DOMINION DIAMOND

New Vision, New Focus, New Name

Ekati Diamond Mine
Waste Rock and Ore Storage Management Plan

Version 4.1, May 2014

May 5, 2014

Wek'èezhìi Land and Water Board
#1, 4905 – 48th Street
Yellowknife, NT
X1A 3S3

Attention: Violet Camsell-Blondin, Chair

Dear Ms. Camsell-Blondin:

Re: Waste Rock and Ore Storage Management Plan Version 4

In its letter dated March 13, 2014, the Board approved Dominion's proposed amendment the Waste Rock and Ore Storage Management Plan (WROMP) that would incorporate the Pigeon Waste Rock Storage Area. Version 4.1 of the WROMP (attached) incorporates that amendment and the other requests provided in the Board's approval and by Board staff. Based on this submission and following from the Board's March approval, Dominion will proceed with construction of the Pigeon WRSA.

Dominion appreciates the effort that the Board and staff have put into the review of the Pigeon amendment, which is a critical development for the on-going operation of the Ekati Diamond Mine. Please contact the undersigned at 669-6116 or Claudine Lee, Superintendent Environment Operations, at (867) 880-2232 if you have any questions or require additional information.

Sincerely,

Eric Denholm, Superintendent Traditional Knowledge and Permitting
Ekati Diamond Mine

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1 Introduction

1.1 Background

Part H.3 of Water Licence W2012L2-0001 for the Ekati Diamond Mine requires a Waste Rock and Ore Storage Management Plan (WROMP or Plan). Detailed requirements for the Plan are specified in Schedule 6 Item 2 of the Water Licence. This update to the Plan, Version 4, addresses the incorporation of the Pigeon WRSA that was approved by the Wek'eezhii Land and Water Board (Board) in March 2014. The Design Plan prepared by the professional design engineer, Tetratech EBA, is appended. Version 4 of the Plan also addresses other requests and directives of the Board as well as editorial and numerical updates. Table 1.1 provides the history of previous versions and amendments to the WROMP.

Version 4 of the Plan has been prepared with technical support from Tetratech EBA, who prepared the Design Plan for the Pigeon WRSA, and the geochemical characterization of the Pigeon waste rock, and SRK Consulting, who previously provided geochemical characterizations. Version 4 of the Plan relies on the most recent ground temperature and seepage monitoring information as published in the *2013 Waste Rock and Waste Rock Storage Area Seepage Survey Report*, *March 2014*, which was prepared with technical support from Tetratech EBA and SRK Consulting.

Table 1.1. Previous Versions of the Plan

Report Title	Year	Areas Covered
Waste Rock and Ore Storage Management Plan	2000 Version 1 (revised 2001 Version 2)	Panda, Koala, Koala North, Misery, Fox
Addendum #1 Waste Rock and Ore Storage Management Plan	2002	Fox pipe
Addendum #2 Beartooth Pipe Waste Rock and Ore Storage Management Plan	2003	Beartooth Pipe
Addendum #3 Expansion of the Panda/Koala WRSA	2007	Panda/Koala
Addendum #4 Misery Waste Rock Storage Area Modification	2010	Misery
Version 3.0	2011	Incorporate relevant aspects of the subsequently eliminated Geochemical Characterization and Metal Leaching (ML) Management Plan, 2007

1.2 Plan Alignment with Requirements

Table 1.2 correlates the Plan with the Water Licence requirements. Table 1.3 correlates the Plan with the Board's Directive for Version 4 of the WROMP, dated March 10, 2014.

Table 1.2. Alignment with Water Licence Requirements

Water Licence Requirement Per Schedule 6 Item 2	Location in WROMP
ARD Characterization	
(a) characterization of the rock types (b) representative sampling and testing (c) assessment of potential for ARD/ML	S.3, Appendix A
(d) predicted loadings and/or impacts	S.5
(e) geochemical characterization for reclamation	see note
(f) process to revise and assess the plans	S.3
Waste Rock and Ore Storage Management	
(g) material schedules and destinations	S.2
(h) description of WRSA's (i) descriptions and locations of wastes in WRSA's	S.6
(j) sources of seepage wrt receiving environment (k) management of seepage	S.7
(l) management of PAG materials	S.6
(m) temperature analysis	S.4
(n) seepage survey methods	S.7, Appendix B
(o) Sable and Pigeon geochemical criteria	S.6

Note: As with previous versions of this Plan, a geochemical characterization of material to be used for reclamation (Schedule 6 Item 2(e)) is provided separately through the Interim Closure and Reclamation Plan.

Table 1.3. **Alignment with Board Directive for Version 4**

Directive	Location in WROMP
1 (a) Notification of change in circumstances	S.6.1
1 (b) Design of Pigeon WRSA	S.6.7, Appendix C
1 (c) Waste rock sampling procedures	S.7.3
1 (d) Table of changes	S.1.3
2 Management of temporary kimberlite storage areas	S.6.8

1.3 Changes in Version 4

Table 1.4 lists the primary changes to the WROMP for Version 4. Editorial updates and corrections are not listed.

Table 1.4 Primary Changes for WROMP Version 4

Location	Change	Rationale
S.1.3	New	Identifies primary changes for V.4 (Board Directive)
S.3.7	Updated	Reflects most recent (2013) data assessment
S.3.9	Updated	Reflects most recent (2013) data assessment
S.3.10	New	Provides Pigeon geochemical characterization
S.4	Updated	Reflects most recent (2013) data assessment
S.6.1	New text added	Provides for notification of changed circumstances to Board (Board directive)
S.6.7	New	Describes Pigeon WRSA (Board directive)
S.6.8	New	Clarifies management of temporary kimberlite storage areas (Board directive)
S.7.3	New bullet	Provides Pigeon waste rock monitoring schedule
S.7.3	New bullet	Clarifies sampling procedure for ‘out of plan’ waste rock (Board directive)
Appendix C	New	Provides Pigeon WRSA Design Plan
Appendix D	New	Provides the most recent (2013) temperature assessment

2 Site Description

2.1 Introduction

The Ekati Diamond Mine is located in the Northwest Territories approximately 300 km northeast of Yellowknife (Figure 2.1). The mine officially opened in October 1998. Planned mining activities are complete in three kimberlite pipes (Panda, Beartooth and Fox) and four remain as part of the planned mining activities to 2019 (Koala underground, Koala North underground, Misery open pit and Pigeon open pit). Future development opportunities include Lynx (undergoing permitting), Sable (permitted), Jay (undergoing environmental assessment), Fox Deep and other diamond-bearing kimberlite pipes. This Plan would be amended to incorporate any of the possible future developments. A list of the completed and planned mine components and the corresponding waste rock storage areas (WRSA) is provided in Table 2.1, with their locations shown in Figure 2.1 and Figure 2.2.

Table 2.1: Planned and Completed Mining Activities and WRSA's

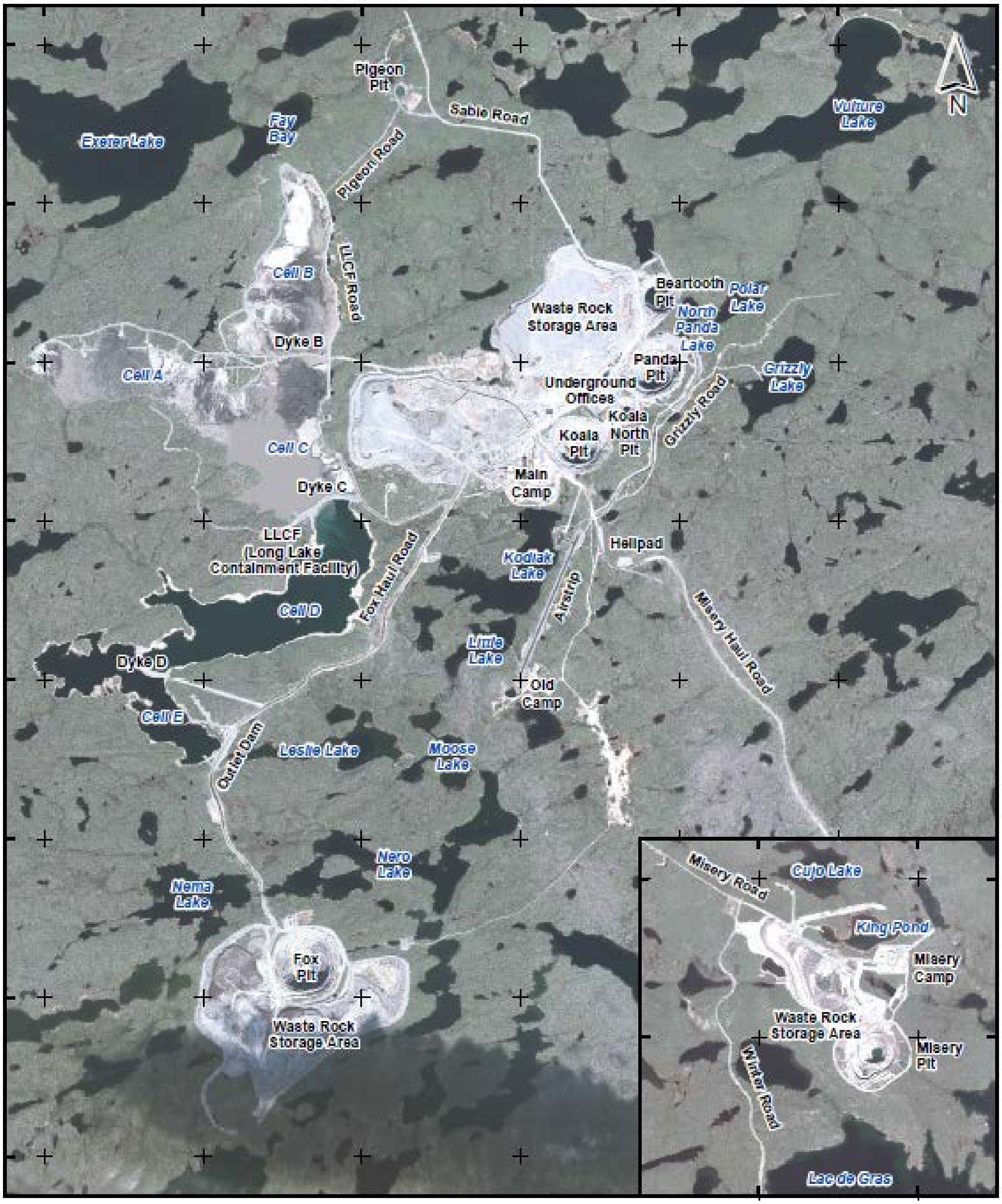
Open Pits	Underground	Waste Rock Storage Areas
Panda (completed)	Panda (completed)	Panda/Koala/Beartooth
Koala (completed)	Koala (underway)	Panda/Koala/Beartooth
Koala North (completed)	Koala North (underway)	Panda/Koala/Beartooth
Beartooth (completed	None Planned	Panda/Koala/Beartooth
Fox (completed)	None Planned	Fox
Misery (underway)	None Planned	Misery
Pigeon (planned 2014)	None Planned	Pigeon (rock and till) and Panda/Koala/Beartooth (till)

2.2 Topography and Geomorphology

The Ekati Diamond Mine is located north of the tree line within sub-Arctic tundra of the Lac de Gras watershed. The mine lies within the zone of continuous permafrost with a seasonal shallow active layer. The original topography and geomorphology of each of the mined areas is described in the previous WROMP and addendum's (BHP 2000, 2002, 2003). Prior to mining, each of the kimberlite pipes was covered by a lake which was subsequently drained to allow mining development. Where possible, lake sediments, glacial sediments and topsoil were removed and stored for possible use during reclamation. The current topography and geomorphology reflects a mined and natural landscape with waste rock storage areas, pit developments and infrastructure surrounded by tundra. The surrounding landscape has low to moderate relief with low-lying muskeg and swamp interspersed with moderately sloping rounded hills. This is intersected by numerous lakes and patchy rock outcrops. Rare rock escarpments and ravines are also present. Glacial deposits are common including tills, moraines, kames, eskers and significant boulder fields.

Figure 2.1 Location of the Ekati Diamond Mine and Kimberlite Pipes

Figure 2.2 Location of Major Mine Components



2.3 Site Geology

The Ekati Diamond Mine is located within the central portion of the Archean Slave Structural Province. The geology of the Ekati claim block is illustrated in Figure 2.3. The detailed geology of each kimberlite pipe is described in Appendix A while the site geology is summarized here.

The following rock types are present on the property, in order of decreasing age (based on geological time scales of millions (Ma) and billions (Ga) of years):

- Archean (>2.66 Ga) **biotite schist/metasediment (occur primarily at Misery pipe)** of the Burwash Formation (Yellowknife Supergroup) formed by the action of heat and pressure on muddy and sandy sediments deposited underwater;
- Archean (2.63-2.58 Ga) **granitic to dioritic plutons (occur at all pipes)** of various compositions (most commonly biotite granite) intruded as hot melts into the metasediments;
- Narrow (several metres thick) Proterozoic (2.23-1.27 Ga) **diabase dykes (observed in Fox, Misery and Beartooth pipes)** of the Mackenzie dyke swarm intruded as hot melts into cracks in the metasediments and plutons; and
- Phanerozoic (75-45 Ma) **kimberlite** pipes intruded into all of the above, but dominantly in the granitic intrusions.
- Figure 2.4 provides a schematic diagram for a typical vertical cross section of an Ekati kimberlite pipe.

The composition of these rocks is predictable regionally and locally across the property. The rock units at Ekati are visibly very distinctive and the contacts between the different rock types are well defined and easily observed in the field. The host rocks generally show no effects from contact with kimberlite, due to the nature of kimberlite emplacement. The kimberlite pipes were intruded rapidly and explosively as relatively cool molten rock from deeper in the crust, resulting in no significant mineralogical or chemical alteration of the surrounding host rocks. This contrasts sharply with the formation of metal and gold ore deposits which typically result from circulation of hot water through the rock and often results in alteration of the host rocks adjacent to the ore body, and can later result in generation of acidic runoff when exposed to the atmosphere.

Very low concentrations of sulphide minerals are found in all rock types on the property. Granites and diabase contain rare disseminated grains of pyrite and chalcopyrite at average concentrations of 0.02% for granite and 0.1% for diabase. Metasediments contain low concentrations (average 0.2%) of fine-grained disseminated pyrite, pyrrhotite, and chalcopyrite. These rock types also have low concentrations of carbonate minerals (typically calcite) which mostly occur as fracture fillings. Kimberlite also contains low concentrations (average 0.3%) of fine-grained disseminated pyrite, and has abundant associated carbonate (i.e. calcite).

Overall, the country rocks and subsequently the waste rock are geochemically non-reactive or have low reactivity.

Figure 2.3 Geology of the Ekati Claim Block

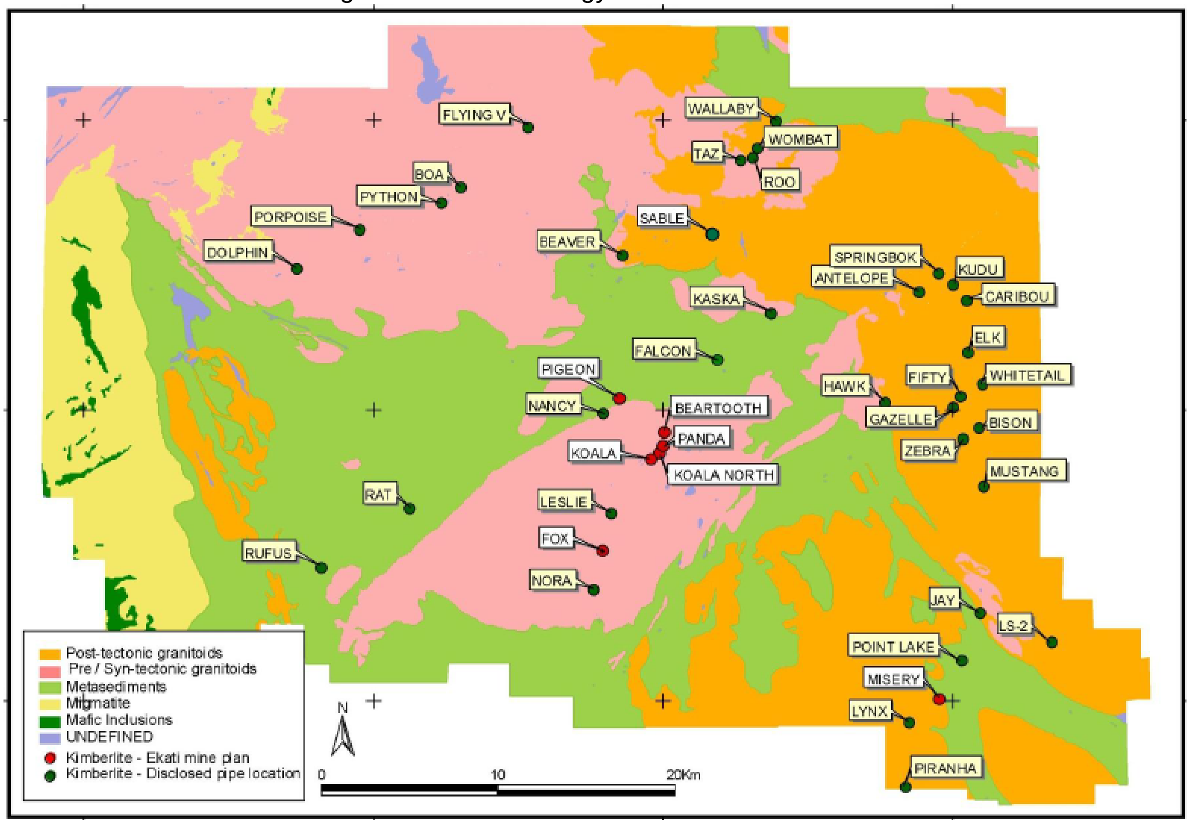
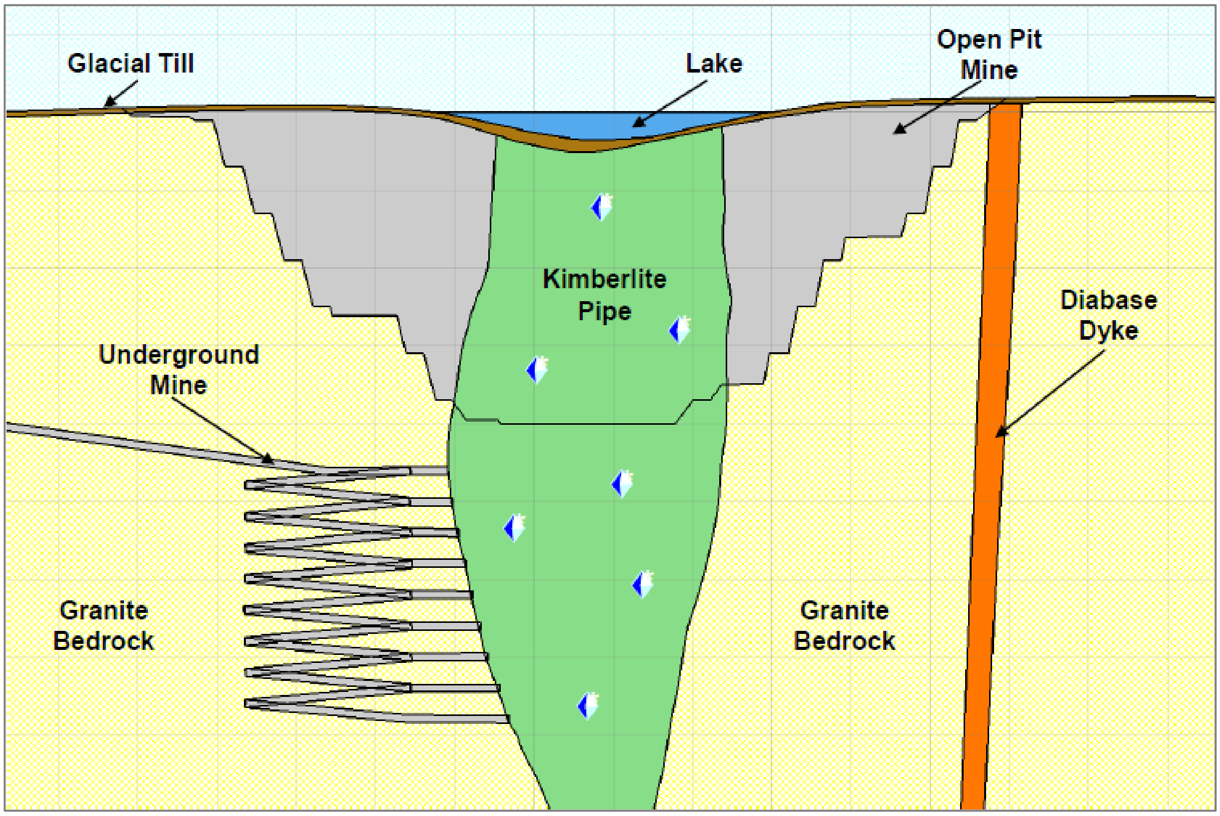


Figure 2.4 Typical Section of Kimberlite Pipe and Mine Workings



2.4 Mining Activities and Existing Storage Areas

Waste materials from open pit and underground mining are placed in WRSA's located adjacent to open pit operations. The WRSA's also contain and store other materials including coarse kimberlite rejects, kimberlite stockpiles, lake sediments, glacial tills and landfill material. Salvage topsoil as well as co-mixed lake sediments/glacial till have also been stockpiled adjacent to WRSA's. There are currently three separate WRSA's constructed at Ekati (Panda/Koala/Beartooth, Fox, and Misery) and an overburden storage area at Pigeon.

The WRSA's at Ekati are all designed and constructed to meet the following primary objectives:

- To be inherently, physically stable structures, both during mine operations and in the long term;

- Designed as permanent structures to remain after mining is completed;
- Constructed to promote permafrost aggradation; and
- Designed to achieve reasonable balance between surface footprint and height, with 50 m the target maximum height.

Waste Rock Storage Areas at Ekati are constructed to minimize the risk of runoff originating from them and to encourage permafrost formation. As Ekati is located within the climate zone of continuous permafrost, water infiltrating the WRSA's becomes trapped in the waste rock as ice when it encounters sub-freezing internal temperatures. Leaching from waste rock is thus limited to the outer surface of the waste rock (active layer) where water produced by melting of seasonal surficial ice and snow runs over the trapped ice surface.

Figure 2.5 provides a schematic diagram illustrating the ice formation and hydrological model for WRSA's.

