.

The 2014 inspection attempted to photograph and GPS locate all of the vent/backfill raises in the vicinity of the subsidence area for future reference. Most of the vent/raise locations have corrugated steel pipe (CSP) extending slightly above ground surface that could be a result of one of the following or a combination thereof:

- CSP that originally extended above ground surface following installation during mine operations;
- Seasonal thaw settlement of backfill placed around and inside the CSP (backfill that was likely frozen and may have contained ice and snow); and/or
- frost jacking that is slowly pushing the CSP out of the ground.

At most of the vent/raise locations the amount of settlement is less than 0.3 m deep which is not considered to present a safety risk to humans or wildlife. There are four vent/backfill raise locations with substantial settlement immediately beside the raise resulting in up to 1 m of exposed CSP that could potentially present a safety risk to humans or wildlife. There are three vent/backfill raise locations with internal settlement (i.e., inside the CSP) that is more than 0.3 m deep and could potentially pose a safety risk to either humans or wildlife. Previous post-reclamation inspections had observed thaw settlement around the vent/backfill raises that was assumed to be unchanged since the mine site was decommissioned. However, it appears that the depth of settlement around and inside the CSP at some raise locations may be increasing over time. Even if there has been some post-reclamation settlement at the vent/backfill raises, it is important to note that any settlement is considered to be a result of seasonal thaw and consolidation of backfill and not related to underground mine subsidence.

5.5.1 Qualitative Risk Assessment

The assessment of potential risk to humans and wildlife and risk mitigation options at the former Polaris mine site needs to consider the following:

- the remoteness of the site;
- frequency of human and animal traffic across the site;
- corresponding very low likelihood of the risk occuring;

- potential consequence of the risk/hazard; and
- the presence of similar natural risks/hazards in the high Arctic.

It should be noted that natural erosion gullies on the tundra can often be 0.5 m deep requiring ATVs to slow down and/or be careful. There are also large boulders, bedrock outcrops, cliffs and other natural hazards that present more significant risk to humans or wildlife than residual risks at the decommissioned Polaris mine site.

A qualitative risk assessment has been carried out for potential hazards identified in the Subsidence Area using a risk matrix approach. A risk matrix is comprised of one index representing the relative likelihood of occurrence and the other index representing the potential consequence severity of the hazard. The assessed risk is the product of the likelihood and consequence which can be visualized with a risk matrix. Table 2 presents a 5 x 5 risk matrix that was used to assess the safety risk to either humans or wildlife of subsidence area hazards. The *Likelihood Index* ranges from a “Rare” event to a “Certain” event along the vertical axis and can be defined by probability values (as percentages) or expected frequency of occurrence. The *Consequence Severity Index* ranges from “Negligible” to “Disastrous” with descriptions of each of the five consequence categories related to safety along the horizontal axis. A risk matrix is a valuable tool for communicating risk assessment results, prioritizing risks and implementing effective risk mitigation options. By qualitatively assessing the likelihood and consequence of potential hazards, a 5 x 5 risk matrix can be used to assign a risk rating from 1 through 25. The risk rating determined by the matrix is color coded to help identify if risk management actions or mitigation is required. For the risk matrix shown in Table 2, a risk rating between 1 and 6 (green) would be considered minor and can be managed by ongoing monitoring. A risk rating between 7 and 15 (yellow) would be considered moderate and require evaluation of mitigation measures to reduce the risk. A risk rating 16 or higher (red) would be considered significant and require immediate action to reduce the risk rating to an acceptable level.

Qualitative risk assessment of the safety hazards listed in Table 3 all result in risk ratings less than 6 that would be considered minor and can be managed by ongoing monitoring. Ongoing geotechnical inspections of the site at the previously proposed frequency will identify if any additional settlement increases risk to an unacceptable level. The next proposed geotechnical inspections are in 2019 (5 years from now) and then 2029 (10 years later). Potential risk mitigation options that could be considered in the future to reduce risk if further settlement is observed include:

- Placing additional backfill inside the CSP at raise locations with significant internal settlement (e.g., more than 0.3 m); and/or
- Placement of high visibility signage or boulders around vent/backfill raises with exposed CSP extending 1 m or more above ground.