The following is a list of generic features that are incorporated into the design of WRSA's at Ekati:

- Construction of a basal layer of granitic waste rock over the tundra, prior to construction of the WRSA. This allows early aggradation of permafrost into the base of the waste rock and limits contact of potentially reactive waste rock with surface flow over tundra soils, which can be naturally acidic;
- Encapsulation of potentially reactive materials (e.g. metasediment) within a thermally protective and geochemically non-reactive cover such that the potentially reactive materials remain at freezing conditions, thereby ensuring stable storage over time;
- Use of rock with low reactivity in zones expected to be subject to seasonal thawing (i.e. the active layer of the piles is intentionally constructed with a granite or glacial till cap);
- Construction of toe berms in selected areas (i.e. drainage gullies) to limit runoff of water from the waste rock; and
- Setbacks from the receiving water bodies as a mitigation measure to allow for attenuation of drainage by tundra soils and contingencies such as construction of frozen toe berms, and water collection structures.

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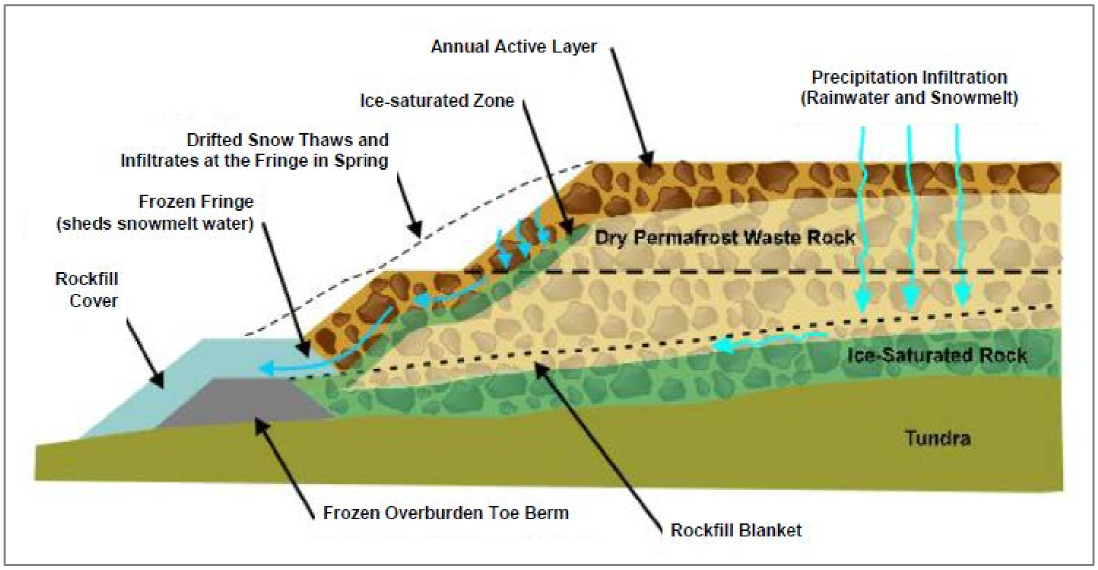
Figure 2.5 Ice Formation in Waste Rock Storage Areas



Application of the above features depends on the specific geochemical characteristics of the waste rock in combination with the topographical features and proximity to the receiving environment for any runoff.

The following sections describe the mining activities for each kimberlite pipe and the associated WRSA's.

The quantity of waste rock removed from each pipe is summarized in Table 2.2.The general design criteria of the WRSA's are shown in Table 2.3.

Table 2.2 Waste Rock Tonnages to 2013

Geological Unit	Million Tonnes Mined – to December 2013					
	Panda	Koala	Koala N	Beartooth	Misery	Fox
Surficial Material	8.6	9.8	0.1	2.0	3.0	7.2
Granite - pit	75.5	61.5	2.9	28.6	29.2	110.6
- underground	4.9	0.9	0.7	na	na	na
Waste Kimberlite	0	0	0	0	0	28.2
Metasediments	0	0	0	0[1]	25.0	0
Diabase	0	0	0	0	1.3	2.8

Notes: 1. A minor incidental quantity of metaseidemtn was mined in the Beartooth Pit (3,000 m^3) that does not appear when rounded to millions.

Table 2.3 General Design Criteria of Waste Rock Storage Areas

Design Parameter	Unit	General Criteria (see note)
Ramp Gradient	%	8 - 10
Road Width	m	30 - 32
Distance from high water marks	m	100
Angle of repose	degrees	35 – 37
Dump lift heights	m	Variable, typ 10-20
Maximum overall height above underlying tundra	m	Target 50
Overall slope angle	degrees	Variable, typ 18 - 28

Note: Design criteria are developed individually for each WRSA dependent on site-specific conditions.

2.4.1 Panda/Koala/Beartooth Production History

Surface mining at Panda Pit spanned 1998 to 2004. Production from Panda underground began in 2005 and was completed in 2010.

Full scale surface mining at Koala began in 2003 and was completed in 2005. A short period of mining in 2006 completed surface mining within Koala Pit. The first exploration drift at Koala underground was in 2005. Underground production from Koala began in 2007 and is on-going.

Koala North open pit mining began in 2001 and was completed in 2003. Production from Koala North underground began in April 2010 and is on-going.

The Beartooth kimberlite pipe was mined by open pit methods from 2004 until 2009, at which time mining operations at the pit ceased.

The tonnages produced from each kimberlite pipe are summarized by rock type in Table 2.2.

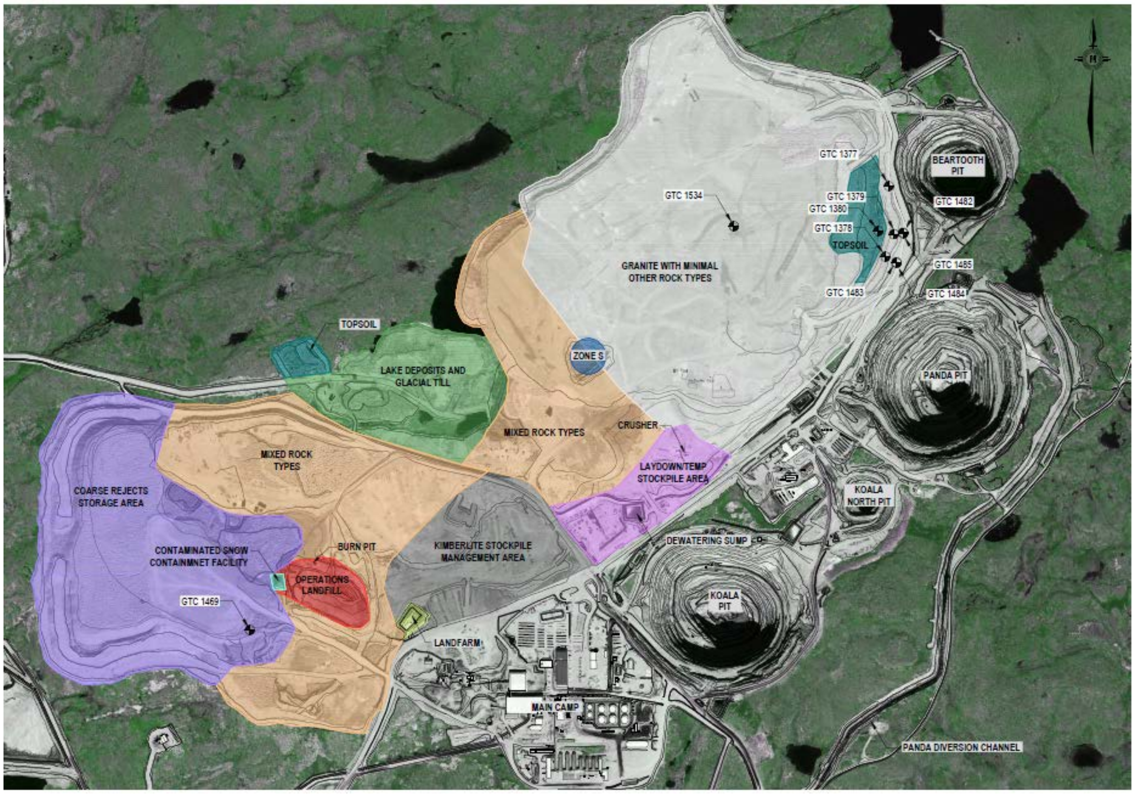
2.4.2 Panda/Koala/Beartooth Waste Rock Storage Area

Waste materials from the Panda, Koala, Koala North, and Beartooth open pits, and the Panda and Koala underground developments are stored together in the waste rock storage area close to the main camp. This WRSA also contains several other waste management facilities including the Coarse Kimberlite Reject Storage Area and the Koala and Beartooth Topsoil Storage Areas. These facilities are discussed below. The total area covered by the Panda/Koala/Beartooth WRSA (defined as the constructed perimeter berms and all enclosed land, including the uncovered tundra) is 4,281,000 m^2. The maximum elevation of the WRSA is 520 m above sea level (ASL), 40 m above the local average tundra elevation of 480 m ASL. The footprint of the WRSA is shown in Figure 2.6.

Waste rock from the Panda, Koala, Koala North, and Beartooth developments consists primarily of biotite granite with minor quantities of kimberlite from rock near the waste/ore geological contact (estimated to be less than 3% of the total waste rock quantity). Beartooth waste rock also includes incidental minor quantities of metasediments (<0.1% of total Beartooth waste rock).

Construction of the Panda/Koala/Beartooth WRSA is complete except for on-going placement of coarse kimberlite rejects, placement of minor incidental underground development rock and placement of glacial till from the Pigeon pit.

Figure 2.6 Panda/Koala/Beartooth WRSA Material Locations



Coarse Kimberlite Reject Storage Area

The Coarse Kimberlite Reject Storage Area (CKRSA) has received material from the Process Plant since 1998. The CKRSA contains processed kimberlite from all pipes at Ekati. The Coarse Kimberlite Rejects (CKR), or Coarse Processed Kimberlite (CPK), are comprised of a mixture of sand to gravel-sized, light and dense minerals remaining after the diamonds have been recovered from the kimberlite. The grain size distribution is in the range of 0.5 to 25 mm diameter. Finer material (<0.5 mm) washed from the kimberlite ore during processing (Fine Processed Kimberlite - FPK) is discharged as a slurry to the Long Lake Containment Facility (LLCF).

As the Panda/Koala waste rock storage facilities were the first to be constructed, the CKRSA was built prior to the knowledge that interaction of kimberlite materials with the naturally acidic tundra soils can result in low pH waters resembling acid rock drainage with high solute concentrations, despite the high neutralization potential within the CKR (SRK 2001; Day *et al.*

2003). As such, early portions of the CKRSA were not built with an underlying granite pad. Subsequently, a granite shell was constructed around the outer edges of the CKRSA to ensure that the CKR remained in permanently frozen portions of the pile. Further expansions of the CKRSA and all newly constructed waste rock storage facilities at all mine components were constructed with a pre-laid granite pad, and operational management procedures are in place to limit accidental disposal of kimberlite in the WRSA's.

Lake Deposits and Glacial Tills

The Panda/Koala Lake Deposits and Glacial Till Storage Area (Figure 2.6) contains lake-bottom sediments and overburden tills excavated during the development of the Panda and Koala North Pits (estimated volume of 20.5 million tonnes) for use during reclamation. This material is mixed to a limited degree with waste rock during transportation. Koala and Beartooth lake sediments were also mixed with waste rock in the western portions of the WRSA.

Salvaged Topsoil

Topsoil, salvaged from the original Koala Lake perimeter has been stockpiled north of the Panda/Koala WRSA. Topsoil from the Beartooth Lake perimeter has been stockpiled on the east end of the WRSA.

Operations Landfill

The Main Camp solid waste landfill was commissioned in July 1998 and is located on the western side of the Panda/Koala/Beartooth WRSA (Figure 2.6). The landfill is an approved facility (under the 1995 Environmental Impact Statement (EIS) and its operation is inspected regularly. The landfill is used for the disposal of inert non-hazardous wastes (metal, cement, etc.) generated as part of the operation of the mine.

Contaminated Snow Containment Facility

The Contaminated Snow/Ice Containment Facility (CSCF) was constructed in 2004 on the CKRSA on the western side of the WRSA (Figure 2.6). The CSCF is an approved facility (under the 1995 EIS and its operation is inspected regularly.The CSCF is a bermed and lined engineered facility designed for the containment of hydrocarbon-impacted snow and ice that are generated as a result of operational spills (diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid and lube oil). Following the spring melt, the hydrocarbon contaminated sheen floating on the surface of the water is physically removed. The remaining water is sampled and tested for hydrocarbons prior to disposal into Cell B of the LLCF.

Landfarm

The landfarm was constructed in 1998 and is a lined engineered facility designed with a leachate collection system and side berms to control runoff. The landfarm is an approved facility (under the 1995 EIS and its operation is inspected regularly. The landfarm is utilized for the management of hydrocarbon-impacted soil generated at the site as a result of operational spills (diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid and lube oil). Hydrocarbon impacted soils with average particle sizes of less than 4 cm are bio-remediated at the landfarm facility. The landfarm may also be used as secure temporary storage for hydrocarbon-impacted material which is unsuitable for bio-remediation, prior to these materials being sent offsite for disposal.

Zone S

Hydrocarbon impacted soils and rock with average particle sizes of greater than 4 cm are combined with waste rock in Zone S of the Panda/Koala/Beartooth WRSA to be encapsulated within the permafrost zone of the WRSA.

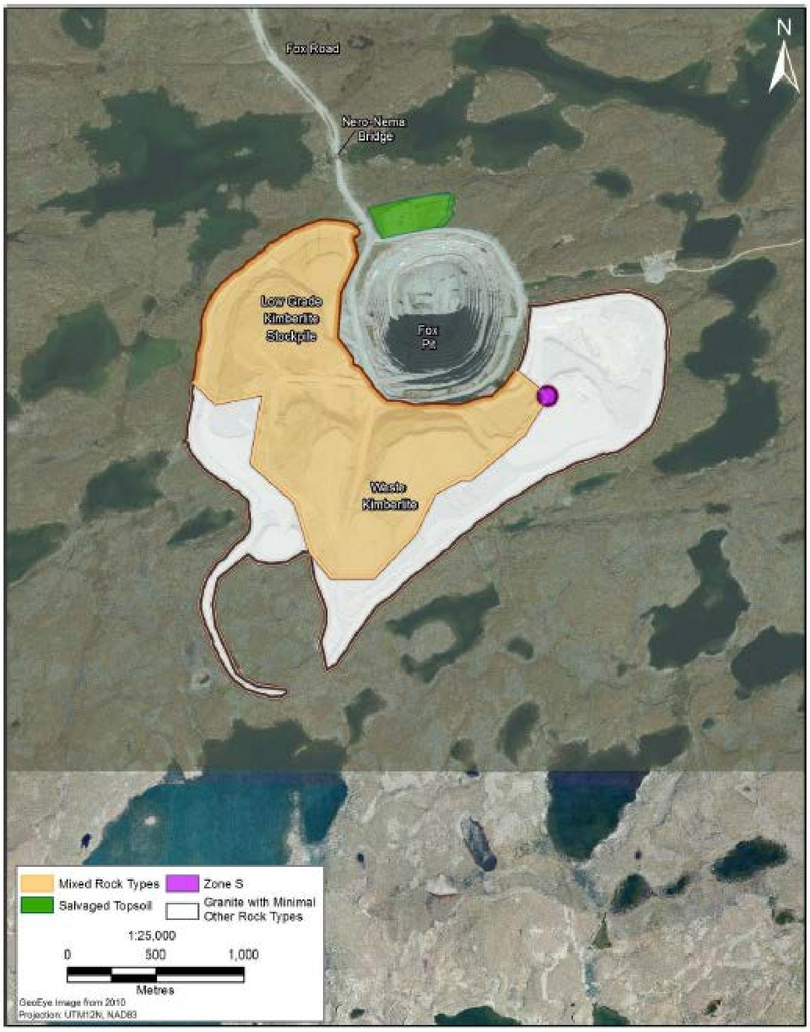
Sump Water Disposal Area

The Sump Water Disposal Area (SWDA also known as the Racetrack) was closed in September 2006. It is located within the footprint of the CKRSA and was designated for the disposal of excess water that had been decanted from the landfarm, CSCF, truck shop sumps and collection ponds or other sources of minewater. Minewater includes runoff from facilities associated with the mine operation and all water or waste pumped or flowing out of any open pit or underground mine. Seepage flowed from the SWDA to the LLCF. All wastewater that formerly discharged to the SWDA now goes directly to Cell B of the LLCF.

2.4.3 Fox Production History

The Fox pipe is the largest of the mining development pipes (17 ha at surface; Figure 2.7) and is located approximately 15 km southwest of the main camp. The Fox pipe was developed by open pit mining methods. Development began in 2002 with mine production starting late in 2005 and was completed in spring 2014. The quantities of various rock units that have been removed from the Fox Pit are provided in Table 2.2.Kimberlite ore from Fox Pit was hauled to the main process plant. Coarse kimberlite rejects from Fox were placed within the existing Panda/Koala/Beartooth CKRSA.

Figure 2.7 Fox WRSA Material Locations



2.4.4 Fox Waste Rock Storage Area

The Fox WRSA covers the western, southern and eastern areas immediately adjacent to the pit. The Fox WRSA is the repository for all waste rock from the Fox Pit. The total area covered by the Fox WRSA (defined as the constructed perimeter berms and all enclosed land including the uncovered tundra) is 3,830,000 m^2. The maximum elevation of the WRSA is 510 m ASL, 50 m above the local average tundra elevation of 460 m ASL. The footprint of the Fox WRSA is shown on Figure 2.7.

The Fox WRSA consists of granite co-disposed with minor diabase, lake-bottom sediments and till. Waste kimberlite is segregated and located within the Fox WRSA in a south-central location and along the northwest side (Figure 2.7). Granite pads were pre-laid to avoid direct contact of waste kimberlite with tundra water and to promote freezing in the pile. All of the waste kimberlite within the WRSA is surrounded by an extensive (~40 m thick) granite zone. Toe berms that limit seepage flows from the Fox WRSA to the surrounding receiving environment were constructed during the fall and winter of 2003/2004.

Limited topsoil from the perimeter of the Fox Lake was salvaged for future reclamation efforts during pre-stripping in 2003. This material has been stored north of the Fox pit (Figure 2.7).

Similar to the Panda/Koala/Beartooth WRSA the Fox WRSA has a Zone S (Figure 2.7) where hydrocarbon impacted soils and rock with average particle sizes of greater than 4 cm are combined with waste rock to be encapsulated within the permafrost zone of the WRSA.

Construction of the Fox WRSA is complete.

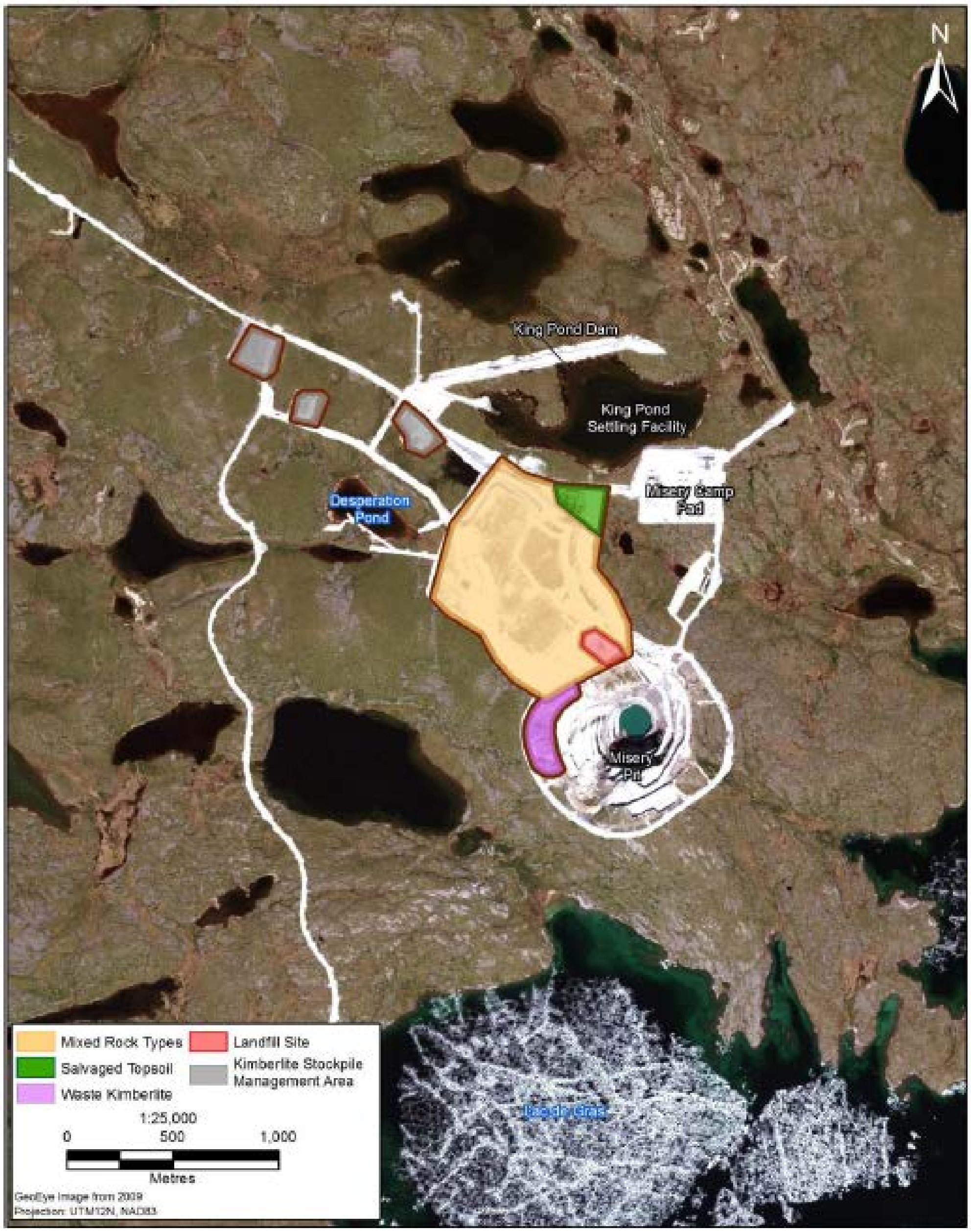
2.4.5 Misery Production History

The Misery pipe is located approximately 30 km southeast of the main camp, close to Lac de Gras. Stripping of the Misery Pit and construction of the WRSA was initiated in 2000 with mine production occurring from 2001 to 2005 by open pit methods. Open pit mining resumed in 2012 as a push-back of the initial open pit.

Table 2.2 provides the quantities of various rock units that have been removed from the Misery Pit. Misery Waste Rock Storage Area

Major facilities in the Misery area include the Misery Pit, the Misery WRSA, the Temporary Kimberlite Storage Area, and Misery Camp. The footprint of these facilities is shown in Figure 2.8. The Misery WRSA is under construction. The total area to be covered by the Misery WRSA (defined as the constructed perimeter berms and all enclosed land including the uncovered tundra) is 1.4M m^2. The maximum elevation of the WRSA will be 500 m ASL, 50 m above the local average tundra elevation of 450 m ASL.

Figure 2.8 Misery WRSA Material Locations



2.4.6 Misery Waste Rick Storage Area

The Misery WRSA is constructed to encapsulate all potentially acid generating (PAG) metasediments within the permanently frozen portions of the pile. Methods used include alternating layers of potentially reactive metasediments (10 m thick) and non-reactive granite and diabase (5 m thick) (Figure 2.9). A final 5 m thick granite cap was placed over the interim storage area in May and June of 2005 and will be placed over the final WRSA upon completion. This is done to maintain the active freeze/thaw zone within the upper granite layer to minimize potential oxidation within the metasediments.

Processed kimberlite from Misery is stored within the existing Panda/Koala/Beartooth CKRSA .

Temporary Kimberlite Ore Storage Areas are used to stockpile kimberlite ore prior to hauling to the main camp for processing. A previous Waste Kimberlite Storage Area was used to store kimberlite that was undergoing further diamond testing (Figure 2.8), constructed by stripping away organic soils for reclamation purposes prior to placing the kimberlite. Materials in the previous Waste Kimberlite Storage Area have been moved to the WRSA or covered over and frozen in place by more recent waste rock placement.

The north end of the Misery WRSA contains a till and lake sediment storage area (Figure 2.8), where approximately 3 million tonnes of material stripped from the Misery Pit and salvaged from the construction of the King Pond Dam are being stored for possible future reclamation use.

A landfill at the Misery site (Figure 2.8) was commissioned in August 2001 and is located north of the Misery Pit within the footprint of the Misery WRSA. When mining was suspended at Misery the landfill was covered with a granite cap. The landfill is not currently in operation. Materials placed within this facility were the same as those disposed of within the Panda/Koala/Beartooth Landfill.

2.4.7 Pigeon 2010 Glacal Till Storage Area

From January to April 2010 the Pigeon trial pit was excavated for bulk sampling of kimberlite. No waste rock was removed but overburden material was removed totalling 829,568 tonnes. This material was partly placed in the Panda/Koala/Beartooth waste rock storage area and partly at Pigeon on the up-slope side of the trial pit which drains naturally into the trial pit (

Figure 2.10). The kimberlite was processed in the process plant, The till stockpiled at the Pigeon test pit will be relocated during the initial development of the Pigeon pit (scheduled 2014) in accordance with the Design Plan described in Section 6.

Figure 2.9 Misery WRSA Metasediment Encapsulation

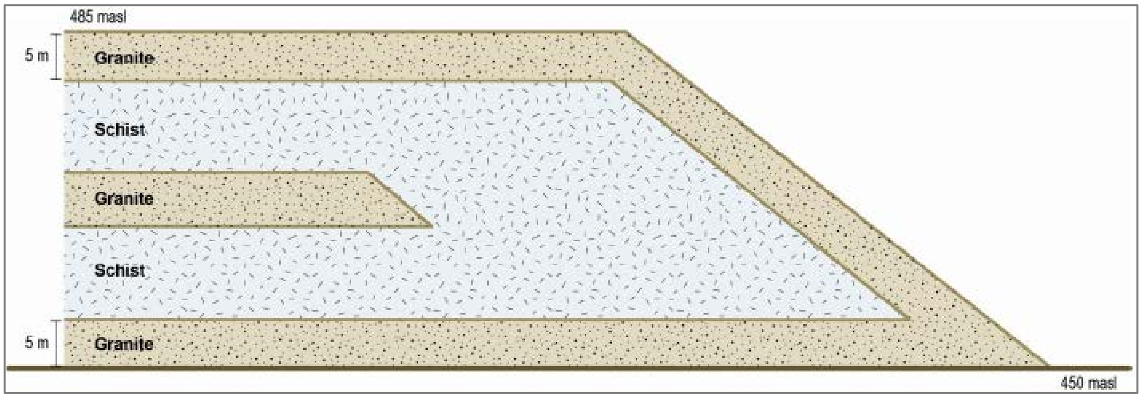


Figure 2.10 Pigeon 2010 Glacial Till Storage Location

3 Geochemical Characterization

3.1 Introduction

The majority of the waste rock from mining at combined Ekati operations is granite (or rocks of similar mineralogical composition), which is physically and chemically least reactive of the rock types at Ekati. It comprises over 90% of the total waste rock volume stored at Ekati. Other types of waste rock that occur in much lesser quantities are metasediment and diabase, and also at Fox pit, waste kimberlite. Granite and metasediments are largely composed of various amounts of the minerals feldspar, quartz, and mica. Diabase also contains feldspar and other dark minerals referred to as pyroxene. When these minerals are exposed to air and water (as in waste rock piles) they begin to decompose by weathering reactions which include oxidation and reaction with dissolved carbon dioxide. Water that trickles through the waste rock picks up some of the chemicals produced by weathering. The minerals in granite contain mainly the chemical elements aluminum and silicon, and metals like potassium, sodium, calcium, magnesium and iron.

Some minerals contain sulphur mixed with metals like iron and copper. These minerals, called sulphides, can produce acid when they oxidize, resulting in water with pH less than 5 (although it is important to note that some waters around Ekati have naturally occurring pH levels of less than 5). The acidic water from this process is referred to as acid rock drainage (ARD), and has the ability to dissolve additional metals (referred to as metal leaching - ML). This sometimes results in elevated dissolved metal concentrations in drainage. Metal leaching, however, can also occur at neutral and high pH as some metals dissolve under these conditions.

Carbonate minerals (or minerals that contain carbon) can and often do prevent ARD from developing. These minerals react readily and most produce water with pH greater than 6, which helps neutralize the acidic waters from sulphide oxidation. Kimberlite generally contains large proportions of carbonate minerals. Silicate minerals are generally considered to be less effective than carbonates for neutralizing acid but they have a role in neutralization when acid is produced at low levels.

Acid-base accounting is the combined measurements of sulphur species, neutralization potential (NP), and pH, and calculations of acid potential (AP) or maximum potential acidity

(MPA)[1], net neutralization potential (NNP) and neutralization potential ratio (NP/AP). Together, these measurements provide a useful indication of potential for ARD. Materials with ARD potential are referred to as potentially ARD generating or PAG. Additional testing such as mineralogical analyses, and laboratory and on-site kinetic testing (eg. humidity cells, column tests, barrel tests) are generally done to refine and calibrate the geochemical assessment.

The NP/AP ratio is generally used to identify materials that may require special handling. In the Northwest Territories, NP/AP ratios of less than 1 are considered to be potentially acid generating (PAG). Samples with NP/AP ratios greater than 3 are considered to be acid consuming (non-PAG), and samples with NP/AP ratios between 1 and 3 are generally considered as having uncertain ARD potential under oxidizing conditions (DIAND 1993). However, at low sulphur concentrations, these ratios tend not to be meaningful due to the abundance of silicate minerals which are not fully quantified by the NP determination.

As summarized in the following sections, on-going waste rock geochemical characterization and seepage monitoring analyses have consistently shown that the Ekati Diamond Mine does not have ARD issues, but does have minor issues associated with metal leaching. As such, the formerly called Acid/Alkaline Rock Drainage (ARD) and Geochemical Characterization Program was renamed the Geochemical Characterization and Metal Leaching (ML) Management Plan (SRK 2007b).

3.2 Methods of Characterization

3.2.1 Waste Rock

Pre-mining characterization of waste rock was described by Norecol, Dames and Moore (1997) and compared to subsequent waste rock characterization during mining in SRK (2007b). The results were very similar therefore this section summarizes the methods currently used and the results of waste rock characterization during mining.

Samples of waste rock are collected and submitted to a Canadian Association for Laboratory Accredation (CALA) certified laboratory for geochemical analysis. Testing is completed to determine how much acid neutralizing and sulphur minerals, and metals, are present in the

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[1] MPA (maximum potential acidity) is calculated from the total sulphur content. It estimates the potential acidity of a sample under the assumption that all the sulphur is in the form of sulphide. Some sulphur however can be in the form of sulphate minerals, which may not generate acid. AP (acid potential) is the actual potential acidity of a sample from sulphide content. Laboratory reports (and therefore tables reported here) refer to MPA and calculate the neutralization potential ratio (NPR) as NP/MPA. Materials at Ekati do not contain significant concentrations of sulphate, therefore total sulphur measurements are representative of sulphide contents, and thus AP and MPA are considered to be comparable terms.

waste rock, and thus estimate if the waste rock will produce acid or non-acidic drainage and metal leaching during interaction with snow melt and rain water.

Samples for waste rock characterization are generally collected from blasted muck (wet broken rock) during mining of a given pit. For each blast selected for sampling, two grab samples (approximately 2 kg each) are collected from two different locations within the blast area such that each sample represents approximately 50% of the blast. Prior to 2007, the frequency of sampling was based on the tonnage mined; typically, a minimum of approximately one sample per 100,000 tonnes of mined material. This was the confirmatory phase of waste rock characterization (phase of routine geochemical characterization during mining to confirm pre-mining results obtained from drill cores).

At that point, monitoring showed that rock characteristics were well documented and not expected to change as mining continued (SRK 2007b). Since 2007, for active open pits, sampling consisted of three samples per rock type per bench every three years. For underground developments waste rock testing was discontinued as the volumes of rock removed were considered to be very minor compared to the large volumes of waste rock produced from open pits.

The majority (>50%) of samples were analyzed using the standard Sobek et al. (1978) procedure for acid-base accounting (ABA), including total sulphur, neutralization potential and paste pH. All samples were analyzed for total sulphur. Metal scans were performed on a subset of samples by inductively coupled plasma emission spectrometry (ICP-ES) following an aqua regia digestion. Results of waste rock characterization are reported annually in Waste Rock and Waste Rock Storage Area Seepage Survey Reports. A summary of the results are presented in Section 3.3 to 3.7.

3.2.2 Coarse Kimberlite Rejects

Coarse Kimberlite Rejects (CKR) prior to 2007, were sampled once per month from the surge pile formed at the outlet of a conveyor located at the southwest corner of the Process Plant. Since 2007, CKR has been sampled quarterly. Samples are analyzed as for waste rock characterization described above. Results of CKR testing are reported annually in Waste Rock and Waste Rock Storage Area Seepage Survey Reports. A summary of the results are presented in Section 3.9.

3.3 Panda Pipe Geochemical Characterization

Routine collection of blast muck samples from the Panda Pit began in 1999 and continued until 2003. A total of 397 samples were collected from the Panda Pit, all granite. Surface mining at Panda Pit was completed in 2004 and no further sampling of Panda waste rock was carried out. Summaries of ABA and elemental results are provided in Table 3.1 and 3.2

Table 3.1 Summary of Panda Waste Rock Acid-Base Accounting Data

Description		Summary Statistic	Paste pH	Total S	Sulphate	Sulphide	NP	MPA	NNP	NP/MPA
Year	Rock Type	Units	s.u.	S%	S%	S%	kg $CaCO_3$/t			
1999-2003	Granite	Average	9.5	0.02	0.01	0.02	16	0.70	15	22
		Max	12	0.39	0.07	0.18	153	12	150	64
		95th Percentile	9.9	0.06	0.01	0.06	20	1.9	19	54
		Median	9.5	0.01	0.01	0.01	14	0.31	14	42
		5th Percentile	9.0	0.01	0.01	0.01	11	0.31	11	8.2
		Min	8.4	0.01	0.01	0.01	7.0	0.31	4.4	1.8
		Count	397	397	43	43	379	395	379	379

Notes: All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
'NP': neutralization potential as determined by the standard Sobek method.
'MPA': maximum potential acidity.
'NNP': net neutralization potential.
'CO_3-NP': carbonate neutralization potential.
'-': indicates parameter not measured.
Source: SRK (2007b)

In general, samples from the Panda Pit had very low sulphur contents (average of 0.02% and 95 percentile values of 0.06%) and average Sobek NP of 16 kg $CaCO_3$/t. Elevated sulphur outliers (maximum of 0.39%) were either located close to the kimberlite pipe contact and also tended to have higher neutralization potentials and/or nickel concentrations, indicating the possible presence of kimberlite in the samples; or thought to contain isolated enrichment of sulphide minerals in xenoliths or veinlets. Since the sulphur content of granite was on average very low, the potential to generated acid was very low (SRK 2007b).

Blast samples had generally uniform metal concentrations. Elevated nickel, cobalt and chromium concentrations (indicated by maximum concentrations) tended to occur in samples with elevated sulphur and neutralization potential, indicative of small amounts of kimberlite in some of the blasts (SRK 2002).

Table 3.2 Summary of Elemental Concentrations in Panda Waste Rock

Description		Summary Statistic	Al	As	Ba	Ca	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Zn
Year	Rock Type	Units	%	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	%	ppm	ppm
1999-2003	Granite	Average	9.3	3.7	631	3.3	18	146	28	2.9	1.8	1.9	381	1.5	3.0	53	65
		Max	13	15	890	5.9	24	229	142	3.6	4.3	5.3	535	5.0	4.4	149	88
		95th Percentile	11	10	746	4.0	22	201	58	3.4	2.1	2.3	498	4.0	4.0	83	80
		Median	9.3	3.0	630	3.3	19	144	25	2.9	1.8	1.9	375	1.0	3.0	48	64
		5th Percentile	7.6	1.0	520	2.1	13	86	6.4	2.3	1.4	1.4	286	1.0	2.3	40	52
		Min	7.2	1.0	430	0.4	4.0	38	1.0	1.2	1.2	0.6	140	1.0	0.5	21	34
		Count	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69

Note: Values below detection were replaced by detection limits for calculation of summary statistics.
Source: SRK (2007b).

3.4 Koala and Koala North Geochemical Characterization

Routine collection of Koala blast muck samples occurred from 1999 through 2005. The database contains analytical results of 341 samples from Koala. The majority of samples are granite, but the database also includes black clay and waste kimberlite samples that were collected in 2002 and 2003. Summaries of ABA and metal analyses results are provided in Table 3.3 and 3.4.

In general, Koala granite samples had low sulphur contents (average of 0.04%) and average Sobek NP of 16 kg $CaCO_3$/t. SRK (2005) distinguished two populations of Koala granite (<0.092% sulphur and >0.092% sulphur). It was concluded that the low-sulphur population consisted entirely of granite, while the high-sulphur population comprised granite with a minor kimberlite component, based on the observation that most of these samples were from blasts near the kimberlite pipe and were associated with elevated NP, and/or nickel concentrations. A very low potential for acid generation was determined.

Elevated sulphur compared to granite was reported for both Koala black clay (average of 0.4%) and Koala waste kimberlite samples (average of 0.26%). Sulphur concentrations as sulphate were small but detectable (0.06% average for Koala black clay and 0.04% average for kimberlite). Average Sobek NP was 293 kg $CaCO_3$/t for black clay and 192 kg $CaCO_3$/t for waste kimberlite. Sobek NP/AP ratios were correspondingly high for both Koala black clay and Koala waste kimberlite (average of 25 and 32, respectively). Results indicate that these materials have a low potential for acid generation.

Table 3.3 Summary of Koala Waste Rock Acid-Base Accounting Data

Description		Summary Statistic	Paste pH	Total S	Sulphate	Sulphide	NP	MPA	NNP	NP/MPA
Year	Rock Type	Units	s.u.	S%	S%	S%	kg $CaCO_3$/t			
1999 - 2005	Granite	Average	9.1	0.04	-	-	16	1.1	14.8	21.3
		Max	10.1	0.31	-	-	248	9.7	238.3	76.8
		95th Percentile	9.8	0.11	-	-	26	3.4	24.6	45.8
		Median	9.2	0.03	-	-	14	0.9	12.8	17.1
		5th Percentile	8.1	0.01	-	-	7.7	0.3	6.3	4.8
		Min	7.2	0.01	-	-	5.0	0.0	3.4	1.5
		Count	297	297	-	-	275	298	275	275
	Black Clay	Average	7.5	0.40	0.07	0.22	293	13	281	25
		Max	7.9	0.93	0.12	0.67	351	29	340	32
		95th Percentile	7.8	0.47	0.11	0.30	326	15	313	32
		Median	7.6	0.37	0.08	0.20	314	12	302	26
		5th Percentile	7.2	0.32	0.02	0.16	216	10	202	15
		Min	7.2	0.31	0.01	0.15	202	10	173	7.0
		Count	20	20	20	20	20	20	20	20
	Waste Kimberlite	Average	7.9	0.26	0.02	0.14	192	8	184	32
		Max	8.3	0.96	0.05	0.26	363	30	358	133
		95th Percentile	8.2	0.88	0.05	0.21	292	27	289	67
		Median	8.0	0.21	0.02	0.13	245	6.5	231	26
		5th Percentile	7.3	0.11	0.01	0.06	92	3.4	87	9.5
		Min	7.3	0.07	0.01	0.03	76	2.2	68	8.9
		Count	22	22	20	14	22	22	22	22

Notes: All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
'NP': neutralization potential as determined by the standard Sobek method.
'MPA': maximum potential acidity.
'NNP': net neutralization potential.
'-': indicates parameter not measured.
Source: SRK (2007b)

Granite samples had generally uniform metal concentrations. As with Panda granite waste rock, elevated nickel, cobalt and chromium concentrations (indicated by maximum concentrations) tended to occur in samples with elevated sulphur and neutralization potential, indicative of small amounts of kimberlite in some of the blasts (SRK 2002).

Koala black clay and Koala waste kimberlite samples were characterized by elevated chromium, barium (Koala black clay), cobalt, magnesium, manganese and nickel compared to Koala granite.

Table 3.4 Summary of Elemental Concentrations in Koala Waste Rock

Description		Summary Statistic	Al	As	Ba	Ca	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Zn
Year	**Rock Type**	**Units**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**%**	**%**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**
1999 – 2005	Granite	Average	8.9	4.6	612	2.6	16	120	24	2.8	1.9	1.9	360	2.3	3.0	65	60
		Max	11	15.0	860	3.7	55	567	132	3.8	3.1	12.0	1110	9.0	6.8	918	84
		95th Percentile	11	6.0	800	3.5	22	192	53	3.5	2.6	2.8	450	6.0	4.1	92	78
		Median	9.2	5.0	620	2.9	16	110	21	2.9	1.9	1.8	365	1.0	3.0	46	62
		5th Percentile	7.4	1.0	380	0.9	9.0	61	8.0	1.9	1.6	1.0	220	1.0	2.3	26	40
		Min	3.4	1.0	100	0.6	7.0	40	2.0	1.4	0.7	0.7	128	1.0	0.4	16	19
		Count	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
	Black Clay	Average	4.0	7.0	1989	5.5	37	779	47	3.9	1.3	8.7	1001	2.7	0.2	486	76
		Max	4.6	30	2910	7.7	48	1265	58	4.3	1.8	11	1785	9.0	0.7	681	90
		95th Percentile	4.5	11	2796	7.2	45	1089	56	4.3	1.6	10	1282	6.2	0.4	653	86
		Median	4.0	5.0	2010	6.0	37	746	49	3.9	1.3	9.0	990	2.0	0.2	484	79
		5th Percentile	3.5	5.0	1337	3.6	29	468	37	3.6	1.0	6.8	754	1.0	0.1	341	65
		Min	3.5	5.0	1270	3.5	19	406	27	3.0	0.8	4.8	630	1.0	0.1	236	44
		Count	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Waste Kimberlite	Average	1.8	7.5	599	1.5	70	714	15	4.0	0.4	14	678	2.1	0.1	1301	46
		Max	4.5	11	1370	2.3	95	1120	31	5.0	1.5	15	935	5.0	0.5	1765	68
		95th Percentile	2.3	10	791	2.0	91	1030	22	4.9	1.0	15	892	4.1	0.2	1670	57
		Median	1.6	7.5	570	1.4	65	658	14	3.8	0.4	14	632	2.0	0.1	1223	42
		5th Percentile	1.4	5.0	436	1.1	58	592	11	3.6	0.3	12	562	1.0	0.0	1069	38
		Min	1.4	5.0	350	1.1	42	441	10	3.6	0.3	11	520	1.0	0.0	668	38
		Count	20	20	20	20	20	20	20	20	20	13	20	20	20	20	20

Note: Values below detection were replaced by detection limits for calculation of summary statistics.
Source: SRK (2007b)

3.5 Beartooth Pipe Geochemical Characterization

Routine collection of blast muck samples from the Beartooth Pit occurred from 2004 to 2009. The database contains analytical results for 83 Beartooth Pit samples that are all granite. The component of metasediment in Beartooth Pit is too small to be represented by blast samples. ABA data and elemental results are summarized in Table 3.5 and Table 3.6..

In general, Beartooth granite samples had low sulphur contents (average of 0.05%) and average Sobek NP of 17 kg $CaCO_3$/t. SRK (2003) distinguished two populations of Beartooth granite (68% had average sulphur = 0.026% and 30% had average sulphur = 0.11% with a threshold between the two groups of 0.07% sulphur). It was concluded that the low-sulphur population consisted entirely of granite, while the high-sulphur samples that were logged as granite, came from areas where metasediments were identified during pre-production drilling and therefore may have contained metasediment with higher sulphur content than the surrounding granite. Alternatively, elevated sulphur values may result from the presence of unidentified sulphide veinlets. One sample had an anomalously high NP (89 kg $CaCO_3$/t) suggesting it contained kimberlite.

No long term issues are anticipated related to Beartooth waste rock with above-average sulphur content, provided that this material is placed in regions of the WRSA which will freeze and remain frozen as described in the WROMP for Beartooth (BHP 2003).

Table 3.5 Summary of Beartooth Waste Rock Acid-Base Accounting Data

Description		Summary Statistic	Paste pH	Total S	Sulphate	Sulphide	NP	MPA	NNP	NP/MPA
Year	Rock Type	Units	s.u.	%	%	%	kg $CaCO_3$ eq/tonne			
2004-2009	Granite	Average	9.1	0.05	0.01	0.034	17	1.6	16	23
		Max	10.1	0.29	0.01	0.10	89	9.1	87	102
		95th Percentile	9.9	0.17	0.01	0.09	18	5.3	18	54
		Median	9.2	0.04	0.01	0.03	15	1.3	14	15
		5th Percentile	7.92	0.01	0.01	0.01	11	0.3	7	2.8
		Min	7.2	0.01	0.01	0.01	5	0	3	1.5
		Count	83	83	11	11	83	83	83	83

Notes: All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
'NP': neutralization potential as determined by the standard Sobek method.
'MPA': maximum potential acidity.
'NNP': net neutralization potential.
Source: SRK project 1CR003.021 (2011)

Beartooth granite samples had generally uniform metal concentrations that were similar to or lower than concentrations in Koala granite. The exception was for barium which had similar 95 percentile concentrations to Koala granite but a significantly higher maximum concentration of barium than Koala granite. Given the high concentrations of barium in black clay from Koala (Table 3.4) the high maximum concentration of barium in Beartooth granite may result from inclusion of some sediment during sampling.