However, it should be noted that placing boulders to warn or prevent access to an area will not remove the risk. For example, the risk of crashing an ATV into a raise CSP that extends above ground surface is no different than crashing into a boulder that naturally exists on the tundra.

Table 2: Risk Matrix

Likelihood	Risk Rating				
Certain • 99% probability, or • could occur within months	11	16	20	23	25
Likely • 50-99% probability, or • could occur annually	7	12	17	21	24
Possible • 20-50% probability, or • could occur in 2-5 years	4	8	13	18	22
Unlikely • 1-20% probability, or • could occur in 5-20 years	2	5	9	14	19
Rare • <1% probability, or • Occurs less than once every 20 years	1	3	6	10	15
Consequence Category	**Negligible**	**Minor**	**Moderate**	**Serious**	**Disastrous**
	Reversible injury requiring first aid	Reversible injury resulting in 5 or less disabling days	Reversible injury resulting in more than 5 disabling days	Single fatality or permanent injury to 1 person	Multiple fatalities or permanent injury to more than 10 persons

Table 3: Subsidence Area Qualitative Risk Assessment Results

Hazard	Likelihood	Consequence Category	Risk Rating	Recommendation
Tripping hazard from settlement inside CSP less than 0.3 m deep	Rare	Negligible	1 (green)	Ongoing monitoring for increased settlement
Tripping hazard from settlement inside CSP more than 0.3 m deep	Rare	Minor	3 (green)	Ongoing monitoring for increased settlement
ATV flat tire from driving over raised CSP edge	Rare	Negligible	1 (green)	Ongoing monitoring for increased settlement
ATV rollover in thaw settlement depression more than 1 m deep	Rare	Moderate	6 (green)	Ongoing monitoring for increased settlement
ATV crash into exposed CSP that extends more than 1 m above ground surface	Rare	Moderate	6 (green)	Ongoing monitoring for increased settlement

6.0 CLOSURE AND RECOMMENDATIONS

Based on the geotechnical inspection completed on September 2, 2014 the decommissioned former Polaris mine site generally appeared to be in a stable condition. A qualitative risk assessment was carried out for safety hazards identified in the subsidence area that identified some minor risks that can be managed by ongoing monitoring. The next geotechnical inspections of the site are scheduled in 2019 and 2029 to identify if any additional settlement at the vent/backfill raises in the subsidence area increases risk to an unacceptable level. No potential safety risks to either humans or wildlife were identified for the other areas inspected in September 2014.

We trust this report meets your present requirements. Please feel free to contact the undersigned should you have any questions.

Report Signature Page

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TABLES

Table 1 - Summary of 2014 Polaris Geotechnical Inspection Waypoints and Photographs

Waypoint #	Photograph #	Date	Inspection Area	Description	Northing (m)	Easting (m)	Elevation (m)
1	1	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,765.70	558,435.30	37.62
2	2	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,796.89	558,424.33	32.33
3	3,4	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,842.11	558,405.08	32.09
4	5	2-Sep-14	Subsidence Area	Thaw settlement	8,368,861.02	558,385.35	23.20
5	6	2-Sep-14	Subsidence Area	Thaw settlement	8,368,781.29	558,325.37	35.21
6	7	2-Sep-14	Subsidence Area	Thaw settlement	8,368,803.34	558,347.12	29.21
7	8	2-Sep-14	Subsidence Area	Thaw settlement	8,368,911.51	558,275.04	18.39
8	9	2-Sep-14	Subsidence Area	Thaw settlement	8,368,933.39	558,245.27	19.59
9	10	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,992.77	558,233.03	14.55
10	11	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,003.94	558,241.42	12.86
11	12	2-Sep-14	Subsidence Area	Thaw settlement	8,369,002.25	558,197.93	12.14
12	13	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,018.89	558,189.71	13.82
13	14	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,018.34	558,188.34	0.00
14	15	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,043.66	558,156.88	9.50
15	16,17	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,069.90	558,166.19	5.65
16	18	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,095.93	558,137.33	3.97
17	19	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,090.54	558,140.10	3.01
18	20	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,098.79	558,159.16	0.13
19	21	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,100.28	558,156.98	1.09
20	22	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,101.81	558,162.37	0.13
21	23	2-Sep-14	Subsidence Area	Anchored metal plate	8,369,117.30	558,161.84	0.37
22	24	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,129.67	558,154.07	0.13
23	25	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,128.65	558,130.35	1.33
24	26	2-Sep-14	Subsidence Area	Thaw settlement	8,369,101.72	558,098.52	-3.72
25	27	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,087.36	558,085.99	-0.35
26	28,29	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,118.78	558,066.70	1.09
27	30	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,137.57	558,070.79	-1.32
28	31,32	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,126.25	558,079.51	-2.28
29	33	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,131.17	558,092.48	-1.56
30	34	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,132.73	558,103.46	0.37
31	35	2-Sep-14	Subsidence Area	Thaw settlement	8,369,144.81	558,100.15	1.09
32	36,37,38	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,145.41	558,084.16	1.09
33	39	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,160.20	558,174.00	-1.08
34	40	2-Sep-14	Subsidence Area	Thaw settlement	8,369,154.57	558,217.49	2.29
35	41	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,136.41	558,226.60	2.05
36	42	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,029.52	558,318.53	9.98
37/51	43	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,033.41	558,362.69	10.46
38/50	44	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,051.54	558,371.95	9.74