Table 3.6 Summary of Elemental Concentrations in Beartooth Waste Rock

Description		Summary Statistic	Al	As	Ba	Ca	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Zn
Year	Rock Type	Units	%	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	%	ppm	ppm
2004-2009	Granite	Average	8.0	5.9	654	3.0	18	131	32	3.5	2.0	2.2	425	1.3	2.5	88	70
		Max	9.1	11	1060	3.6	35	352	67	4.6	2.7	7.4	664	4.0	3.0	479	82
		95th Percentile	8.9	9.2	770	3.6	29	241	65	4.3	2.5	5.2	563	3.0	2.8	314	80
		Median	8.1	5	620	3.1	16	118	28	3.3	1.9	1.8	420	1.0	2.6	49	70
		5th Percentile	7.4	5	570	2.1	14	63	9	3.1	1.5	1.6	320	1.0	2.0	44	61
		Min	1.4	1	20	0.4	4	20	1	1.2	0.3	0.6	20	1.0	0.0	16	19
		Count	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

Note: Values below detection were replaced by detection limits for calculation of summary statistics.
Source: SRK project 1CR003.021 (2011)

3.6 Fox Pipe Geochemical Characterization

Routine collection of blast muck samples from the Fox Pit has occurred since June 2003. To date, the database contains analytical results for 564 samples from Fox Pit: 417 waste granite samples, 146 waste kimberlite samples and 1 waste diabase sample. ABA data and elemental results are summarized in Tables 3.7 and 3.8.

Fox granite samples generally had low sulphur contents that ranged from undetectable (<0.01%) to 0.29% (0.11% 95 percentile value), with an average of 0.04%. The average Sobek NP for Fox granite was 19 kg $CaCO_3$/t. These results were similar to Panda, Koala and Beartooth granite. As with the other data sets, analysis of the Fox data (SRK, 2007b) showed two populations of Fox granite (<0.085% sulphur and >0.085% sulphur). The higher sulphur group typically had higher NP suggesting that a component of kimberlite was included in the samples. It is known that Fox Pit naturally has regions where fragmented kimberlite is contained within the granite. A few samples with sulphur contents greater than 0.085% had typical NP values for Fox granite, so kimberlite was not suspected as a cause of the elevated sulphur values. Anomalous concentrations of sulphide minerals in xenoliths or veinlets may account for the slightly elevated sulphur values in these samples, as documented in the WROMP for Fox (BHP 2002). The low-sulphur population were concluded to consist entirely of granite.

Fox waste kimberlite had similar ABA characteristics to Koala waste kimberlite, with an average total sulphur content of 0.35% (range of 0.14 to 1.6%). Sobek NP ranged from 73 to 334 kg $CaCO_3$/t, with an average of 262 kg $CaCO_3$/t. The average NP/AP ratio was 29 (range of 4 to 71) such that the kimberlite is classified as non-acid generating (NAG).

Only one sample of Fox diabase has been analysed as part of the routine geochemical characterization program at Fox as diabase makes up such a small component of the rock at Fox. The sample had a paste pH of 9.0 and contained 0.05% total sulphur, undetectable sulphate sulphur and Sobek NP of 14 kg $CaCO_3$/t. The NP/MPA was 9 indicating that the diabase sample was non-acid generating. These results were within the range of values observed in diabase samples analyzed for pre-mining characterization (BHP 2002, SRK 2007b).

Metal concentrations for Fox granite are similar to values reported for Koala and Beartooth granite. Compared to Koala waste kimberlite, Fox waste kimberlite has lower average concentrations of cobalt, chromium, magnesium and nickel, and higher average concentrations of aluminum, barium, calcium, copper, potassium, molybdenum, sodium and zinc.

DOMINION DIAMOND

Table 3.7 Summary of Fox Waste Rock Acid-Base Accounting Data

Description		Summary Statistic	Paste pH	Total S	Sulphate	Sulphide	NP	MPA	NNP	NP/MPA
Year	Rock Type	Units	pH	%	%	%	kg $CaCO_3$ eq/tonne			
2003-2009	Granite	Average	9.1	0.04	-	-	19	1.2	18	24
		Max	10.0	0.29	-	-	217	9.1	213	102
		95th Percentile	9.8	0.11	-	-	33	3.4	31	51
		Median	9.2	0.03	-	-	16	0.9	15	20
		5th Percentile	8.1	0.01	-	-	13	0.3	11	6.4
		Min	7.5	0.01	-	-	5.0	0.3	5	1.5
		Count	417	417	12	12	417	417	417	417
	Waste Kimberlite	Average	8.2	0.35	0.04	0.31	258	11	248	29
		Max	9.8	1.6	0.26	1.4	334	51	329	71
		95th Percentile	8.7	0.68	0.10	0.62	319	21	311	53
		Median	8.3	0.30	0.03	0.26	274	9.4	267	29
		5th Percentile	7.5	0.16	0.01	0.14	91	5.0	77	6.6
		Min	7.1	0.09	0.01	0.09	17	2.8	14	4.0
		Count	146	146	146	146	146	146	146	146
2009	Diabase	Value	9.0	0.05	0.01	0.05	14	1.6	12	9.0
		Count	1	1	1	1	1	1	1	1

Notes: All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
'NP': neutralization potential as determined by the standard Sobek method.
'MPA': maximum potential acidity.
'NNP': net neutralization potential.
Source: SRK project 1CR003.021 (2011)

Table 3.8 Summary of Elemental Concentrations in Fox Waste Rock

Description		Summary Statistic	Al	As	Ba	Ca	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Zn
Year	Rock Type	Units	%	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	%	ppm	ppm
2003-2009	Granite	Average	8.2	6.2	643	3.2	17	109	42	3.3	2.0	2.0	436	1.3	2.7	58	64
		Max	9.9	15	1160	7.1	45	388	333	8.4	2.7	6.2	1375	6	3.8	379	97
		95th Percentile	9.8	12	790	3.7	26	200	95	3.8	2.4	3.0	606	3	3.2	106	73
		Median	8.1	5	630	3.2	16	101	30	3.1	2.0	1.8	406	1	2.7	48	65
		5th Percentile	7.3	5	540	2.3	13	59	15	2.8	1.5	1.6	350	1	2.2	42	57
		Min	6.7	5	170	0.5	3	22	3	0.9	0.66	0.5	100	1	1.6	4	12
		Count	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101
	Waste Kimberlite	Average	3.9	6.7	1535	3.5	39	524	36	3.6	2.1	9.1	658	2.9	0.4	580	74
		Max	7.7	16	2160	5.1	51	759	60	4.5	3.2	11.7	833	15	2.4	791	306
		95th Percentile	5.0	12	1838	4.3	46	652	42	4.0	2.8	10.9	739	7	0.8	733	93
		Median	3.8	5	1560	3.6	39	527	36	3.7	2.2	9.3	664	2	0.4	589	70
		5th Percentile	3.4	5	1152	2.8	31	395	30	3.2	1.5	7.1	558	1	0.2	417	60
		Min	3.1	5	320	2.3	15	127	16	2.9	1.2	2.0	425	1	0.2	77	57
		Count	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145
2009	Diabase	Value	7.6	10.0	70	7.0	43	91	210	9.2	0.7	3.6	1525	1.0	1.7	75	104
		Count	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Note: Values below detection were replaced by detection limits for calculation of summary statistics.
Source: SRK project 1CR003.021 (2011)

3.7 Misery Pipe Geochemical Characterization

Routine collection of blast muck samples from the Misery Pit occurred from 2001 until 2005, when mining was suspended. This database contains analytical results from nearly 650 Misery Pit samples, including granite, metasediments, diabase and waste kimberlite. Sampling was resumed in 2012 and 2013 for the Misery pit push back. ABA data and metal analysis results for Misery blast muck samples are summarized in Tables 3.9 and 3.10, and a summary is provided below based on the Ekati Mine *2013 Waste Rock and Waste Rock Storage Area Seepage Report*.

Paste pH of the granite sampled during the 2013 pit expansion was 8.2 to 9.9, compared to 8.8 to 10 in 2012 and 6.5 to 10 in samples collected during 2001 to 2005 monitoring. Total sulphur and sulphate concentrations were within the range of the 2001 to 2005 database samples, with a median total sulphur content of 0.010% and a range of 0.010 to 0.030% total sulphur in 2013 samples. In 2013 samples, CO3 NP ranged from below the DL of 4.5 kg CaCO3/tonne to 9.3 kg CaCO3/tonne, similar to the range of the 2001-2005 samples, and slightly higher than the 2012 samples which were all below the DL. Sobek NP values were all slightly higher than the CO3-NP values indicating that silicate minerals contributed to the neutralization potential in the lab tests. Sobek NP typically over estimates effective field NP due to the strong acid used in the test. In 2013 samples, Sobek NP ranged from 3.0 to 10 kg CaCO3/tonne, compared to 5.0 to 7.0 kg CaCO3/tonne in 2012 and 2.0 to 330 kg CaCO3/tonne in 2001 to 2005 monitoring samples. The median Sobek NP was 5.0 kg CaCO3/tonne for the 2013, 2012 and 2001 to 2005 samples. The Sobek NP/MPA (maximum potential acidity calculated from total sulphur) for 2013 samples was 4.3 to 38 compared to 6.4 to 32 in 2012, and 1.5 to 500 in the 2001 to 2005 samples. The median Sobek NP/MPA ratios for 2013 misery granite samples was 13, which is a slight decrease from a median of 16 in 2012. NP/MPA ratios above 3 indicate that samples are non-potentially acid generating (non-PAG), whereas ratios below 1 indicate potentially acid generating (PAG). Values in between indicate uncertain potential to generate acidity. The data therefore indicate that Misery granite sampled in 2013 as part of the Misery push back was not potentially acid generating. Major and trace element concentrations in the 2013 samples were within the range of previous results for the 2012 and 2001 to 2005 database samples (Table 3.10).

Paste pH for the 2013 Misery schist samples was neutral to alkaline at pH 8.2 to 10, which was within the range of pH 8.2 to 9.4 in 2012 and pH 7.1 to 9.7 in 2001 to 2005. Total sulphur content in 2013 ranged from 0.04 to 0.23 %, compared to 0.07 to 0.23 % in 2012 and <0.01 to 1.0 % for the 2001 to 2005 samples. The median sulphur concentration in 2013 decreased slightly to 0.13% compared to the median of 0.17% sulphur in 2012 and 0.15% in the 2001 to 2005 samples. Sulphate in the 2013 samples ranged from <0.01 to 0.04% with a median of <0.01 %, similar to the 2012 and 2001 to 2005 monitoring results. Again indicating that sulphide was the dominant form of sulphur in Misery schist. In 2013, Sobek NP values ranged from 9.0 to 100 kg CaCO3/tonne compared to 8.0 to 19 kg CaCO3/tonne in 2012 and 1.0 to 410 kg CaCO3/tonne in the 2001 to 2005 samples. The median Sobek NP for 2013 was 11 kg CaCO3/tonne which is similar to the median of 10 kg CaCO3/tonne for 2012 and 9.0 kg CaCO3/tonne for the 2001 to 2005 samples. Carbonate NP ranged from below the DL (less than 4.5 kg CaCO3/tonne) to 25 kg CaCO3/tonne in the 2013 samples compared to less than 4.5 to 9.1 kg CaCO3/tonne in the 2012 samples and less than 4.5 to 170 kg CaCO3/tonne for the 2001 to 2005 samples. The median CO3-NP was less than 4.5 kg CaCO3/tonne for the 2013, 2012 and 2001 to 2005 monitoring samples.

Figure 6.1 shows Sobek NP plotted against for 2013 samples, compared to 2012 and 2001 to 2005 samples from the monitoring database. Misery schist samples in 2013 had Sobek

NP/MPA ratios ranging from 1.5 to 21 with a median of 3.6 which is slightly higher than the 2012 median of 1.9. A ratio between 1 and 3 is considered to have uncertain ARD potential, as with most 2013 samples of Misery schist. 2001 to 2005 samples showed a similar Sobek NP/MPA range of 0.33 to 110, with a median value of 2.2 (several samples with NP greater than 100 kg CaCO3/tonne are off the scale of the chart). Carbonate NP/MPA was <0.60 to 5.0 for 2013 samples compared to 0.6 to 4.1 for 2012 samples, and 0.21 to 43 for 2001 to 2005 samples. The median carbonate NP/MPA in 2013 of <1.6 indicated uncertain potential for acid generation or PAG. Based on Sobek NP/MPA ratios, Misery schist mined in 2013 was uncertain (47% of samples) to non-PAG (52% of samples). Approximately one third of all samples analyzed in 2012 and 2013 were non-PAG, which is the same proportion as can be found with the 2001-2005 samples. Based on the carbonate NP/MPA ratios, the schist had the potential to generate acid. However, these characteristics are similar to Misery schist mined previously. Misery schist has generated acid in previous kinetic lab tests (Norecol Dames and Moore 1997, SRK 2003, 2004), but has not generated acid from the Misery WRSA. Major and trace element concentrations in the schist samples were similar to results previously recorded in the 2012 and 2001 to 2005 samples (Table 3.10).

Table 3.9 Misery Waste Rock ABA Data

Description	Summary Statistic (1) Units	Paste pH pH	S (T)(2) %	S (SO_4)(3) %	CO_3-NP(4) kg $CaCO_3$ eq/tonne	NP(5) kg $CaCO_3$ eq/tonne	MPA(6) kg $CaCO_3$ eq/tonne	NNP(7) kg $CaCO_3$ eq/tonne	NP/MPA(8)	CO_3-NP/MPA
Misery Granite (2001-2005)	Average	9.0	0.03	0.01	4.9	11	1.0	10	18.5	5.3
	Max	10	0.42	0.02	9.1	330	13	320	496	29
	95th Percentile	9.7	0.14	0.02	6.5	17	4.4	15	32	15
	Median	9.0	<0.01	<0.01	<4.5	5.0	0.3	4.7	12.8	<4.5
	5th Percentile	7.8	<0.01	<0.01	<4.5	4.0	0.3	3.5	2.8	<1.1
	Min	6.5	<0.01	<0.01	<4.5	2.0	0.3	2.0	1.5	<0.89
	Count	320	320	26	26	292	320	292	292	26
Misery Granite (2012)	Average	9.7	0.015	0.016	<3.7	5.5	0.45	5.1	15	<9.9
	Max	10	0.030	0.030	<4.5	7.0	0.90	7.0	32	<15
	95th Percentile	9.9	0.025	0.030	<4.5	6.5	0.74	6.5	27	<15
	Median	9.7	0.010	0.010	<4.5	5.0	0.30	5.0	16	<11
	5th Percentile	9.2	0.010	0.010	<1.1	5.0	0.30	4.0	7.3	<1.9
	Min	8.8	<0.010	<0.010	<1.1	5.0	<0.30	4.0	6.4	<1.9
	Count	12	12	12	12	12	12	12	12	12
Misery Granite (2013)	Average	9.3	0.015	0.014	4.6	5.1	0.46	4.7	15	12
	Max	9.9	0.030	0.040	6.8	10	0.90	9.0	38	15
	95th Percentile	9.8	0.030	0.031	4.8	7.3	0.90	7.2	33	15
	Median	9.5	0.010	0.010	<4.5	5.0	0.30	4.0	13	<15
	5th Percentile	8.4	0.010	0.010	<4.5	3.9	0.30	3.0	5.2	<5.0
	Min	8.2	0.010	0.010	<4.5	3.0	<0.30	3.0	4.3	<5.0
	Count	19	19	19	19	19	19	19	19	19
Misery Schist (2001-2005)	Average	8.7	0.16	0.01	7.8	18	5.0	13	4.8	2.3
	Max	9.7	1.0	0.09	170	410	31	400	110	43
	95th Percentile	9.4	0.30	0.02	21	50	9.1	47	12	4.5
	Median	8.7	0.15	<0.010	<4.5	9.0	5.0	5.0	2.2	<1.1
	5th Percentile	7.8	0.020	<0.010	<4.5	6.0	0.6	0.00	1.0	<0.57
	Min	7.1	<0.010	<0.010	<4.5	1.0	0.3	-14	0.33	0.21
	Count	334	334	327	328	334	334	334	334	327
Misery Schist (2012)	Average	8.8	0.16	0.01	4.9	11	5.0	6.4	2.7	1.2
	Max	9.4	0.23	0.02	9.1	19	7.2	17	8.7	4.1
	95th Percentile	9.3	0.21	0.02	6.1	19	6.6	14	5.6	2.6
	Median	8.8	0.17	0.01	<4.5	10	5.3	5.0	1.9	<0.86
	5th Percentile	8.2	0.08	<0.010	<4.5	8.5	2.4	3.0	1.5	<0.69
	Min	8.2	0.07	<0.010	<4.5	8.0	2.2	3.0	1.4	<0.63
	Count	14	14	14	14	14	14	14	14	14.0
Misery Schist (2013)	Average	9.0	0.13	0.012	6.0	17	4.1	13	4.5	1.8
	Max	10	0.23	0.040	25	100	7.2	98	21	5.0
	95th Percentile	9.5	0.22	0.016	10	41	7.0	36	9.9	3.8
	Median	9.0	0.13	<0.010	<4.5	11	4.1	7.0	3.6	<1.6
	5th Percentile	8.4	0.048	<0.010	<4.5	9.0	1.5	4.0	1.6	<0.64
	Min	8.2	0.040	<0.010	<4.5	9.0	1.3	4.0	1.5	<0.60
	Count	17	17	17	17	17	17	17	17	17

Source: P:\01_SITES\Ekati\1CD015.000_Seepage Monitoring_2013\080_Deliverables\2013_Final Report\030_Appendices\Appendix A.1\[A.1.4_MiseryBlast_Database.1CD015.000_2013_LM_01]

Notes: 1) All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
2) 'S (T)': total sulphur.
3) 'S (SO_4)': sulphur as sulphate.
4) 'CO_3-NP': carbonate neutralization potential.
5) 'NP': neutralization potential as determined by the standard Sobek method.
6) 'MPA': maximum potential acidity calculated from total sulphur.
7) 'NNP': net neutralization potential.

Table 3.10 Misery Waste Rock Elemental Concentrations

Description	Summary Statistic	Al	As	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb
	Units	%	ppm	ppm	%	ppm	ppm	ppm	ppm	%	%	%	ppm	ppm	%	ppm	ppm	ppm
Misery Granite (2001-2005)	Average	8.1	11	670	1.3	0.50	6.8	88	21	1.7	2.3	0.65	260	1.9	3.2	25	510	19
	Max	12	200	1200	4.8	0.50	39	340	190	8.7	4.7	5.2	1300	7.0	5.5	400	1900	42
	95th Percentile	9.4	25	950	2.4	0.50	24	180	91	4.2	3.5	2.1	690	5.1	4.3	77	1000	26
	Median	8.0	<5.0	650	1.3	<0.50	3.0	70	7.0	1.0	2.1	0.35	180	1.0	3.2	9.0	420	19
	5th Percentile	6.9	<1.0	400	0.51	<0.50	1.0	8.0	2.0	0.76	1.5	0.20	130	<1.0	2.1	3.0	250	10
	Min	6.6	<1.0	290	0.34	<0.50	<1.0	5.0	1.0	0.71	1.1	0.17	110	<1.0	1.6	1.0	190	2.0
	Count	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Misery Granite (2012)	Average	7.6	3.9	680	1.4	0.38	2.0	11	2.4	0.88	2.0	0.26	160	0.91	3.8	3.6	360	17
	Max	7.9	<5.0	890	1.6	<0.50	3.3	21	5.9	1.1	3.2	0.34	180	<1.0	4.1	8.8	590	25
	95th Percentile	7.9	<5.0	820	1.6	<0.50	2.9	16	5.4	1.0	2.6	0.32	170	<1.0	4.0	7.3	530	22
	Median	7.6	<5.0	660	1.5	<0.50	2.0	10	2.0	0.86	1.9	0.25	160	<1.0	3.8	2.6	350	17
	5th Percentile	7.2	0.42	600	1.0	0.03	1.0	8.0	1.0	0.80	1.8	0.22	140	0.51	3.3	1.6	260	13
	Min	7.1	0.20	590	1.0	0.02	1.0	8.0	1.0	0.79	1.8	0.21	140	0.48	3.0	1.0	250	12
	Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Misery Granite (2013)	Average	7.4	1.6	690	1.5	0.04	2.2	17	3.7	0.96	1.9	0.27	170	0.50	3.7	4.9	320	24
	Max	8.0	5.4	900	2.2	0.19	8.4	45	13	2.0	2.3	0.97	270	0.85	4.1	21	570	77
	95th Percentile	7.8	5.1	830	1.7	0.073	4.7	32	9.5	1.4	2.2	0.47	210	0.84	4.0	13	400	63
	Median	7.5	1.0	690	1.5	0.030	1.9	16	2.1	0.86	1.8	0.21	160	0.60	3.7	2.9	300	19
	5th Percentile	7.0	0.29	550	1.4	0.02	<0.05	9.0	<0.01	0.81	1.6	0.19	140	0.14	3.5	2.4	240	16
	Min	6.6	0.20	420	1.3	0.02	<0.05	9.0	<0.01	0.76	1.4	0.18	130	0.09	3.5	2.0	240	15
	Count	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Misery Schist (2001-2005)	Average	7.9	37	560	1.1	0.54	21	180	49	3.6	2.3	1.9	420	2.5	1.9	100	620	15
	Max	12	940	1200	5.8	1.5	70	830	310	11	4.0	16	1900	14	4.0	1400	1800	38
	95th Percentile	9.4	150	780	2.2	0.68	34	280	77	4.7	3.1	3.2	680	7.0	2.7	200	980	22
	Median	8.0	14	550	0.92	<0.5	21	160	46	3.7	2.3	1.6	390	2.0	1.9	73	580	16
	5th Percentile	6.5	<5.0	370	0.55	<0.5	9.0	89	19	2.0	1.6	0.79	260	1.0	1.0	29	440	7.6
	Min	1.8	1.0	200	0.30	<0.5	2.0	27	1.0	0.64	0.50	0.18	120	<1.0	0.05	1.0	220	2.0
	Count	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297	297
Misery Schist (2012)	Average	8.1	21	590	0.84	0.26	22	140	44	3.9	2.8	1.7	430	1.5	1.9	76	620	12
	Max	8.6	120	680	1.1	0.50	24	160	56	4.6	3.4	1.9	480	2.2	2.3	93	830	18
	95th Percentile	8.5	60	680	1.0	0.50	24	160	53	4.4	3.4	1.8	480	2.1	2.3	90	760	16
	Median	8.0	12	580	0.84	0.11	22	130	46	3.8	2.7	1.7	430	1.6	1.8	74	590	11
	5th Percentile	7.7	3.4	510	0.52	0.067	19	110	31	3.5	2.2	1.5	390	1.0	1.4	66	540	7.3
	Min	7.6	3.3	470	0.51	0.060	19	110	30	3.2	2.1	1.4	370	<1.0	1.3	66	520	6.0
	Count	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Misery Schist (2013)	Average	7.7	54	600	0.82	0.10	19	130	36	3.6	2.8	1.6	400	2.0	1.8	70	740	17
	Max	8.9	390	900	1.4	0.15	27	210	68	5.2	3.6	3.0	580	5.9	2.8	180	1500	71
	95th Percentile	8.7	170	800	1.2	0.14	27	190	52	5.0	3.5	2.9	540	3.4	2.7	110	1200	31
	Median	7.8	25	610	0.75	0.090	23	150	38	4.0	2.6	1.7	400	1.7	1.8	79	650	13
	5th Percentile	6.7	3.4	340	0.45	0.068	7.4	41	18	1.8	2.3	0.68	240	1.0	1.0	28	540	8.9
	Min	6.6	1.8	290	0.42	0.060	5.3	32	13	1.4	2.3	0.43	180	0.63	0.73	16	530	8.4
	Count	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17

DOMINION DIAMOND

Table 3.11 Misery Waste Rock Elemental Concentrations

Description	Summary Statistic	Sb	Sr	Ti	V	W	Zn	Hg	U
	Units	ppm	ppm	%	ppm	ppm	ppm	ppb	ppm
Misery Granite (2001-2005)	Average	4.2	430	0.16	38	<10	50	9.4	-
	Max	5.0	640	0.90	290	10	126	20	-
	95th Percentile	5.0	610	0.41	130	10	90	10	-
	Median	<5.0	460	0.10	15	<10	42	<10	-
	5th Percentile	<0.20	200	0.070	9.0	<10	32	<10	-
	Min	<0.20	160	0.070	8.0	<10	22	<10	-
	Count	80	80	80	80	80	80	80	-
Misery Granite (2012)	Average	3.8	550	0.091	11	7.6	40	18	3.7
	Max	5.0	650	0.14	17	<10	49	100	5.8
	95th Percentile	<5.0	640	0.12	16	<10	47	50	5.5
	Median	<5.0	540	0.090	9.5	<10	40	10	2.9
	5th Percentile	<0.05	440	0.080	8.6	0.41	33	10	2.5
	Min	<0.05	420	0.080	8.0	0.30	30	10	2.5
	Count	12	12	12	12	12	12	12	3
Misery Granite (2013)	Average	0.12	560	0.10	12	0.35	44	15	1.8
	Max	0.29	640	0.19	40	0.50	87	100	5.1
	95th Percentile	0.26	630	0.14	27	0.50	59	19	3.8
	Median	0.09	550	0.087	10	0.30	40	<10	1.4
	5th Percentile	<0.05	520	0.078	8.9	0.20	36	<10	1.1
	Min	<0.05	520	0.078	8.0	0.20	32	<10	1.1
	Count	19	19	19	19	19	19	19	19
Misery Schist (2001-2005)	Average	4.4	240	0.32	102	11	82	9.4	-
	Max	15	840	1.1	380	190	170	30	-
	95th Percentile	5.0	400	0.41	135	10	120	10	-
	Median	<5	230	0.32	102	<10	80	10	-
	5th Percentile	0.20	140	0.17	49	<10	46	0.01	-
	Min	<0.20	64	0.060	7.0	<10	24	0.01	-
	Count	297	297	294	297	297	297	297	-
Misery Schist (2012)	Average	2.2	220	0.36	110	4.7	87	<10	2.7
	Max	<5.0	320	0.42	140	10	98	<10	3.2
	95th Percentile	<5.0	306	0.39	130	10	96	<10	3.2
	Median	<0.05	230	0.37	110	1.0	87	<10	2.7
	5th Percentile	<0.05	150	0.32	97	0.63	79	<10	2.2
	Min	<0.05	140	0.31	92	0.50	77	<10	2.1
	Count	14	14	14	14	14	14	14	8
Misery Schist (2013)	Average	0.08	210	0.32	100	1.0	90	10	2.7
	Max	0.34	370	0.44	150	2.8	160	10	5.6
	95th Percentile	0.15	320	0.43	150	2.0	140	10	3.8
	Median	0.05	200	0.35	120	0.90	80	<10	2.4
	5th Percentile	0.05	100	0.17	38	0.60	50	<10	2.0
	Min	<0.05	100	0.13	23	0.60	50	<10	1.8
	Count	17	17	17	17	17	17	17	17

Source: P:\01_SITES\Ekati\1CD015.000_Seepage Monitoring_2013\080_Deliverables\2013_Final Report\030_Appendices\Appendix A.1\[A.1.4_MiseryBlast_Database.1CD015.000_2013_LM_01]

Notes: 1) All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
2) 'S (T)': total sulphur.
3) 'S (SO_4)': sulphur as sulphate.
4) 'CO_3-NP': carbonate neutralization potential.
5) 'NP': neutralization potential as determined by the standard Sobek method.
6) 'MPA': maximum potential acidity calculated from total sulphur.
7) 'NNP': net neutralization potential

3.8 Kinetic Testing of Misery Metasediment

Kinetic testing of Misery metasediment was first conducted during pre-mining characterization (Norecol Dames and Moore 1997). The sample had a total sulphur concentration of 0.15% S. During the first 20 weeks of humidity cell testing, the pH of leachate declined from 7.5 to 4.8. The pH continued to fall reaching a low of around 3.6 between week 30 and week 40. The pH then remained around 4 for the duration of the test (120 weeks). Sulphate production followed a similar trend, with sulphate concentrations initially around 40 mg/L, increasing to around 140 mg/L once the pH dropped to 4.

This was supplemented by testing of two additional Misery metasediment samples in humidity cells (SRK 2003, 2004). One of the samples had a total sulphur concentration (0.19% S) that was comparable to the average Misery metasediments composition and the other contained a much higher total sulphur concentration (0.34% S) above the 95th percentile.

The sample containing typical sulphur concentrations released near neutral pH leachate for 30 weeks before decreasing to below pH 5 and fluctuating erratically between pH 4.6 and 6.6. The pH then continued to decline to more acidic values and reached a value just below 4 in the 110th week of testing. Release of sulphate, iron and acidity was low, though iron release increased as pH decreased below 5. Release of other metals was very low until week 60, but release of copper, nickel and zinc began to increase along with declining pH. Average sulphate release for 108 weeks of testing was 6 mg/kg/week.

The sample containing elevated sulphur produced acidic leachate almost immediately and pH steadily decreased to below 4 over the first 25 weeks, before stabilizing at about pH 3.7. Average sulphate release reached a maximum of 30 mg/kg/week. Iron and acidity release peaked and then began to decrease. Copper, nickel and zinc release peaked concurrently with acidity. This test was stopped after 60 weeks.

These tests confirmed that Misery metasediment generates acid under laboratory conditions, though oxidation rates are low and related to sulphur concentration (SRK 2003). These materials have not resulted in ARD in the field. As discussed in Section 0, the WRSA was constructed to mitigate ARD potential by enhanced cooling. Current indications are that these measures have been effective.

3.9 Coarse Kimberlite Reject Geochemical Characterization

ABA data and elemental results for Coarse Kimberlite Reject (CKR) samples collected routinely from 2000 through 2013 are summarized in Table 3.11 and Table 3.12 and a summary is provided below, based on the Ekati Mine *2013 Waste Rock and Waste Rock Storage Area Seepage Report*.

Monitoring results from the 2013 CKR samples were generally within the range of CKR ABA results from previous years.

CKR sampled during 2013 had total sulphur contents of 0.05% to 0.09%, with a median sulphur content of 0.08%. This is lower than the median of 0.26% sulphur from samples collected between 2000 and 2012. The 2013 samples had a slightly higher median neutralization potential (NP) of 290 kg CaCO3/t compared to a long-term median of 270 kg CaCO3/t. The ratio of NP to maximum potential acidity (MPA) provides a measure of the acid generating potential of the sample. Values of greater than 3 indicate that samples are likely to be non-acid generating. The 2013 CKR samples had NP/MPA that ranged from 88 to 170, with a median ratio of 130. This is significantly higher than the long term median NP/MPA of 33. The carbonate NP/MPA ratio was also higher than the long-term results with a range of 13 to 23 and a median of 21, compared to the long-term median of 6.5. These results continue to indicate that there is sufficient NP within CKR to neutralize any acid produced as a result of oxidation of contained sulphides.

Major and trace element concentrations in the 2013 CKR are similar to the range of concentrations observed for Fox kimberlite or Koala kimberlite. Kimberlite is enriched in magnesium, chromium and nickel compared to other rock types at Ekati, and these elements are present at similar concentrations in CKR. Major element concentrations are within the range of previous results for CKR (2000 to 2012); however, average Ca and Na concentrations were higher in 2013 samples than the long-term average. Sodium concentrations in particular were on an increasing trend from 2009 through 2012. The median concentration in 2001 to 2009 samples was 0.68% Na, and in 2010 to 2012 it was 1.1 to 1.4 % Na. The median concentration in 2013 was 1.6% Na, indicating that the concentration has continued to increase. This coincides with an increase in the proportion of Fox kimberlite being processed, from around 50% of total kimberlite in 2008 and 2009, 65% of total kimberlite in 2010, 76% of total kimberlite in 2011 and 82% of total kimberlite in 2012 and 2013. Higher Na in Fox kimberlite reflects a higher amount of Na-rich smectite/montmorillonite clays in the intensely clay-altered Fox kimberlite compared to Panda/Koala /Beartooth kimberlite.

Table 3.12 Summary of Coarse Kimberlite Reject Acid-Base Accounting Data

Description	Summary Statistic (1)	Paste pH	S (T)(2)	S (SO_4)(3)	CO_3-NP(4)	NP(5)	MPA(6)	NNP(7)	NP/MPA(8)	CO_3-NP/MPA
	Units	pH	%	%	kg $CaCO_3$ eq/tonne	kg $CaCO_3$ eq/tonne	kg $CaCO_3$ eq/tonne	kg $CaCO_3$ eq/tonne		
2000-2012 CKR	Average	8.5	0.28	0.034	52	250	8.7	240	43	8.1
	Max	9.8	0.61	0.12	95	350	19	340	160	31
	95th Percentile	9.5	0.51	0.080	73	320	16	310	130	21
	Median	8.4	0.26	0.030	52	270	8	260	33	6.5
	5th Percentile	7.8	0.07	0.010	34	90	2.2	77	8.3	3.0
	Min	6.5	0.04	<0.010	20	50	1.3	48	4.8	2.3
	Count	166	166	141	152	162	166	166	166	152
2013 CKR	Average	9.4	0.075	0.015	43	290	2.4	290	130	19
	Max	9.8	0.090	0.020	55	330	2.8	330	170	23
	95th Percentile	9.8	0.090	0.020	53	330	2.8	330	170	23
	Median	9.3	0.080	0.015	41	290	2.5	290	130	21
	5th Percentile	9.1	0.053	0.010	36	250	1.7	240	88	13
	Min	9.1	0.050	0.010	36	250	1.6	240	88	13
	Count	6	6	6	6	6	6	6	6	6

Source: P:\01_SITES\Ekati\1CD015.000_Seepage Monitoring_2013\080_Deliverables\2013_Final Report\030_Appendices\Appendix A.2\[A.2.2_Compiled_Coarse KimberliteRejects_ABA&Metals_LM_KK_ver01

Notes: 1) All results reported as 'below detection' were replaced with detection limit values for the calculation of summary statistics.
2) 'S (T)': total sulphur.
3) 'S (SO_4)': sulphur as sulphate.
4) 'CO_3-NP': carbonate neutralization potential.
5) 'NP': neutralization potential as determined by the standard Sobek method.
6) 'MPA': maximum potential acidity calculated from total sulphur.
7) 'NNP': net neutralization potential.

Table 3.13 Summary of Elemental Concentrations in Coarse Kimberlite Reject

Description	Summary Statistic (1)	Al	As	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Pb	Sr	Zn	U
	Units	%	ppm	ppm	%	ppm	ppm	ppm	ppm	%	%	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
2000-2012 CKR	Average	3.9	5.7	890	2.5	0.59	54	620	28	4.0	1.2	12	690	2.0	0.82	910	9.1	470	58	9.4
	Max	7.3	19	1300	4.0	2.5	82	1500	48	5.1	1.7	16	880	11	2.3	1530	47	690	120	10
	95th Percentile	5.2	10	1100	3.6	1.0	72	960	41	4.6	1.7	15	820	6.0	1.5	1200	20	650	72	10
	Median	4.0	5.0	890	2.4	0.50	52	590	28	4.1	1.1	13	690	1.0	0.77	860	8.0	460	56	10
	5th Percentile	2.7	3.7	610	1.7	0.50	44	370	20	3.4	0.66	9.8	580	1.0	0.25	680	2.0	330	48	4.7
	Min	1.7	2.0	380	1.2	0.18	29	230	15	3.0	0.47	6.4	500	1.0	0.12	410	2.0	210	38	1.8
	Count	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	28
2013 CKR	Average	5.0	<5.0	1000	3.6	0.50	47	370	38	4.1	1.9	11	660	1.0	1.5	700	13	680	63	4.0
	Max	5.7	<5.0	1100	3.9	0.50	51	390	46	4.4	2.1	12	690	1.0	1.8	790	29	760	84	4.0
	95th Percentile	5.6	<5.0	1100	3.8	0.50	51	390	45	4.4	2.1	12	690	1.0	1.7	780	27	750	79	4.0
	Median	5.2	<5.0	990	3.6	0.50	50	370	38	4.0	1.9	11	660	1.0	1.6	730	9.0	680	62	4.0
	5th Percentile	4.1	<5.0	900	3.3	0.50	41	350	33	3.9	1.7	9	620	1.0	1.1	600	5.0	630	53	4.0
	Min	3.8	<5.0	890	3.3	0.50	41	350	31	3.9	1.7	9	610	<1.0	0.97	600	5.0	620	52	<4.0
	Count	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

Source: P:\01_SITES\Ekati\1CD015.000_Seepage Monitoring_2013\080_Deliverables\2013_Final Report\030_Appendices\Appendix A.2\[A.2.2_Compiled_Coarse KimberliteRejects_ABA&Metals_LM_KK_ver01

Note: Values below detection were replaced by detection limits for calculation of summary statistics

3.10 Pigeon Pipe Geochemical Characterization

The Pigeon Kimberlite Complex occurs within a field of kimberlite intrusions situated within the Lac de Gras area, Northwest Territories, Canada. The Pigeon Pipe is a small steep-sided kimberlite pipe, approximately 3.5 ha in surface area. The kimberlite occurs near a regional lithological contact between granitoid and metasedimentary rocks. Two parallel diabase dykes intrude in a north-south direction adjacent to the Pigeon Pipe. The pipe is interpreted to intersect the eastern-most diabase dyke.

The Pigeon kimberlite pipe is overlain by a substantive depth of glacial till (5 - 30 m), which is not common among the kimberlite pipes that have been developed at the Ekati Mine where very little glacial till is typically encountered (generally <5 m till thickness).

An updated geological model was finalized in 2012 in which the Pigeon Pit waste rocks have been divided into the Northwest Domain and the Southeast Domain (Figures 3.1 and 3.2) based on assessment of Pigeon drill logs, core photographs and petrographic analysis. The Northwest Domain is dominated by metasediment material (95%) and the Southeast Domain by a range of lithologies, including granitoid (16%), metasediment (34%), granitoid material with >30% intermixed metasediment (32%), and diabase (18%). The relative proportion of the units is based on the proportion of each lithology intercepted within all drill cores in each domain, not including the overburden (glacial till) unit.

Figure 3.1 Pigeon Pit Geological Model

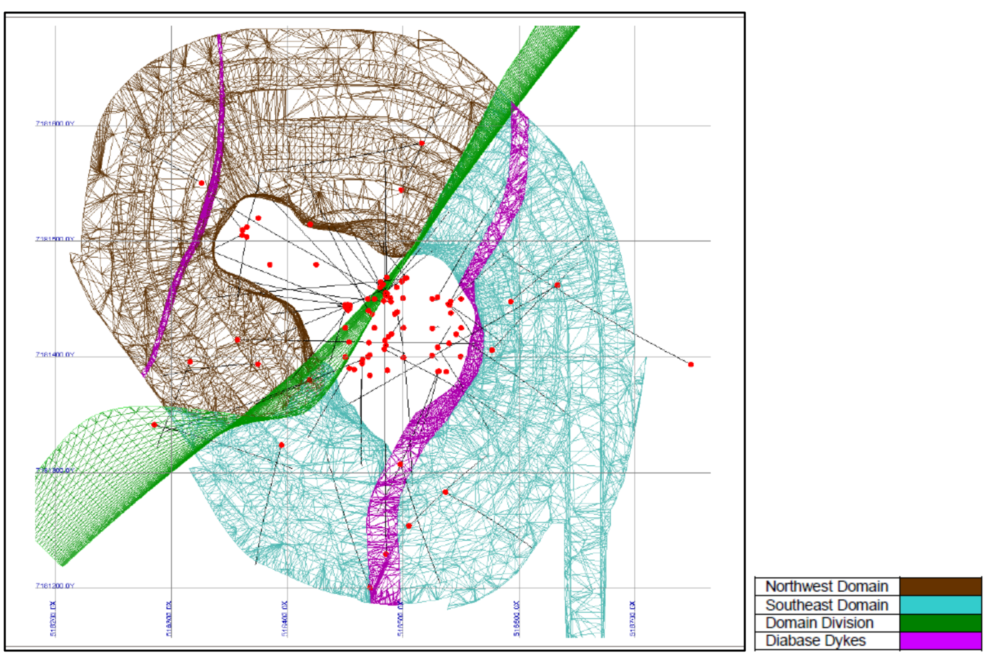
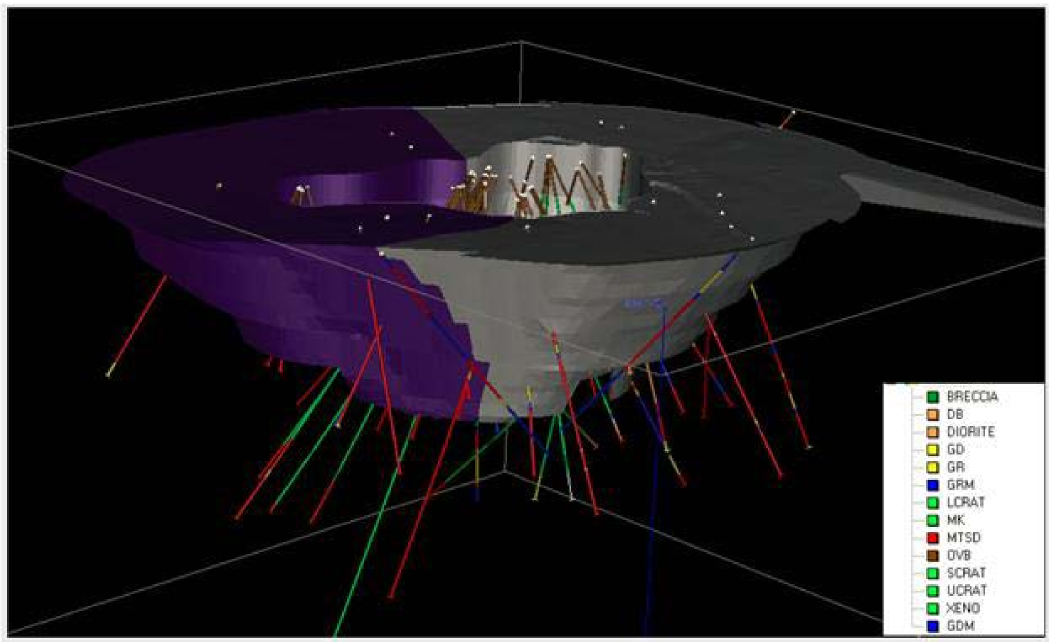


Figure 3.2 Pigeon Pit Geological Model

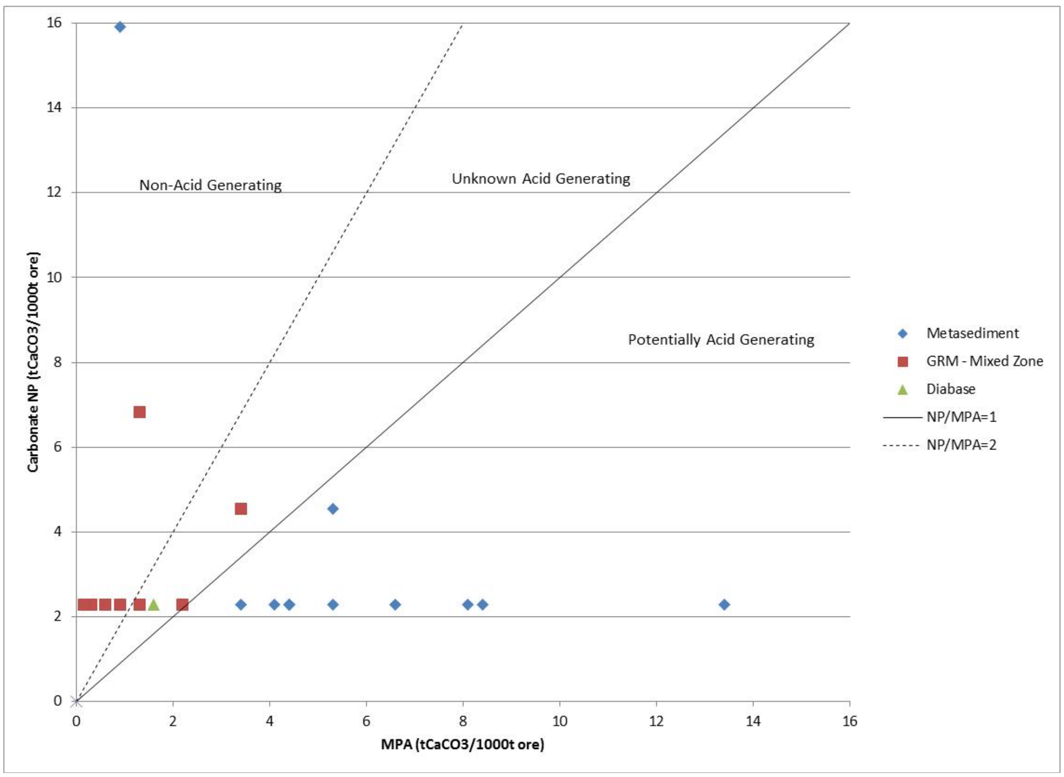


3.10.1 Acid Base Accounting

Acid-base accounting (ABA) and geochemical characterization conducted prior to 2012 was based on an assumption that the geological contact between granite and metasediment would be visually distinct and obvious, as occurs in the Misery open pit. However, the final (2012) geological model identifies an inter-fingered contact zone that precludes the identification and isolation of all but a small amount of granite at a mining scale. Rock samples that were collected and analyzed for ABA prior to 2012 have been re-logged according to the final geological model as presented in Table 3.13. The 'pre-2012' ABA data suggests that significant variability exists in the mineralogical make-up of the metasediment unit. Specifically, a low sulphur form of metasediment was identified in the presence of abundant biotite and muscovite. The intrusives units show less variability geochemically, specifically with respect to low sulphur content. Mineralogical analysis indicated a lack of carbonate minerals in the metasediment, which was confirmed in the ABA analysis and indicates that neutralization potential within this rock unit is provided through weathering of aluminosilicates. The results are not dissimilar to ABA results for the same rock types at other open pits at the Ekati Mine.