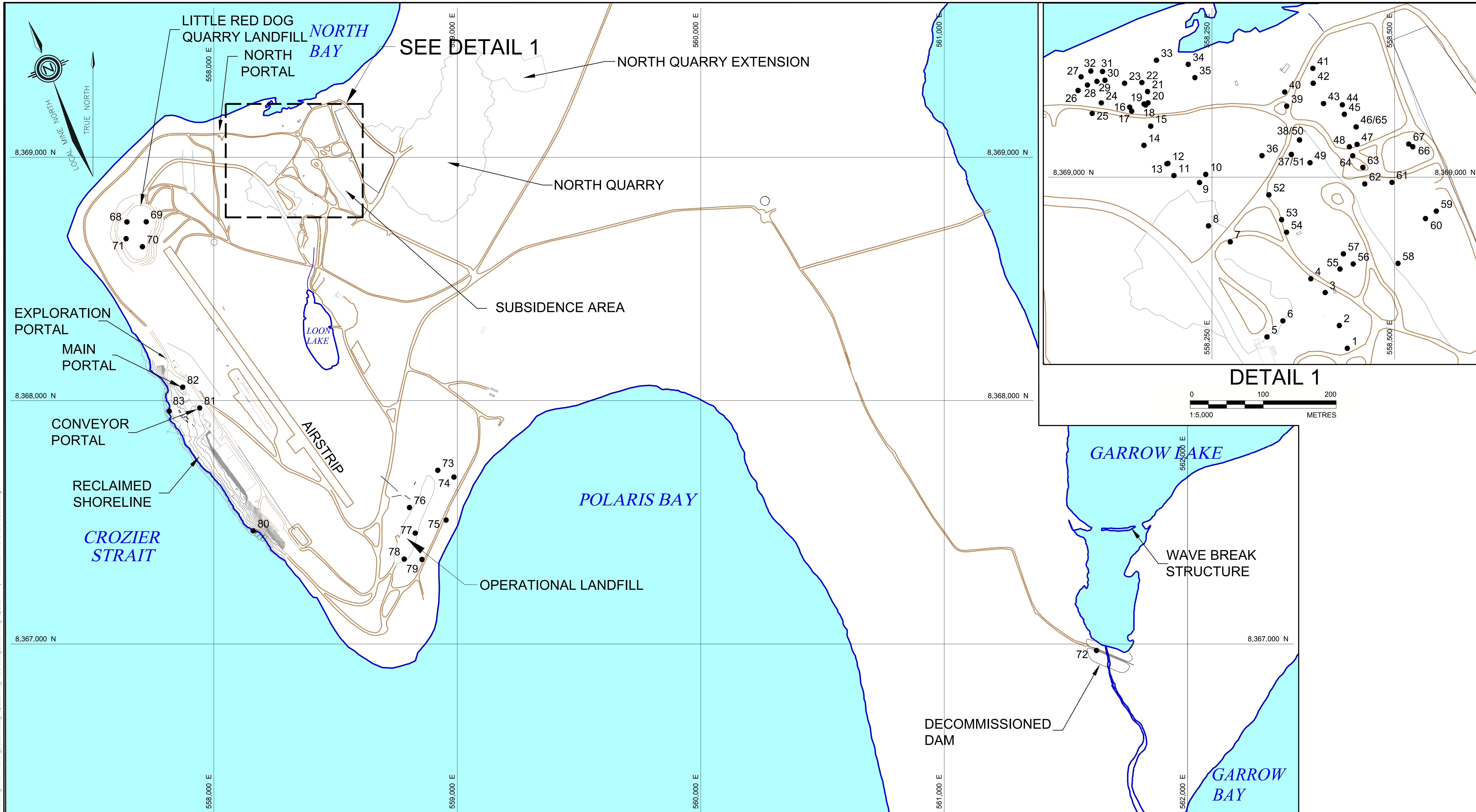
Table 1 - Summary of 2014 Polaris Geotechnical Inspection Waypoints and Photographs

Waypoint #	Photograph #	Date	Inspection Area	Description	Northing (m)	Easting (m)	Elevation (m)
39	45,46	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,097.41	558,352.35	7.34
40	47	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,116.73	558,349.60	5.65
41	48	2-Sep-14	Subsidence Area	Pole anchor	8,369,149.10	558,388.16	5.65
42	49	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,128.70	558,388.63	5.89
43	50	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,100.89	558,402.82	9.74
44	51	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,099.19	558,428.53	9.02
45	52	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,086.18	558,431.23	9.26
46/65	53	2-Sep-14	Subsidence Area	Thaw settlement	8,369,063.93	558,445.19	9.26
47	54,55	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,045.03	558,448.67	9.74
48	56,57	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,041.73	558,438.16	12.14
49	58,59	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,019.87	558,384.25	17.19
38/50	60	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,051.03	558,369.92	19.35
37/51	61	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,031.14	558,358.66	18.15
52	62	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,975.90	558,327.87	21.76
53	63	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,941.83	558,345.35	22.96
54	64	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,924.59	558,352.07	23.92
55	65	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,368,874.29	558,425.35	28.72
56	66	2-Sep-14	Subsidence Area	Thaw settlement	8,368,881.16	558,443.41	22.72
57	67	2-Sep-14	Subsidence Area	Thaw settlement	8,368,895.06	558,429.98	21.27
58	68,69	2-Sep-14	Subsidence Area	Thaw settlement	8,368,881.97	558,504.76	17.19
59	70	2-Sep-14	Subsidence Area	Tension crack	8,368,953.50	558,557.17	22.72
60	71	2-Sep-14	Subsidence Area	Tension crack	8,368,943.37	558,542.36	22.00
61	72,73	2-Sep-14	Subsidence Area	Thaw settlement	8,368,992.97	558,496.46	15.51
62	74	2-Sep-14	Subsidence Area	Ponded water	8,368,990.86	558,459.23	9.74
63	75	2-Sep-14	Subsidence Area	Ponded water	8,369,013.42	558,456.66	9.02
64	76	2-Sep-14	Subsidence Area	Ponded water	8,369,029.39	558,442.73	10.46
46/65	77,78	2-Sep-14	Subsidence Area	Thaw settlement	8,369,068.93	558,447.46	8.06
66	79	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,041.74	558,525.03	9.74
67	80	2-Sep-14	Subsidence Area	Vent/Backfill Raise	8,369,045.45	558,519.37	9.26
68	81	2-Sep-14	Little Red Dog Quarry Landfill	North end	8,368,734.09	557,643.27	20.31
69	82	2-Sep-14	Little Red Dog Quarry Landfill	East end	8,368,734.78	557,722.54	27.76
70	83-87	2-Sep-14	Little Red Dog Quarry Landfill	Southeast end	8,368,632.35	557,706.79	23.68
71	88	2-Sep-14	Little Red Dog Quarry Landfill	Southwest end	8,368,665.42	557,639.61	22.72
72	89-94	2-Sep-14	Garrow Lake Dam	Breach slopes and channel	8,366,973.44	561,625.93	4.45
73	95,96	2-Sep-14	Operational Landfill	North end crest	8,367,713.79	558,919.96	29.21
74	97,98	2-Sep-14	Operational Landfill	North end slope from toe	8,367,685.98	558,986.36	11.90
75	99	2-Sep-14	Operational Landfill	Panorama from toe of slope	8,367,509.19	558,954.14	1.57
76	100	2-Sep-14	Operational Landfill	Back of central crest	8,367,560.78	558,803.84	25.36