An additional thirty five (35) samples underwent ABA analysis in 2012, to validate previous results according to the final geological model. Core samples from each waste rock lithology were selected from drill holes geographically distributed throughout the footprint of the planned Pigeon Pit, and from different depths within the planned pit, to provide representative samples of each waste rock lithology and capture the geochemical variability within the waste rock. Tables 3.14 and 3.15 provide the 2012 ABA sample results. Figure 3.3 shows the results of the 2012 ABA analysis.

Figure 3.3 Pigeon Waste Rock Acid Base Accounting Summary



The average sulphur content of metasediment samples was 0.11% with a maximum of 0.43% S. Sobek NP values averaged 10.8 kg $CaCO_3$ eq/t. The average ratio of neutralization potential (NP) to acid potential (AP), or neutralization potential ratio (NPR) was 9.7 but the minimum was 1.1, which is classified as unknown acid generating potential (MEND, 2009). Pigeon metasediment therefore has the potential to be acid-generating. The results confirm that the metasediment unit is overall classified as potentially acid generating (11 of 23 samples PAG); however the presence of a low-sulphur component within the metasediment rock unit is also confirmed through 11 of 23 samples reported as non-acid generating (NAG).

The average sulphur content of the mixed granite/metasediment samples was 0.04% with a maximum of 0.11%. Average Sobek NP was 8.7 kg $CaCO_3$ eq/t, ranging from 7.0 to 13 kg $CaCO_3$ eq/t. The NPR ranges from 2.0 to 58 with an average of 15, indicating that this unit has a low probability of generating acid. The results indicate that the mixed granite/metasediment rock unit could be classified as NAG (9 of 12 samples NAG); however, because of the presence of metasediment in varying proportions from 30% to 70%, further confirmation would be adviseable before assuming this classification for long-term performance.

A single sample was collected of the Pigeon diabase material for ABA analysis. The total sulphur content was 0.05%, with a maximum potential acidity (MPA) of 1.6 kg $CaCO_3$ eq/t and a Sobek NP of 15 kg $CaCO_3$ eq/t yielding an NPR of 9.6. The results confirm that diabase is classified as NAG.

Table 3.14 Pigeon Geochemical Classifications (pre-2012)

Rock Group	Rock Domain	Samples Collected (prior to 2012)	Geochemical Classification		
			PAG	Uncertain	NAG
Mixed Granite/Metasediment	Northwest	4	0	0	4
Metasediment	Northwest	14	9	4	1
Diabase	Southeast	12	0	0	12
Diorite	Southeast	2	0	0	2
Mixed Granite/Metasediment	Southeast	7	0	0	7
Mixed Granite/Metasediment	Southeast	5	0	0	5

Table 3.15 Pigeon Acid-Base Accounting Classifications (2012)

Sample Lithology	Number of Samples Submitted	Geochemical Classification		
		PAG	NAG	Uncertain
Metasediment	23	11	11	1
Mixed Granite/Metasediment	11	1	8	2
Diabase	1	0	1	0

Table 3.16 Pigeon Acid-Base Accounting Results (2012)

Description	Summary Statistic	Paste pH	Total S	Sulphate	Sulphide	NP	MPA	NNP	NP/MPA
Rock Type	**Units**	**s.u.**	**%**	**%**	**%**	**kg $CaCO_3$ eq/tonne**			
Diabase	Single Measurement	8.7	0.05	0.01	0.04	15	1.6	13	9.6
Mixed Granite/Metasediment	Average	9.4	0.04	0.01	0.03	8.7	1.1	7.6	15
	Max	10	0.11	0.01	0.10	13	3.4	12	58
	95th Percentile	10.0	0.09	0.01	0.09	12	2.8	11	42
	Median	9.3	0.02	0.005	0.02	8.0	0.6	8	11
	5th Percentile	9.0	0.008	0.005	0.008	7.0	0.23	5	2.9
	Min	9.0	0.005	0.005	0.005	7.0	0.15	4	2.0
	Count	11	11	11	11	11	11	11	11
Matesediment	Average	9.4	0.11	0.01	0.10	10.8	3.3	7.6	9.7
	Max	9.8	0.43	0.02	0.43	22	13.4	19	35
	95th Percentile	9.8	0.27	0.02	0.3	20	8.4	15	28
	Median	9.4	0.04	0.005	0.03	9.0	1.3	7	7.2
	5th Percentile	8.8	0.010	0.005	0.010	7.1	0.3	3.1	1.5
	Min	8.0	0.010	0.005	0.010	7.0	0.3	1.0	1.1
	Count	23	23	23	23	23	23	23	23

3.10.2 Whole Rock Element Analysis

Subsamples of core submitted for humidity cell analysis were also submitted for x-ray diffraction and elemental mapping using SEM-EDS to confirm the mineralogical analysis. Sparsely distributed discrete sulphide grains are present within the majority of samples tested.

In general, element concentrations were typical of global characteristics for these rock types. On a relative basis:

- Diabase can primarily be distinguished geochemically by considerably higher copper and vanadium concentrations. It is also characterized by elevated Au, Ca, Fe, P, Sr, and Ti, and lower Ba, Cr, K, Mg, Ni, Pb, Sc, Th, and U relative to all other rock types.
- Metasediments can primarily be geochemically distinguished from granitoids by the higher sulphide content. In addition, metasediments have higher Cu, Co, Fe, Mn, Ni, V, and Zn, and lower Ca and U than granitoids.

- Granitoids have higher uranium and lead concentrations, and have considerably lower copper concentrations (generally less than 10 ppm Cu) than the other rock types.
- Diorite samples contained higher barium and lower molybdenum than the other rock types.

  Heavy element concentrations were evaluated for correlation with sulphur content to evaluate which metals might be associated with sulphides and may therefore be expected to have a higher metal leaching potential due to release by sulphide oxidation. Only copper in metasediments showed a correlation with sulphur content, and may therefore have a higher metal leaching potential from samples containing elevated sulphide contents. Copper concentrations were well below the level expected if chalcopyrite is the host and is likely hosted mainly by iron sulphide minerals.

3.10.3 Humidity Cell Tests

Core samples were selected for humidity cell analysis in 2012, based on the results of acid-base accounting results and to provide a representative range of sulphide content. A total of eight core samples were selected for humidity cell analysis (Table 3.16). Six tests were initiated in October 2012 (HC-Pdef-1, 3, 4, 5, 10 and 16), and two tests were initiated in December 2012 (HC-Pdef-29 and 30). A total of 51 weeks of data are available for the initial six tests, and 44 weeks for the two mixed granitoid/metasediment tests.

Table 3.17 Pigeon Humidity Cell Samples

Sample ID	Domain	Lithology	Sulphide Content (%)
HC-Pdef-1	NW	Diabase	0.04
HC-Pdef-3	NW	Metasediment	0.2
HC-Pdef-4	NW	Metasediment	0.14
HC-Pdef-5	NW	Metasediment	0.43
HC-Pdef-10	SE	Metasediment	0.26
HC-Pdef-16	SE	Metasediment	0.15
HC-Pdef-29	SE	Mixed Granite/Metasediment (est. 70% metasediment)	0.02
HC-Pdef-30	SE	Mixed Granite/Metasediment (est. 30% metasediment)	0.03

Trends in leachate pH and sulphate concentration over time are shown in Figures 4 and 5. Four of the five metasediment tests (HC-PDef-3, HC-Pdef-5, HC-Pdef-10, HC-Pdef-16) produced acidic leachate with solution pH declining to approximately 3.5 to 5. Solution pH in the remaining tests has remained circumneutral. Chemical stability of a test is defined as less than a factor of two difference between a given week's release rate and the running average of the previous five weeks data (Day, 1994; MEND, 1997).

After an initial pH of 8.65 in test HC-Pdef-1, the pH of the diabase decreased gradually over time to a value of 7.09 (week 51). The total alkalinity decreased from an initial concentration of 21.4 mg/L to a concentration of 3.9 mg/L. The sulfate concentration remained below 6.5 mg/L. Sulphide depletion outpaced NP depletion, indicating that the material will have sufficient neutralization capacity to mitigate any acid generation from sulphide oxidation. The dissolved metal concentrations in the diabase material maintained low concentrations. The test results are stable and confirm that diabase is NAG.

Initial pHs of the metasediment tests (HC-Pdef-3, -4, -5, -10, -16) ranged from 5.60 in HC-Pdef-16 to 9.35 in HC-Pdef-10, and all decreased over time to values ranging from 3.54 in HC-Pdef-16 to 7.46 in HC-Pdef-4 (week 51). Tests HC-Pdef-10, HC-Pdef-16, HC-Pdef-05, and HC-Pdef-3 depleted all available alkalinity and became acid generating within the first 40 weeks. Only test HC-Pdef-04 remained circumneutral, with alkalinity of 10.7 mg/L at week 51. The sulfate concentration generally increased in all tests. Sulphide generation outpaced alkalinity production, indicating that the material will likely become acid generating in the field.

The dissolved metal concentrations maintained elevated concentrations of various metals including: aluminum, arsenic, cadmium, copper, iron, nickel, selenium, uranium, and zinc. In tests HC-Pdef-03, HC-Pdef-04, and HC-Pdef-16, metal concentrations stabilized or were decreasing at week 51. In test HC-Pdef-5, concentrations of cobalt, nickel, and iron rapidly increased beginning around week 30 from below detection limits at week 0 to 0.293 mg/L, 0.0204 mg/L and 1.86 mg/L, respectively, at week 51; more modest increases were also observed in zinc and copper. These increases correspond with the onset of mildly acidic conditions in the cell. Test HC-Pdef-10 showed a similar behaviour with the onset of acidic conditions at week 25; however only nickel concentrations have increased significantly to 2.63 mg/L at week 51. The results confirm that Metasediment is potentially acid generating and metal leaching.

After initial pHs of 9.23 and 9.01 in tests HC-Pdef-29 and HC-Pdef-30, respectively, the pH of the mixed granite/metasediment decreased gradually over time to values of 7.59 and 7.01 (week 44). The total alkalinity decreased from initial concentrations of 28.8 and 20.8 mg/L to concentrations of 13.6 and 3.1 mg/L. The sulfate concentration remained below 2.5 mg/L in both cells. Alkalinity production outpaced sulphate production, indicating that the material will have sufficient neutralization capacity to mitigate any acid generation from sulphide oxidation. The dissolved metal concentrations in the mixed material maintained low concentrations;

although, in HC-Pdef-29, aluminum was slightly elevated at 0.01 mg/L. The test results are stable and indicate that the mixed granite/metasediment unit is NAG.

Figure 3.4 Pigeon Humidity Cell Tests Leachate pH

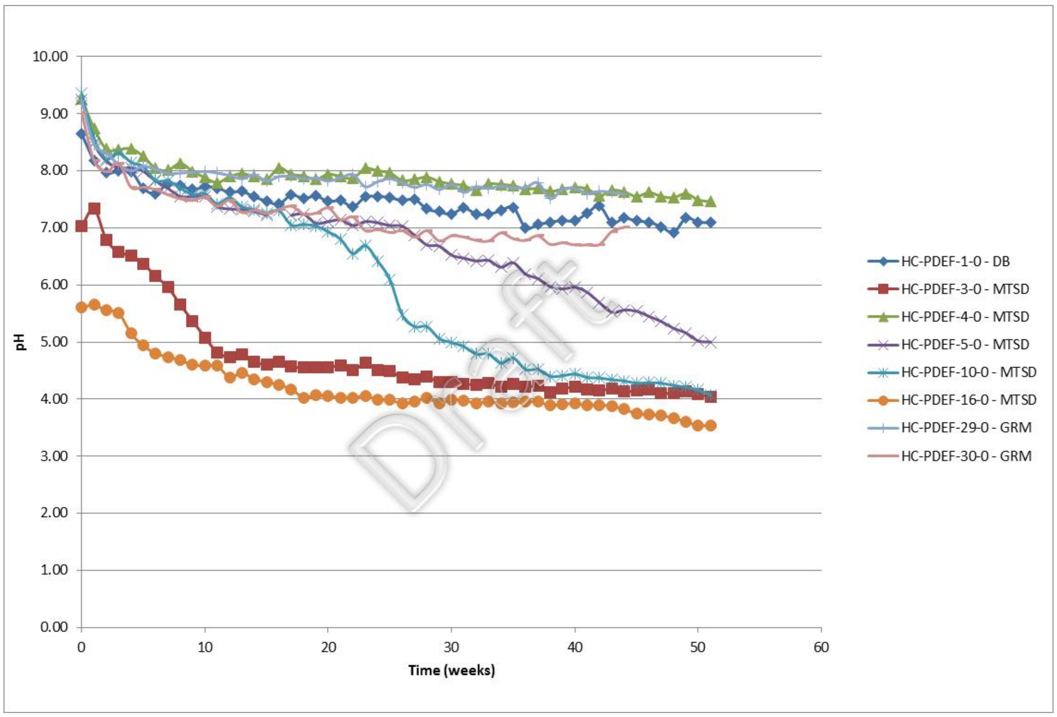
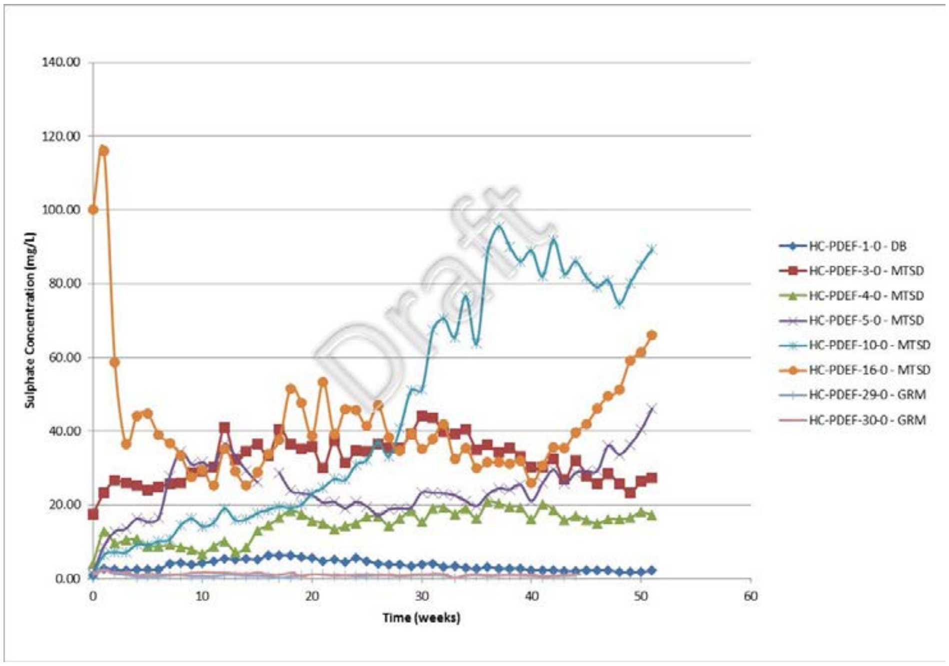


Figure 3.5 Pigeon Humidity Cell Tests Cumulative Sulphate Production



3.10.4 Pigeon Geochemical Characterization Summary

The Pigeon ABA and humidity cell test results indicate that:

- The diabase, diorite and granite rock units are classified as NAG, and are not a material risk of metal leaching, the same as the classification of these rock types at other open pits at the Ekati Mine.
- Metasediment is PAG, and a risk of metal leaching, the same as the classification of this rock type at other open pits at the Ekati Mine.
- The mixed granite/metasediment unit (30-70% metasediment) is classified as NAG.

3.11 General Summary of Geochemical Characterization

- The majority of rock types mined at Ekati are not potentially acid generating or have low potential to generate acidity.
- Metasediment rock at the Misery and Pigeon pits is classified as potentially acid generating (PAG).

- Misery metasediment generated acid under laboratory conditions over a time frame of several tens of weeks. It is estimated that this would translate to periods of several years under site conditions (SRK 2010b).
- The Misery WRSA is probably of sufficient age that the effects of acidification ought to be apparent if the schist were becoming acidic (SRK 2010b).
- The Misery WRSA seepage is currently not acidic (see Section 5).

4 Ground Temperature

Ground temperatures in the WRSA's are measured four times annually, using ground temperature cables (GTCs) installed at various locations. The locations and current operating status of the GTCs are shown in Figures 4.1 through 4.3. Monitoring of the GTS's has been undertaken since 2000 and is reported to the Board annually as part of the annual Seepage Reports. The most recent (2013 data) assessment as prepared by Tetratech EBA is appended to this Plan (Appendix D) and the broad observations are summarized below.

(Section 3.0 of Tetratech EBA 2013 Summary of Ground Temperature Conditions in Waste Rock Storage Area)

Ground temperatures within the EKATI WRSAs and toe berms generally show similar temperature trends to those observed last year. It is recommended that ground temperature readings continue to be obtained four times per year, keeping consistent with past practice.

The Panda / Koala WRSA and toe berms remain in a permafrost condition, consistent with previous years. Some fluctuations in ground temperatures were observed in response to the removal of cover material for use as crusher feed. Ground temperatures appear to be stabilizing; however, the time required to achieve thermal equilibrium is unknown. There are no immediate concerns or issues with respect to thermal conditions in the Panda/Koala WRSA and toe berms, but it is recommended that the ground surface around the GTC locations be surveyed to evaluate the quantity of cover material which was removed for crusher feed.

Large portions of the Fox WRSA remain unfrozen, as in previous years. Temperature measurements indicate that ground temperatures are equilibrating and trending towards freezing in GTC 1931 and 1933; however, the time for freeze back is unknown. At GTC 1931 ground temperature measurements indicate some warming in the central portion of the pile (up to 1°C) when compared to the 2011 and 2012 measurements, and a slowing of the rate of cooling at the pile base. The precise reason for this is unknown. GTC 1931 is located in the low grade kimberlite storage *area, and the increasing temperature may be a function of seasonal temperature variations, thermal conductivity of the kimberlite material, dark surface conditions or chemical reactions within the pile. The thermal conditions in the Fox WRSA are recognized as a possible issue with respect to long-term waste rock pile performance. In the short term, ground temperature conditions in the Fox WRSA should continue to be monitored in conjunction with WRSA seepage monitoring, and this data used to develop long-term planning for the Fox WRSA. Thermal conditions in the Fox WRSA should continue to be monitored to evaluate pile freeze back.*

The Fox toe berms remain in a permafrost condition, consistent with previous years. The active layer is contained within the waste cover and the minimum temperature of the lacustrine core material is -0.6°C. There are no immediate concerns or issues with respect to thermal conditions in the Fox toe berms.

The Misery WRSA remains in a permafrost condition, consistent with previous years. Active layer thicknesses vary significantly within the Misery WRSA as was also observed in previous years. Although not an immediate cause for concern, the variability in active layer thickness (causes and mitigation) should be further evaluated in subsequent studies.

Temperatures in the coarse PK pile show little change from 2010 measurements. Freeze back of the pile is expected; however, the time required for this to occur is unknown. There are no immediate issues or concerns with respect to the ground temperatures in the coarse PK pile.

DOMINION DIAMOND

Figure 4.1 Thermistor Locations – Panda/Koala Waste Rock Storage Area

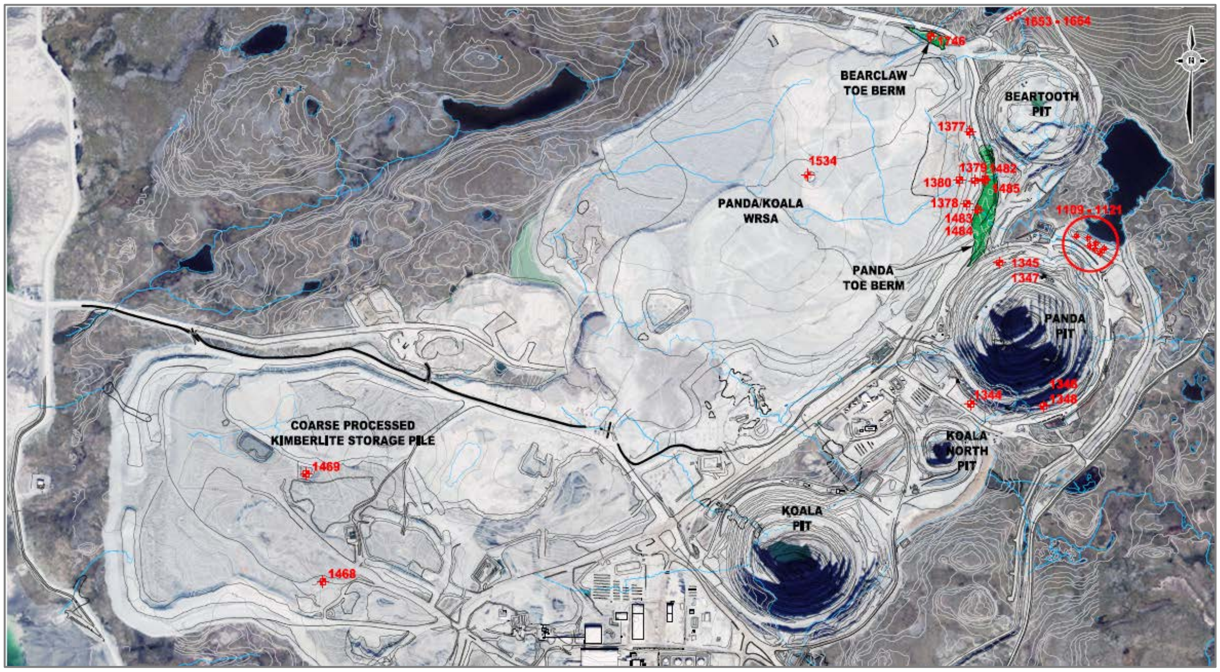


Figure 4.2 Thermistor Locations – Fox Waste Rock Storage Area

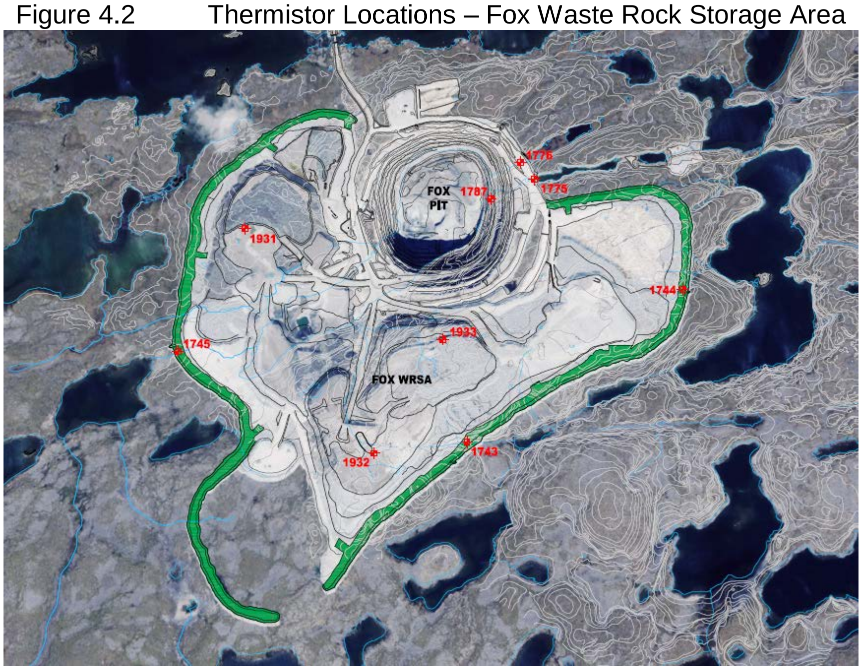
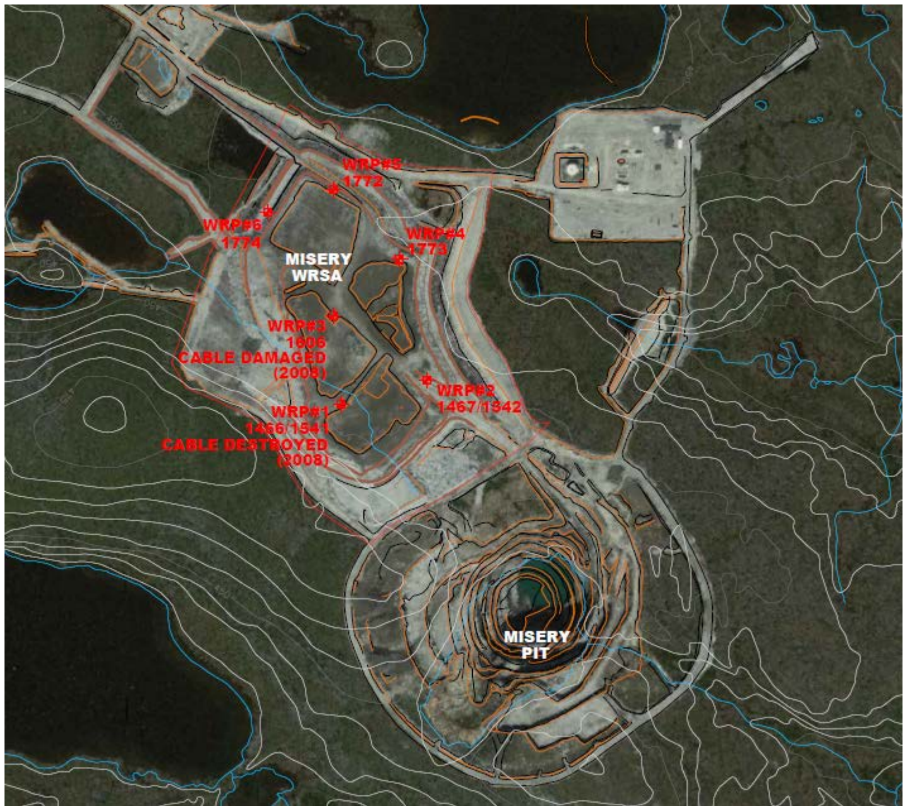


Figure 4.3 Thermistor Locations – Misery Waste Rock Storage Area



5 Seepage Quality

5.1 Introduction

The main potential source of chemical loading from waste rock storage areas is infiltration during late freshet as a result of seasonal melting of surface snow and ice. In addition, there is a small amount of melting within the active layer during the summer. As described in Section 2.4, WRSA's were designed so that the active layer comprises low or non-reactive materials (granite and glacial till). In addition, toe berms have been constructed at certain WRSA that further reduce seepage to the receiving environment.Some seepage flows are small such that the water pools on the tundra and does not enter the aquatic receiving environment. Water. Most other seepage water flows to minewater management facilities (LLCF, King Pond Settling Facility, Desperation Pond, etc). A portion of seepage water flows to the receiving environmentThe general drainage flow paths are shown in Figure 5.1

5.2 Physical Seepage Management

WRSA's are designed such that seepage water flows to minewater management areas where possible. Where this cannot occur, both active (collection and pumping) and passive (diversionary berm) collection methods can be used if required to re-route seepage into managed areas.

5.2.1 Panda/Koala/Beartooth Waste Rock Storage Area

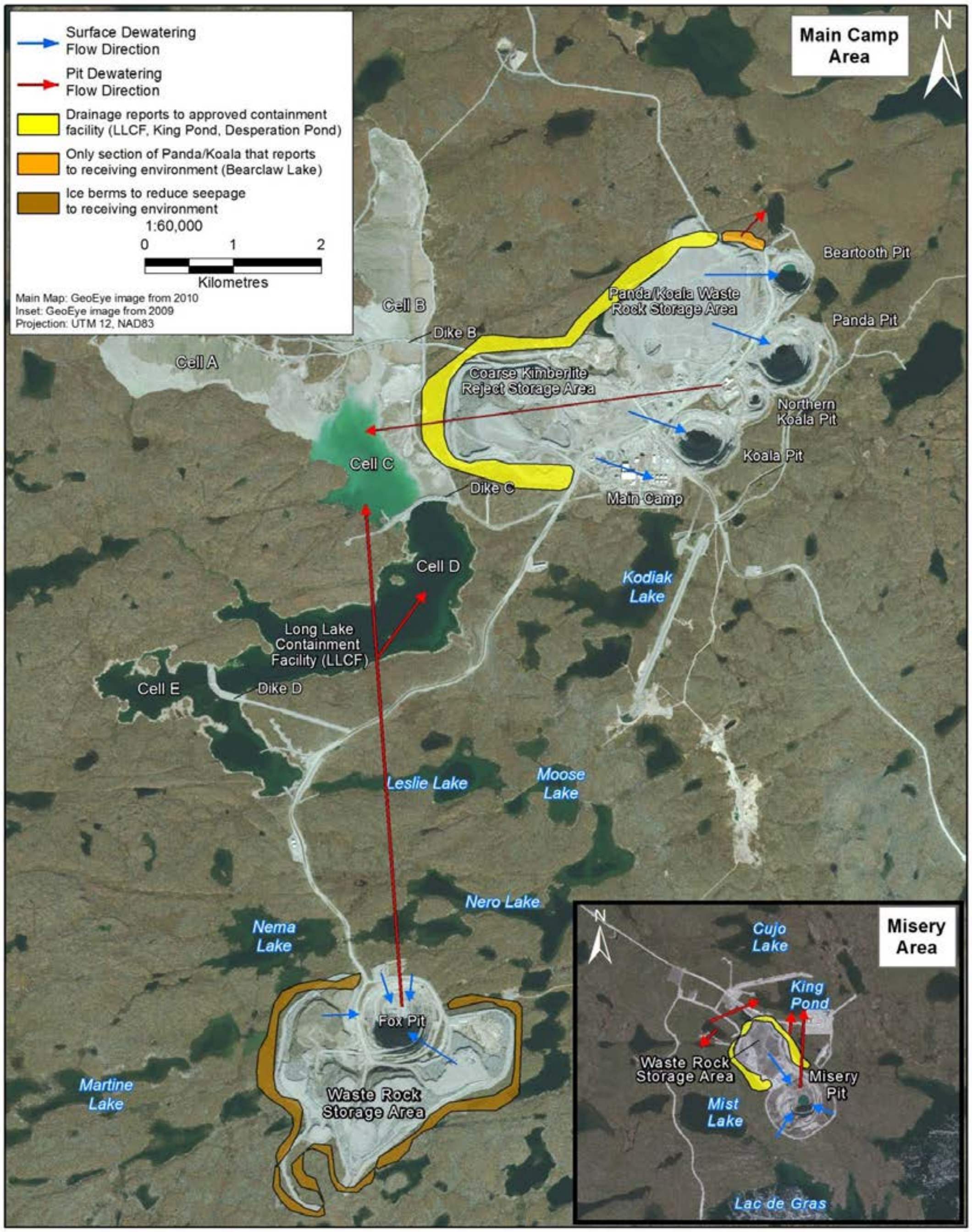
The location of the Panda/Koala/Beartooth WRSA was selected and constructed such that the majority of the seepage flows either towards the LLCF or into surface and pit dewatering systems which are tied into the central dewatering system which ultimately discharges into the LLCF. The northeast corner of the WRSA (~3% of a ~24 km perimeter, shown in orange on Figure 5.1) flows to Bearclaw Lake via a small flow monitored during seepage surveys. A toe berm was constructed in this location in response to past water quality concerns that have since resolved.

5.2.2 Fox Waste Rock Storage Area

The Fox WRSA was located such that the majority of drainage flows into the Fox Pit drainage catchment. The WRSA is surrounded by toe berms that limit seepage to the surrounding receiving environment.

DOMINION DIAMOND

Figure 5.1 General Seepage Flow Paths



5.2.3 Misery Waste Rock Storage Area

The location of the Misery WRSA was selected so that the majority of drainage flows into the pit, or minewater management facilities (Desperation Pond, Waste Rock Dam and King Pond Settling Facility). To restrict the flow of runoff and seepage into Lac de Gras (the receiving environment), a runoff and seepage containment structure (Waste Rock Dam in Figure 5.4, page 58) was constructed down gradient and east of the Misery WRSA. This structure temporarily stores runoff and seepage that flows towards Lac de Gras. Two coffer dams were constructed south of Desperation Pond (Figure 5.4) to capture seepage and runoff down gradient and northwest of the Misery WRSA.

Drainage from the north side of the Temporary Kimberlite Ore Storage Area (Figure 5.4) (~2% of a ~6 km perimeter) flows to Cujo Lake via a small north-eastward flow monitored during seepage surveys. The Temporary Kimberlite Ore Storage Area is no longer in use, and it is therefore not expected to adversely affect long-term drainage chemistry. However, the WSRA will be expanded to this location (Section 6.6).

5.3 Seepage Monitoring

Seepage surveys of all constructed waste rock storage areas and ore stockpiles are conducted twice a year (during spring freshet, and again in late summer or fall before freeze up), in accordance with the requirement of the Water Licence. The testing of seepage chemistry is designed to detect changes that may affect the receiving environment. Samples are also collected from reference areas near the mine that are not affected by waste rock and other mining activities to determine the chemical composition of natural waters in the area. Laboratory testing of seepage samples includes the set of parameters defined under Water Licence W2012L2-0001. Field testing includes measurement of volume and rate of flow, field pH, and conductivity. The detailed seepage sampling protocol is provided in Appendix B. The results of seepage monitoring are reported annually as required by the Water Licence.

5.4 Chemical Weathering Mechanisms

Waste rock leachate quality is dependent on the actual minerals present and the mechanisms by which the minerals break down chemically (decompose) to release metal ions to solution. Understanding of these mechanisms is important to predicting the long term chemical loadings from waste disposal areas. The following sections describe expected chemical weathering mechanisms for each of the main rock types.

5.4.1 Granite

The main mineralogical features of granite are the presence of abundant silicate minerals (mainly plagioclase, quartz and biotite mica), low concentrations of sulphide minerals and negligible carbonate minerals.

The dominant chemical process for granite under site conditions is the reaction of carbonic acid (carbon dioxide dissolved in rainwater and snowmelt) with silicate minerals. This reaction produces clay from weathering of silicates, some dissolved metals (calcium, magnesium, potassium) and dissolved alkalinity. The rate of the reaction is limited by the formation of thin clay layers on the fresh silicate surfaces; however, kinetic testing on granite samples has consistently shown that low levels of alkalinity are produced by this process (Norecol Dames and Moore 1997).

Oxidation of the small amounts of sulphide minerals will release protons (acidity) to solution. However, since this occurs at a very low rate, the acidity produced is readily consumed by reaction with the dissolved alkalinity and carbonate minerals from silicate weathering.

Overall, granite will not produce ARD because the capacity to generate dissolved alkalinity by long term weathering of abundant silicates will offset the acid produced by short term weathering of small quantities of sulphides. In the long term, no major changes in drainage chemistry are expected except for slowly declining loadings of metals released by silicate weathering. Drainage pH is not expected to change. Therefore, the chemistry of drainage observed under current conditions is a conservative indication of long term drainage chemistry and can be used to predict future loadings.

5.4.2 Metasediment

Metasediments at Ekati contain higher concentrations of fine-grained sulphide minerals than granite, similar silicate minerals (though with greater abundance of micas) and negligible carbonate minerals. Laboratory testing showed that metasediments generate acid at room temperature but the Misery WRSA has not produced ARD.

Silicate minerals in metasediments can be expected to weather in the same way as granites. The rock is less competent than granite which should result in accelerated silicate weathering. However, in the laboratory, the presence of fine-grained reactive sulphides caused acid generation under room temperature conditions to exceed the rate of alkalinity generation by weathering of silicates.

The lack of acidity under field conditions is likely the result of deliberate measures to prevent ARD by cooling and encapsulation of metasediment in granite, and slow sulphide oxidation rates at low temperatures for which acid generation does not exceed bicarbonate generation.

5.4.3 Diabase

The performance of diabase is expected to be mid-way between granite and metasediments. The balance of information suggests that diabase waste rock will not show pH depression due to its competency which limits the exposure of sulphide minerals. Diabase is a low proportion of waste rock at all the pits and is not expected to have a significant effect on overall water quality.

5.4.4 Kimberlite and Processing Products

Kimberlite is geologically different from the host rocks. While it contains similar or greater levels of sulphide minerals as metasediments, kimberlite mostly consists of magnesium silicates (serpentine and olivine) and also contains abundant carbonates. The carbonates are thought to be calcite but may also contain magnesium (magnesite and/or dolomite).

Interaction of carbonic acid with kimberlite and its processing products is expected to result in three chemical processes:

- Weathering of magnesium silicates – release of dissolved magnesium, bicarbonate and formation of clay weathering products (magnesium silicates and hydroxides).
- Weathering of other silicates (e.g. phlogopite mica) - release of dissolved magnesium, potassium, bicarbonate and formation of clay weathering products.
- Dissolution of carbonates - release of dissolved calcium, magnesium and bicarbonate.

Kimberlite will also experience oxidation of pyrite which will release acidity and sulphate, and result in precipitation of ferric hydroxide. The acidity will be readily neutralized by dissolved alkalinity produced by the above processes and interaction with carbonates. Weathering of kimberlite produces soluble magnesium rather than calcium. Under these conditions, sulphate concentrations in solution can become elevated because magnesium sulphate is more soluble than calcium sulphate.

Due to the excess of neutralizing minerals, decrease in pH will not occur and therefore the chemistry of seepage from kimberlite disposal areas under current conditions is a conservative indicator of long term drainage chemistry.

5.5 Seepage Quality

Since weathering processes occurring now are expected to continue and slowly diminish into the future due to depletion of reactive mineral components, current drainage chemistry can be used to conservatively predict long-term water quality. The possible exception is metasediment that is exposed for extended durations where pH depression and increases in metal concentrations would result; however, the ARD mitigation measures (i.e., encapsulation) are effective in preventing this outcome. Based on this reasoning, conservative predictions of long-term drainage quality were calculated from the median and 95th percentile (5th percentile for pH) values of all water quality data collected from seepage monitoring stations around each storage facility.

The median, like the average is a statistical measure of the central tendency of a sample population (data set); however the median is less sensitive to outlying values than the average which can be greatly influenced by the presence of outliers. The median is the middle value when the data are ordered from smallest to largest in magnitude (also described as the 50th percentile value). Similarly, the 95th percentile separates the highest 5% from the bottom 95%, so 95% of the data are less than or equal to the 95th percentile value.

For water quality predictions presented here, the median value was selected to indicate “typical” values that can be expected for long-term drainage chemistry. The 95th percentile value was determined instead of the maximum value to show higher concentrations that might be expected, while excluding outliers that tend to be influenced by localized effects. Localized effects are short term changes in chemistry that are not representative of the overall chemistry of a seep. Localized effects, if and when they occur, are reported in the annual Seepage Reports.

For pH, the 5th percentile values were selected instead of the 95th percentile to show how low pH levels might be expected. Table 5.1 summarizes the predicted water chemistry for each WRSA.

The chemistry of nearby reference stations (Bearclaw Lake drainage and Sable Lake area) and baseline studies (where available) for each mine component are provided for comparison. A comparison of reference or baseline data with seepage chemistry provides an indication of the contribution to water chemistry from weathering and leaching of the waste rock materials. The results for each waste rock storage area are discussed below.

5.5.1 Panda/Koala/Beartooth Waste Rock Storage Area

Seeps from the Panda/Koala/Beartooth WRSA are shown in Figure 5.2. The median and 95th percentile values (5th percentile for pH) of data collected from June 1999 to September 2010 are given in Table 5.1. For comparison, the same statistical values are given for data collected over the same period of time from the Panda/Koala/Beartooth reference stations in the Bearclaw Lake drainage.

The monitoring results indicate that typical runoff from the Panda/Koala/Beartooth WRSA has similar pH to naturally acidic tundra water, but with enrichment in several parameters (sulphate, calcium, magnesium, manganese, potassium and sodium) compared to median values for the reference area. This reflects slight weathering of both granite and kimberlite. The 95th percentile results are enriched in these same parameters plus several others (TSS, ammonia, alkalinity, aluminum, cadmium, cobalt, molybdenum, nickel and zinc) compared to 95th percentile reference station results. These waters are more strongly influenced by granite and kimberlite waste rock interaction and leaching of explosives residues (ammonia).

Figure 5.2 Panda/Koala/Beartooth/ WRSA and CKRSA Seeps

Table 5.1 Summary of Water Chemistry Data from Seepage Monitoring Around Waste Rock and Coarse Kimberlite Reject Storage Areas

Parameter	Unit	Sable Reference Area		Panda/ Koala/Beartooth Area						Misery Area				Fox Area			
				Reference Stns[1]		WRSA		CKRSA		WRSA		WKSA & TKOSA		Baseline		WRSA	
		Median	P95	Median	P95	Median	P95	Median	P95	Median	P95	Median	P95	Median	P95	Median	P95
Field pH	s.u.	5.5	*4.8	5.6	*4.7	5.7	*4.4	6.5	*4.2	5.9	*5.0	5.4	*4.1	6.0	*4.3	5.9	*4.9
Lab pH	s.u.	5.7	*5.4	5.5	*5.3	6.0	*4.7	7.0	*3.8	6.6	*5.3	5.9	*5.3	6.1	*4.4	6.4	*5.5
TSS	mg/L	3.0	11	3.0	12	4.1	68	6.3	34	5.0	61	4	37	3.0	6.2	4.8	78
Alkalinity (HCO_3)	mg $CaCO_3$/L	4.7	7.0	5.0	8.0	6.0	37	37	190	13	61	5	17	7.0	13	5.0	13
SO_4	mg/L	1.7	5.0	4.8	10	71	620	570	4200	26	230	32	160	1.5	5.1	2.5	12
Ammonia-N (NH_4)	mg/L	0.011	0.051	0.018	0.16	0.072	13	0.92	17	0.43	22	0.16	4.6	0.0050	0.11	0.021	0.63
Dissolved Metals																	
Al	mg/L	0.20	0.49	0.37	0.64	0.22	2.1	0.071	3.7	0.16	0.71	0.23	0.57	0.17	0.43	0.17	0.43
As	mg/L	0.00042	0.00094	0.00090	0.0023	0.0004	0.0011	0.001	0.0052	0.00100	0.0051	0.00044	0.0015	0.0004	0.0011	0.0004	0.0013
Cd	mg/L	0.00005	0.00010	0.00010	0.00010	0.00010	0.00075	0.0003	0.0024	0.00010	0.00076	0.00010	0.0003	0.000080	0.0001	0.000050	0.00010
Ca	mg/L	1.3	2.0	1.6	2.5	21	110	120	350	9.8	72	6.7	28	1.2	2.5	1.7	6.2
Cr	mg/L	0.00060	0.0057	0.0011	0.0024	0.0005	0.0028	0.00075	0.0055	0.0005	0.0023	0.00057	0.0014	0.0004	0.0012	0.0005	0.0014
Co	mg/L	0.00060	0.0018	0.0018	0.0031	0.0032	0.051	0.0048	0.040	0.0084	0.042	0.007	0.019	0.00035	0.0018	0.0004	0.0025
Cu	mg/L	0.0024	0.0047	0.0064	0.014	0.0029	0.0073	0.0034	0.012	0.0038	0.011	0.0031	0.0044	0.003	0.0061	0.003	0.0071
Fe	mg/L	0.28	1.0	0.33	1.4	0.090	0.86	0.047	6.0	0.30	2.1	0.15	0.62	0.16	1.5	0.18	0.81
Pb	mg/L	0.000050	0.00020	0.00010	0.00071	0.00010	0.00040	0.00010	0.0010	0.00016	0.0015	0.0001	0.00024	0.000090	0.00021	0.000084	0.00020
Mg	mg/L	0.72	1.2	1.5	2.4	12	66	100	830	7.8	58	4.8	24	0.76	2.1	0.94	3.9
Mn	mg/L	0.010	0.036	0.010	0.038	0.096	1.40	0.30	1.20	0.16	1.1	0.063	0.37	0.0066	0.040	0.0067	0.054
Mo	mg/L	0.000056	0.00020	0.00010	0.00030	0.00020	0.018	0.07	1.1	0.0016	0.022	0.00032	0.0066	0.00010	0.00023	0.00020	0.0016
Ni	mg/L	0.0016	0.0035	0.0064	0.016	0.0082	0.55	0.036	0.26	0.014	0.34	0.0088	0.021	0.0013	0.0037	0.0016	0.0048
K	mg/L	2.0	2.0	0.60	2.0	5.1	23	25	110	6.1	21	2.7	7.9	0.70	1.2	2.0	4.8
Si	mg/L	1.7	5.0	2.2	5.3	2.6	4.3	4.2	7.7	3.5	6.0	2.6	5	-	-	0.94	3.1
Na	mg/L	2.0	2.0	1.4	2.0	5.3	25	21	150	7.1	29	5.2	10	0.80	1.6	2.0	5.1
Zn	mg/L	0.0037	0.0079	0.0057	0.049	0.0074	0.18	0.010	0.070	0.012	0.12	0.012	0.024	0.0026	0.015	0.0033	0.013

Notes: Panda/Koala/Beartooth reference area is for the Bearclaw Lake drainage.