Table 1 - Summary of 2014 Polaris Geotechnical Inspection Waypoints and Photographs

Waypoint #	Photograph #	Date	Inspection Area	Description	Northing (m)	Easting (m)	Elevation (m)
77	101,102	2-Sep-14	Operational Landfill	South central crest	8,367,455.52	558,827.49	25.84
78	103,104,105	2-Sep-14	Operational Landfill	South end crest	8,367,348.90	558,782.18	25.84
79	106,107,108	2-Sep-14	Operational Landfill	South end slope	8,367,347.29	558,855.15	13.10
80	109,110	2-Sep-14	Marine Foreshore	Wood pile in water	8,367,465.16	558,161.49	4.93
81	111	2-Sep-14	Marine Foreshore	Conveyor Portal	8,367,969.97	557,942.01	9.26
82	112,113	2-Sep-14	Marine Foreshore	Main Portal	8,368,055.30	557,872.07	10.70
83	114	2-Sep-14	Marine Foreshore	Gravel berm deposition	8,367,956.48	557,817.01	9.02

FIGURES



0 250 500
1:15,000 METRES

LEGEND:

● 16 PHOTOGRAPH LOCATION NUMBER

REFERENCES:

1. GRID IS REFERENCED TO NAD83 ZONE 14.
2. SITE PLAN PROVIDED BY TECK RESOURCES LTD.

Teck

CLIENT
TECK RESOURCES LTD.

PROJECT
2014 POLARIS GEOTECHNICAL INSPECTION

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-09-28
PREPARED	TDR
DESIGN	DCJ
REVIEW	DCJ
APPROVED	WPM

TITLE
SITE PLAN AND PHOTOGRAPH LOCATIONS

PROJECT No.	PHASE	Rev.	FIGURE
1408454	4000	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A

2014 Polaris Geotechnical Inspection Photographs

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 1, Subsidence Area, Vent/Backfill Raise (WP#1)

Photo 2, Subsidence Area, Vent/Backfill Raise (WP#2)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 3, Subsidence Area, Vent/Backfill Raise (WP#3)

Photo 4, Subsidence Area, panoramic view facing East from WP#3

Photo 5, Subsidence Area, thaw settlement area (WP#4)

Photo 6, Subsidence Area, graded slope with some thaw settlement (WP#5)

Photo 7, Subsidence Area, thaw settlement area with tension cracks (WP#6)

Photo 8, Subsidence Area, shallow thaw settlement area (WP#7)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 9, Subsidence Area, tension cracks on slope (WP#8)

Photo 10, Subsidence Area, Vent/Backfill Raise (WP#9)

Date Taken: September 2, 2014
Project: 1408454

Golder Associates

Drawn: GK
Checked: DCJ

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 11, Subsidence Area, Vent/Backfill Raise with exposed CSP (WP#10)

Photo 12, Subsidence Area, minor thaw settlement (WP#11)

Date Taken: September 2, 2014
Project: 1408454

Golder Associates

Drawn: GK
Checked: DCJ

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 13, Subsidence Area, Vent/Backfill Raise (WP#12)

Photo 14, Subsidence Area, Vent/Backfill Raise (WP#13)

Date Taken: September 2, 2014
Project: 1408454

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Photo 15, Subsidence Area, Vent/Backfill Raise (WP#14)

Photo 16, Subsidence Area, thaw settlement adjacent to Vent/Backfill Raise (WP#15)

Photo 17, Subsidence Area, Vent/Backfill Raise (WP#15)

Photo 18, Subsidence Area, Vent/Backfill Raise (WP#16)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 19, Subsidence Area, Vent/Backfill Raise (WP#17)

Photo 20, Subsidence Area, Vent/Backfill Raise (WP#18)

Date Taken: September 2, 2014
Project: 1408454

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Appendix A - Polaris 2011 Geotechnical Inspection

Photo 21, Subsidence Area, Vent/Backfill Raise (WP#19)

Photo 22, Subsidence Area, Vent/Backfill Raise (WP#20)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 23, Subsidence Area, Anchored Metal Plate (WP#21)

Photo 24, Subsidence Area, Vent/Backfill Raise (WP#22)

Photo 25 , Subsidence Area, Vent/Backfill Raise with 0.3 m internal settlement (WP#23)

Photo 26, Subsidence Area, thaw settlement ~1m deep (WP#24)

Appendix A - Polaris 2011 Geotechnical Inspection

Photo 27, Subsidence Area, Vent/Backfill Raise (WP#25)

Photo 28, Subsidence Area, Vent/Backfill Raise (WP#26)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 29, Subsidence Area, facing North from WP#26

Photos 30, Subsidence Area, Vent/Backfill Raise with ~0.3 m internal settlement (WP#27)

Date Taken: September 2, 2014
Project: 1408454

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Appendix A - Polaris 2014 Geotechnical Inspection

Photo 31, Subsidence Area, Vent/Backfill Raise beside ponded water (WP#28)

Photo 32, Subsidence Area, Vent/Backfill Raise with ~0.3 m internal settlement (WP#28)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 33, Subsidence Area, Vent/Backfill Raise (WP#29)

Photo 34, Subsidence Area, Vent/Backfill Raise (WP#30)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 35, Subsidence Area, graded slope with some thaw settlement (WP#31)

Photo 36, Subsidence Area, Vent/Backfill Raise (WP#32)

Date Taken: September 2, 2014
Project: 1408454

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Checked: DCJ

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 37, Subsidence Area, Vent/Backfill Raise (WP#32)

Photo 38, Subsidence Area, facing North from WP#32

Photo 39, Subsidence Area, Vent/Backfill Raise (WP#33)

Photo 40, Subsidence Area, thaw settlement ~1m deep (WP#34)

Photo 41, Subsidence Area, Vent/Backfill Raise (WP#35)

Photo 42, Subsidence Area, Vent/Backfill Raise (WP#36)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 43, Subsidence Area, Vent/Backfill Raise (WP#37/51)

Photo 44, Subsidence Area, Vent/Backfill Raise (WP#38/50)

Photo 45, Subsidence Area, Vent/Backfill Raise with internal HPDE liner (WP#39)

Photo 46, Subsidence Area, Vent/Backfill Raise with internal HPDE liner (WP#39)

Photo 47, Subsidence Area, Vent/Backfill Raise (WP#40)

Photo 48, Subsidence Area, Pole Anchor (WP#41)

Photo 49, Subsidence Area, Vent/Backfill Raise (WP#42)

Photo 50, Subsidence Area, Vent/Backfill Raise (WP#43)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 51, Subsidence Area, Vent/Backfill Raise (WP#44)

Photo 52, Subsidence Area, Vent/Backfill Raise (WP#45)

Date Taken: September 2, 2014
Project: 1408454

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Drawn: GK
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Appendix A - Polaris 2014 Geotechnical Inspection

Photo 53, Subsidence Area, thaw settlement area (WP#46/65)

Photo 54, Subsidence Area, Vent/Backfill Raise (WP#47)

Appendix A - Polaris 2014 Geotechnical Inspection

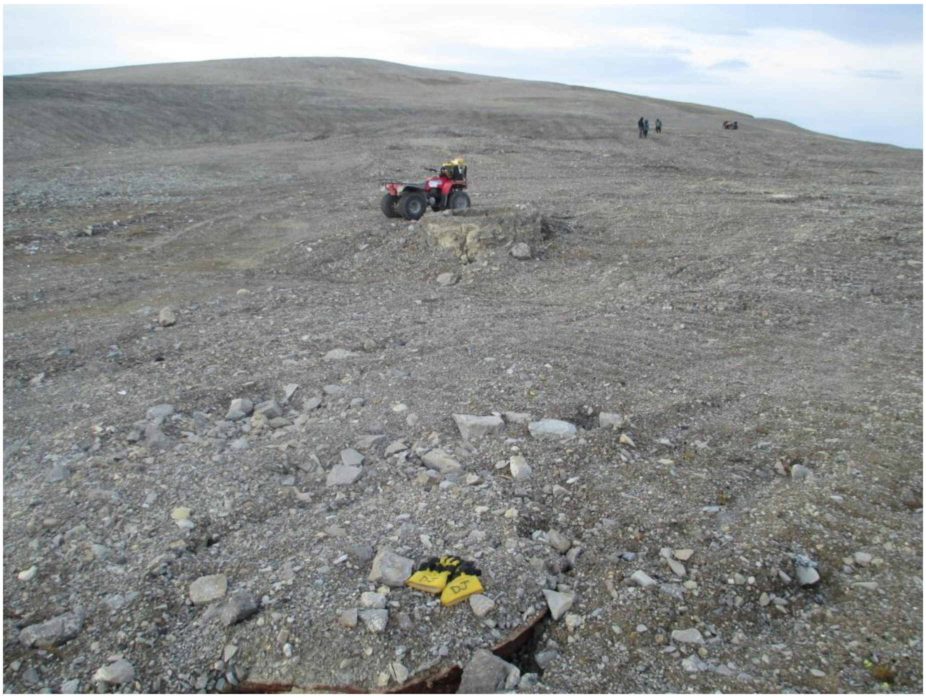

Photo 55, Subsidence Area, facing west from WP#47 towards WP#48

Photo 56, Subsidence Area, Vent/Backfill Raise (WP#48)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 57, Subsidence Area, Vent/Backfill Raise with ~0.7 m internal settlement (WP#48)

Photo 58, Subsidence Area, Vent/Backfill Raise (WP#49)

Date Taken: September 2, 2014
Project: 1408454

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Checked: DCJ

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 59, Subsidence Area, Vent/Backfill Raise sideview (WP#49)

Photo 60, Subsidence Area, Vent/Backfill Raise (WP#38/50)

Photo 61, Subsidence Area, Vent/Backfill Raise (WP#37/51)

Photo 62, Subsidence Area, Vent/Backfill Raise (WP#52)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 63, Subsidence Area, Vent/Backfill Raise (WP#53)

Photo 64, Subsidence Area, Vent/Backfill Raise (WP#54)

Date Taken: September 2, 2014
Project: 1408454

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Drawn: GK
Checked: DCJ

Photo 65, Subsidence Area, Vent/Backfill Raise (WP#55)

Photo 66, Subsidence Area, thaw settlement (WP#56)

Photo 67, Subsidence Area, thaw settlement (WP#57)

Photo 68, Subsidence Area, thaw settlement (WP#58)

Photo 69, Subsidence Area, facing Northeast from WP#58

Photo 70, Subsidence Area, old tension crack (WP#59)

Photo 71, Subsidence Area, old tension crack (WP#60)

Photo 72, Subsidence Area, thaw settlement (WP#61)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 73, Subsidence Area, facing Northwest from WP#61

Photo 74, Subsidence Area, ponded water (WP#62)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 75, Subsidence Area, ponded water (WP#63)

Photo 76, Subsidence Area, ponded water (WP#64)

Date Taken: September 2, 2014
Project: 1408454

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Drawn: GK
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Appendix A - Polaris 2014 Geotechnical Inspection

Photo 77, Subsidence Area, thaw settlement (WP#46/65)

Photo 78, Subsidence Area, thaw settlement (WP#46/65)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 79, Subsidence Area, Vent/Backfill Raise (WP#66)

Photo 80, Subsidence Area, Vent/Backfill Raise (WP#67)

Date Taken: September 2, 2014
Project: 1408454

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Appendix A - Polaris 2014 Geotechnical Inspection

Photo 81, Little Red Dog Quarry Landfill, North end near quarry entrance (WP#68)

Photo 82, Little Red Dog Quarry Landfill, East end facing quarry entrance (WP#69)

Date Taken: September 2, 2014
Project: 1408454

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Appendix A - Polaris 2014 Geotechnical Inspection

Photo 83, Little Red Dog Quarry Landfill, Southeast end facing rockfill berm (WP#70)

Photo 84, Little Red Dog Quarry Landfill, Southeast end facing West (WP#70)

Date Taken: September 2, 2014
Project: 1408454

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Photo 85, Little Red Dog Quarry Landfill, facing entrance to quarry from top of berm (WP#70)

Photo 86, Little Red Dog Quarry Landfill, top of rockfill berm in Southeast end (WP#70)

Photo 87, Little Red Dog Quarry Landfill, rockfill berm slope (WP#70)

Photo 88, Little Red Dog Quarry Landfill, Southwest end (WP#71)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 89, Garrow Lake Dam, facing East from West abutment (WP#72)

Photo 90, Garrow Lake Dam, facing North towards Garrow Lake (WP#72)

Date Taken: September 2, 2014
Project: 1408454

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Photo 91, Garrow Lake Dam, Garrow Creek facing South (WP#72)

Photo 92, Garrow Lake Dam, channel rip-rap (WP#72)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 93, Garrow Lake Dam, dam breach channel (WP#72)

Photo 94, Garrow Lake Dam, facing East across channel (WP#72)

Photo 95, Operational Landfill, crest at North end (WP#73)

Photo 96, Operational Landfill, crest at North end (WP#73)

Photo 97, Operational Landfill, facing upslope at North end (WP#74)

Photo 98, Operational Landfill, facing across slope at North end (WP#74)

Photo 99, Operational Landfill, Panorama from toe of slope (WP#75)

Photo 100, Operational Landfill, Back of central crest (WP#76)

Photo 101, Operational Landfill, South central crest facing North (WP#77)

Photo 102, Operational Landfill, South central crest facing South (WP#77)

Photo 103, Operational Landfill, Back of crest at South end (WP#78)

Photo 104, Operational Landfill, crest edge at South end (WP#78)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 105, Operational Landfill, South end facing down slope (WP#78)

Photo 106, Operational Landfill, South end slope (WP#79)

Photo 107, Operational Landfill, slope from toe at South end (WP#79)

Photo 108, Operational Landfill, slope from toe at South end (WP#79)

Photo 109, Marine Foreshore, wood pile in water (WP#80)

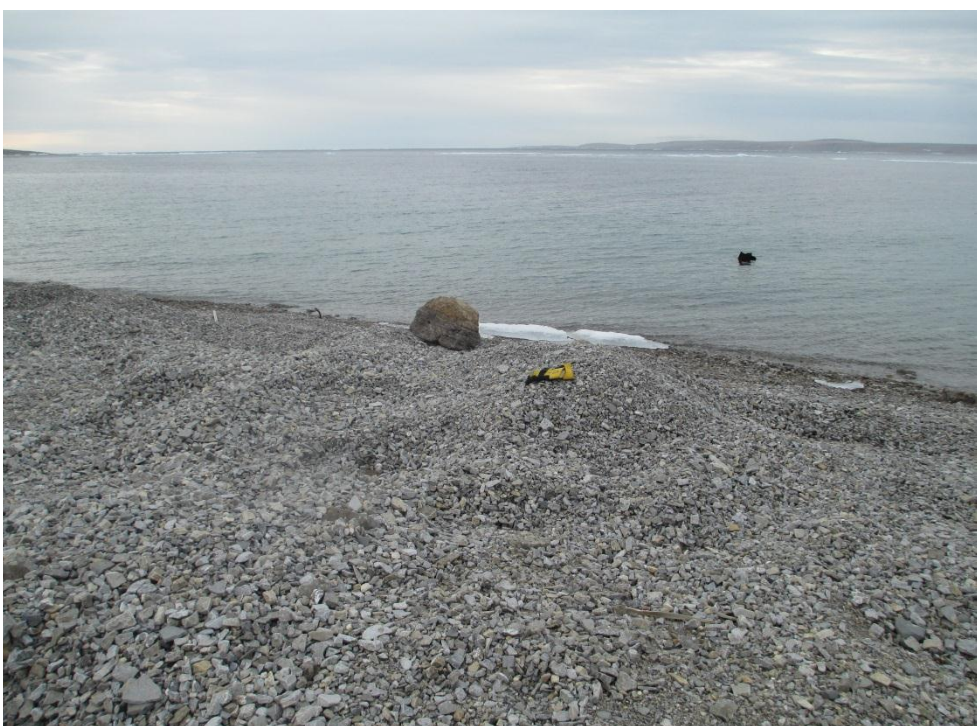

Photo 110, Marine Foreshore, wood pile in water (WP#80)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 111, Conveyor Portal (WP#81)

Photo 112, Main Portal, snow covered slope (WP#82)

Appendix A - Polaris 2014 Geotechnical Inspection

Photo 113, Main Portal, minor slumping of slope above portal (WP#82)

Photo 114, Marine Foreshore, gravel berm deposition from waves and ice (WP#83)

Date Taken: September 2, 2014
Project: 1408454

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