* - For pH, the 5th percentile value is reported rather than the 95th percentile to show how low pH values could be expected.

P95 - 95th percentile

WRSA - Waste Rock Storage Area; CKRSA - Coarse Kimberlite Reject Storage Area

WKSA & TKOSA - Waste Kimberlite Storage Area and Temporary Kimberlite Ore Storage Area

Source: SRK project 1CR003.021 (2011)

5.5.2 Coarse Kimberlite Reject Storage Area

Seeps from the CKRSA are shown in Figure 5.2. It should be noted that only a small proportion of these seeps are usually flowing in any given year as flow paths change within the CKRSA and seeps often dry up after flowing for a few years.

The median and 95th percentile values (5th percentile for pH) of seepage data collected around the CKRSA between June 1999 and September 2010 are given in Table 5.1. Comparison of the median values with median values for the Bearclaw Reference area indicates that typical drainage from the CKRSA has near-neutral pH and is enriched in ammonia, alkalinity, sulphate, calcium, magnesium, manganese, molybdenum, nickel, potassium and sodium. The 95th percentile results have pH around 4 and show elevated concentrations of these same elements plus enrichment in aluminum, cadmium, cobalt and iron, and high TSS compared to 95th percentile results for the reference area.

5.5.3 Fox Waste Rock Storage Area

Fox WRSA seeps are shown on Figure 5.3. The median and 95th percentile values (5th percentile for pH) of seepage data collected around the Fox WRSA between June 2003 and September 2010 are given in Table 5.1, along with pre-mining baseline values for the Fox area collected in 2001 and 2002.

Comparison of the median seepage concentrations with median baseline values indicate that typical run-off from the Fox WRSA has water chemistry that is almost identical to baseline conditions which reflect natural tundra water, with only slight enrichment seen with ammonia, magnesium and potassium. The 95th percentile concentrations show enrichment in these same parameters in addition to TSS, sulphate, calcium, molybdenum and sodium compared to 95th percentile baseline concentrations. The pH is again similar to baseline. These data reflect slight weathering of both granite and kimberlite.

Figure 5.3 Fox WRSA Seeps

5.5.4 Misery Waste Rock Storage Area

Misery WRSA seeps are shown on Figure 5.4. The median and 95th percentile values (5th percentile for pH) of seepage data collected around Misery waste storage facilities between May 2001 and September 2010 are given in Table 5.1. Due to a lack of baseline seepage data for the Misery area or data from nearby reference stations, seepage results from the Misery WRSA and kimberlite storage areas were compared to median and 95th percentile values from reference stations in the Sable Lake and Bearclaw Lake area. This is a reasonable comparison based on similar geology, climate conditions, and topography.

The monitoring results indicate that typical runoff from the Misery WRSA has similar pH to natural tundra water, but with enrichment in several parameters (alkalinity, sulphate, ammonia, calcium, magnesium, manganese, molybdenum, nickel, potassium, sodium and zinc) compared to median values for the reference areas.

The 95^{th} percentile results from Misery WRSA have elevated total suspended solids (TSS), ammonia, alkalinity, sulphate, arsenic, calcium, cobalt, lead, magnesium, manganese, molybdenum, nickel, potassium, sodium, and zinc, compared to 95^{th} percentile reference station results. pH however is around 5 and similar to naturally acidic tundra waters. These waters are likely influenced by leaching of granite, diabase, metasediment and kimberlite waste rock and leaching of explosives residues.

Seepage from the Temporary Kimberlite Ore Storage Area and the Waste Kimberlite Storage Area at Misery has rather better water quality than that from the main Misery WRSA, likely reflecting a lack of metasediment and diabase in these storage areas.

The existing seepage chemistry in the Misery WRSA is believed to be a conservative indicator of long term seepage chemistry. It is likely that seepage chemistry will improve as permafrost aggrades completely into the pile, sulphide minerals from material in the active layer are depleted, and silicate weathering products continue to decompose more slowly. A recent study on the performance of the Misery WRSA concluded however, that the age of the WRSA coupled with the low sulphide content, suggested that exhaustion of sulphide may be occurring and significant worsening of water quality was unlikely to occur (SRK 2010b). However, should the pH of drainage from the WRSA decrease, metal loadings would increase due to increased metal solubility at lower pH. There are currently no site precedents for these conditions, and the existing monitoring program would provide early detection if these changes occurred.

Figure 5.4 Misery WRSA Seeps

5.6 Summary of Seepage Quality

Low-level metal leaching at neutral/near-neutral pH is anticipated and is occurring at Ekati as a result of weathering and leaching of waste rock. Dissolved alkalinity is also being produced. This process is expected to occur into the future. Conservative projections of long-term drainage from the WRSA's indicate minor enrichment in several cations and metals (magnesium, calcium, manganese, molybdenum, nickel, potassium and sodium, in addition to ammonia and sulphate) as a result of leaching from granite and kimberlite waste rock. Sulphate will eventually decline as sulphide is exhausted over time and once mining ceases, ammonia will decline as blasting residues decompose.

The 95th percentile results presented above show conservative potential concentrations that may be expected if leaching of waste rock under neutral/near-neutral pH conditions were to unexpectedly increase. With the exception of the Fox WRSA, the concentrations are elevated further and the list of parameters is extended (including aluminum, cadmium, cobalt, and zinc, plus arsenic and lead at Misery), compared to reference/baseline conditions.

6 Waste Rock and Ore Storage Management

6.1 Approach

The Waste Rock and Ore Storage Management Plan is based on the most reasonable information available for design and natural conditions. This information is inherently variable over time and diligent management responds to changes in natural conditions (such as storm events or a sequence of wet years) or design factors (such as volumes of each rock type mined). The Board will be notified of changes in circumstances or conditions that represent new or greatly heightened environmental concerns (operational or closure) for the WRSA's. This will include plans for responding to the change encountered.

Measures to optimize the design of a WRSA will be implemented during construction and the Board will be notified of such measures.

6.2 Material Generation and Disposal Schedule

Estimated tonnages of each type of material are shown in Table 6.1. The volume of granite in the Misery Pit is sufficient to layer and encapsulate the Misery metasediment.

Table 6.1 Estimated Waste Rock Tonnages for Planned Mining Activities

Geological Unit	Million Tonnes to be Mined – 2014 to 2019			
	Koala	Koala N	Misery	Pigeon
Surficial Material	0	0	0	2.3
Granite - pit	0	0	27.6	0[2]
- underground	0.09	0.08	na	na
Waste Kimberlite	0	0	3.2	0[1]
Metasediments	0	0	14.1	7.8[2]
Diabase	0	0	1.9	0.3

Notes:

1. A minor incidental quantity of waste kimberlite may be mined from the Pigeon pit, which is zero when rounded to tenths of millions. Such material will be managed as part of the mixed metasediment/granite material.

2. The material to be mined from Pigeon pit is mixed metasediment and granite, which will be managed as PAG material.

6.3 Panda/Koala/Beartooth Waste Rock Storage Area

Underground mining of the Koala and Koala North pipes is planned to continue to 2019. Underground mining produces a considerably reduced volume of waste rock compared to open pit mining. Waste rock from these operations is granite and will continue to be placed in the Panda/Koala/Beartooth WRSA or used as construction material for roads, dikes, pads, etc. The incidental placement of this rock in the WRSA does not affect the footprint. The final footprint of the Panda/Koala/Beartooth WRSA is shown in Figure 6.1..

6.4 Coarse Kimberlite Reject Storage Area

The CKRSA will continue to receive CKR from processing of kimberlite from all operations.

6.5 Fox Waste Rock Storage Area

Open pit mining in Fox pit was completed in spring 2014. There is not further construction planned for the Fox WRSA. The final footprint of the Fox WRSA is shown in Figure 6.2.

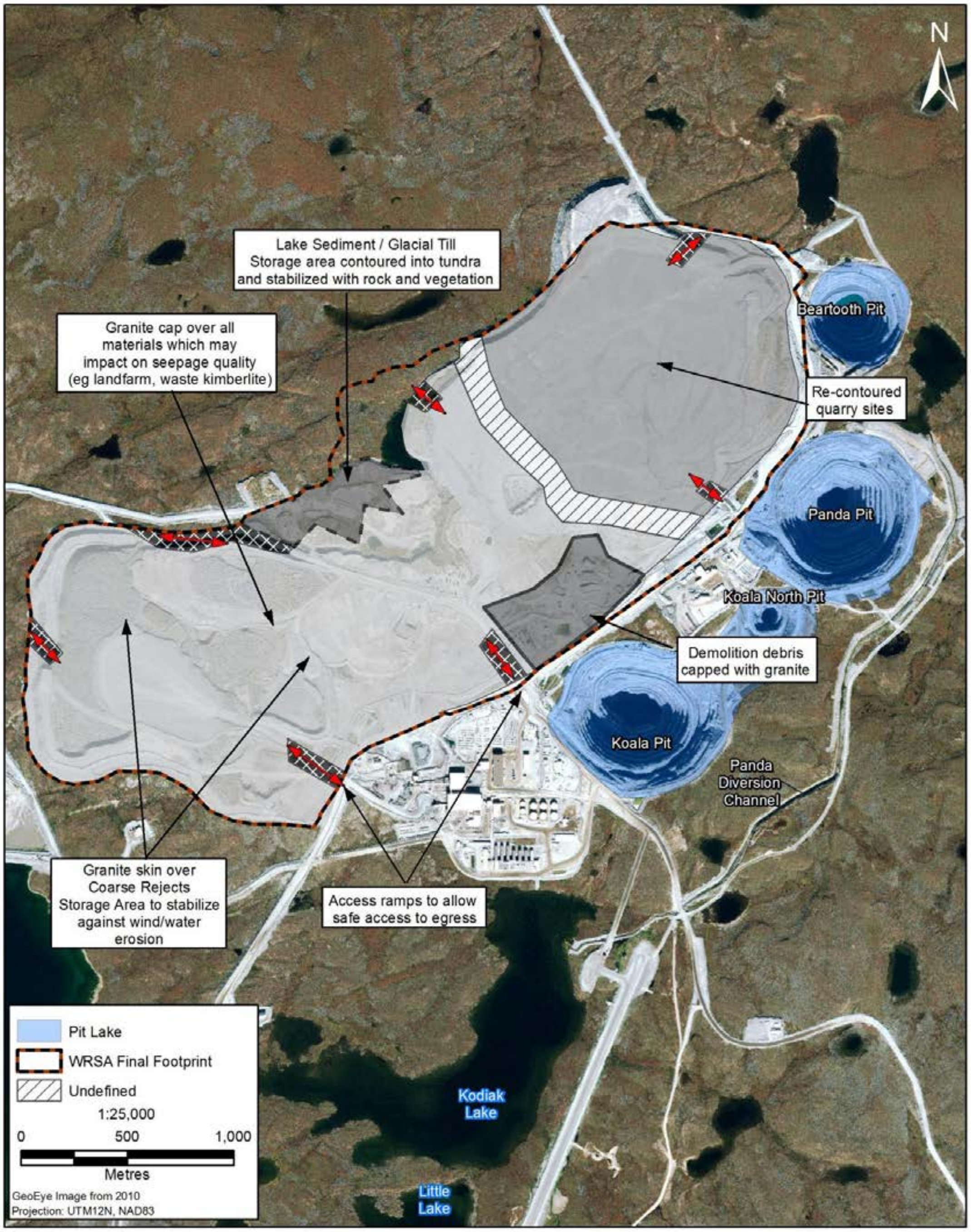
6.6 Misery Waste Rock Storage Area

Mining resumed at the Misery Pit in 2011, through a pushback to increase the size of the open pit. Open pit mining is planned to continue to 2018. The final footprint of the WRSA is shown in Figure 6.3.

Because of the interest in managing and documenting the metasediment rock, geochemical characterization of waste rock during the Misery expansion is conducted annually (rather than every three years as occured at Fox; see section 7.3).

Other design elements for the Misery WRSA remain the same as those successfully utilized across the Ekati mine site and described in Section 2.4.6. For example potentially acid generating metasediment will be layered with and encapsulated within granite to promote freezing and to ensure that the seasonally active zone is within low reactive granite.

Figure 6.1 Final Footprint of Panda/Koala/Beartooth WRSA and CKRSA



A Temporary Kimberlite Ore Storage Area is used to store kimberlite ore prior to haulage back to the processing plant at Main Camp (Figure 6.3). It may also be used for temporary storage of granite to facilitate the appropriate layering of rock types in the Misery WRSA. The base of the storage area will be a pad constructed out of granite waste rock. Temporary ore storage areas have been located in various locations in past; a pad is currently being developed at the location identified on Figure 6.3. At this location, seepage from the pad will flow towards Waste Rock Dam, which is a managed water body. The material stored on the pad will be removed from this storage area as ore to the process plant and the pad will be reclaimed according to the measures described in the Interim Closure and Reclamation Plan. Also see Section 6.8 re Temporary Ore Storage.

Figure 6.2 Final Footprint of Fox WRSA

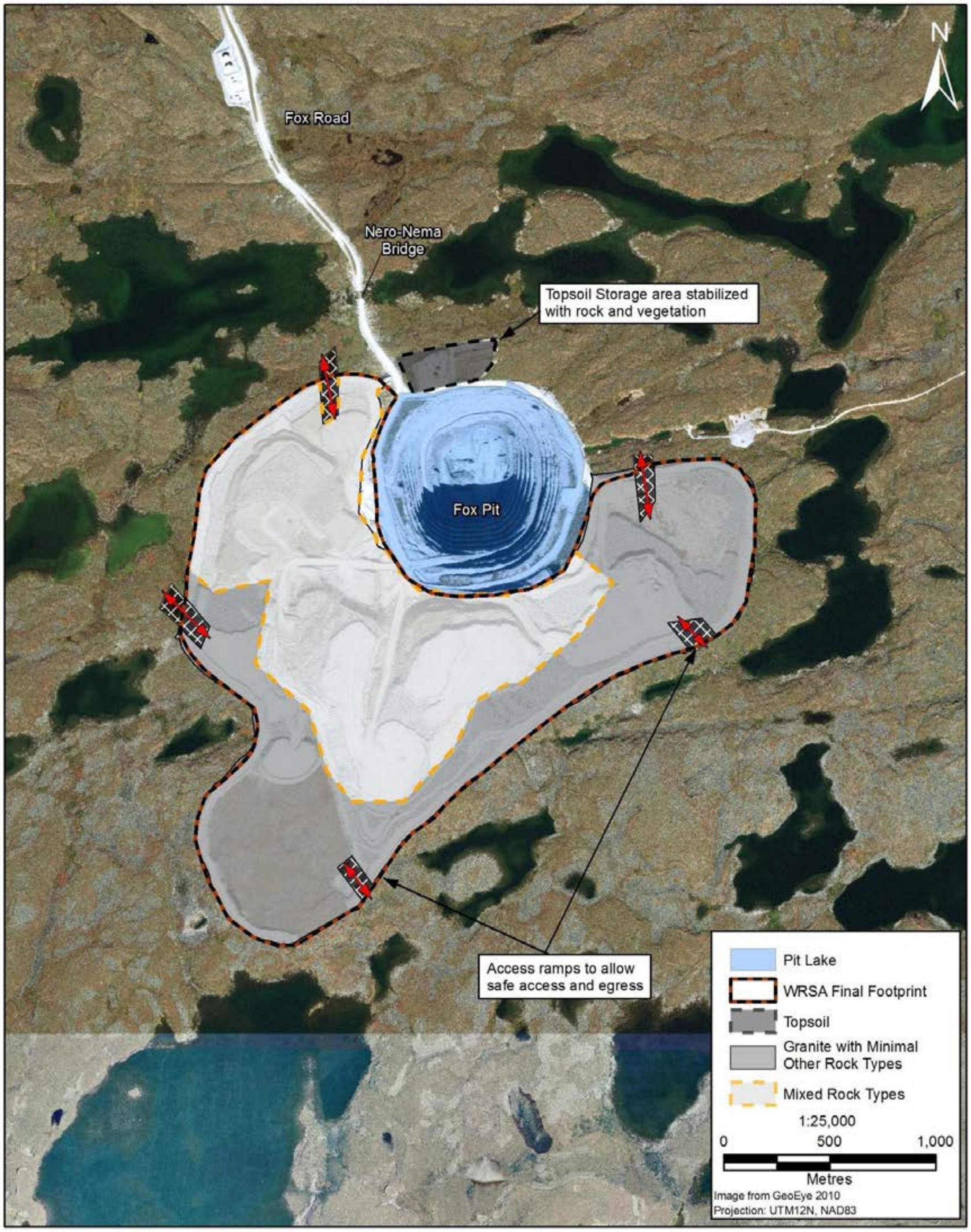
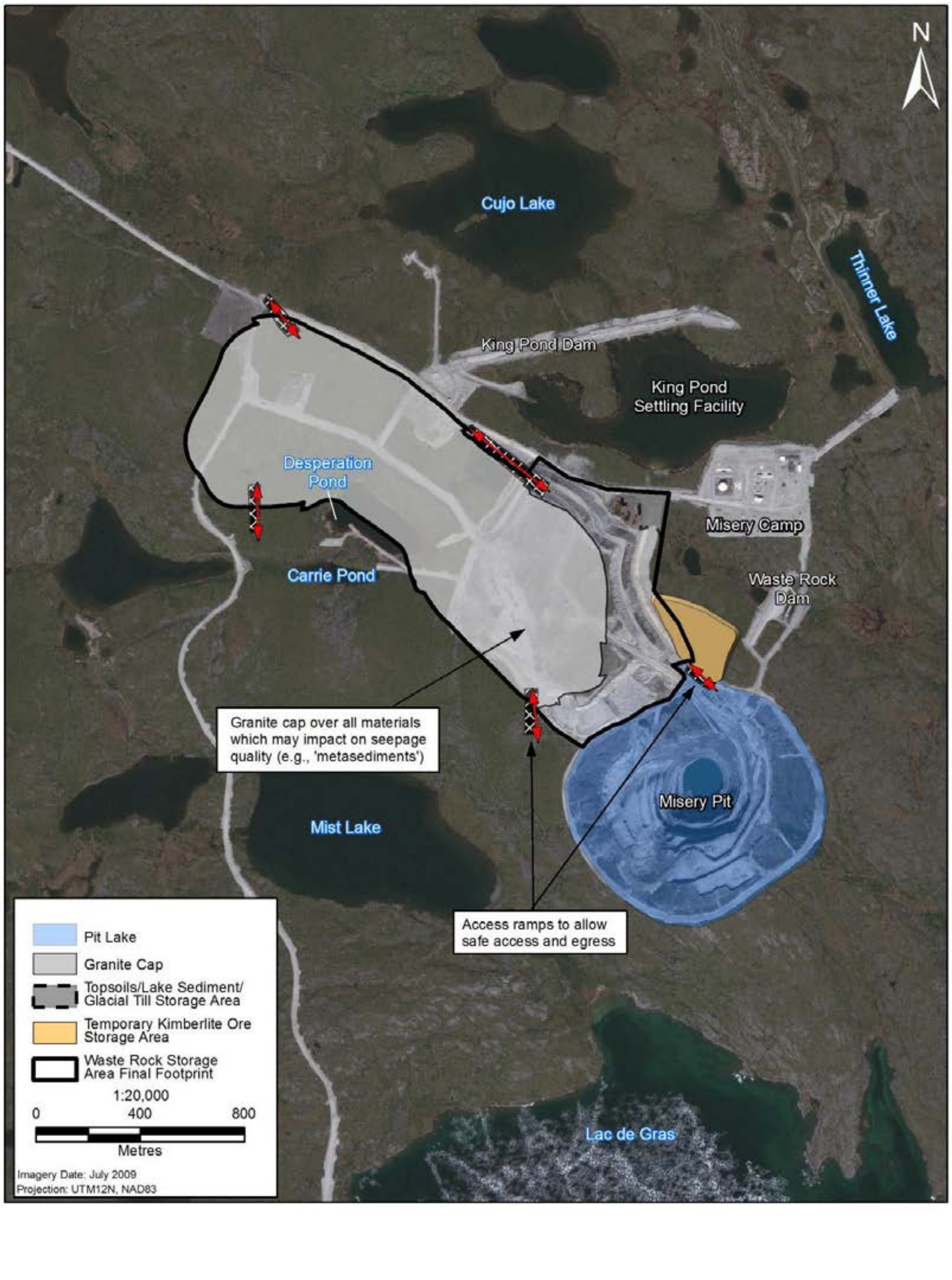


Figure 6.3 Final Footprint of Misery WRSA



6.7 Pigeon Waste Rock Storage Area

The estimated volumes of waste rock and glacial till to be mined from the Pigeon Pit are listed in Table 6.2.

Table 6.2 Pigeon Pit Estimated Waste Rock and Glacial Till Production

Geological Unit	Estimated Volume to be Mined
Glacial Till	2.3 Mm^3
Granite/Metasediment Mixture	7.8 Mm^3
Diabase	0.3 Mm^3
Diorite	0.02 Mm^3
Waste Kimberlite	0.04 Mm^3

A bulk sample test pit was constructed at the Pigeon kimberlite in winter 2010, as allowed under the regulatory permits and as approved by the Inspector. Exposure of the kimberlite pipe required removal only of glacial till (i.e., no waste rock) with some of the till placed in a pile immediately upslope of the test pit (i.e., runoff returns into the test pit). The balance of the glacial till was placed in the Panda/Koala/Beartooth WRSA. The Pigeon site till pile lies within the planned open pit. The till pile will be relocated prior to open pit construction, and handled according to the plan for glacial till described below.

The interbanded occurrence of the geological contact between granite and metasediment in the Pigeon open pit precludes the mining of granite separately at an operational scale. Therefore, for waste rock management purposes, all of the mixed granite and metasediment waste rock is to be managed as if it were PAG material (i.e., encapsulation within a thermally protective cover). This approach provides a conservative element to the long-term performance of the Pigeon WRSA since the geochemical characterization shows that a granite/metasediment mixture in the range of 30-70% metasediment can be classified as NAG (i.e., non-acid generating). Additionally, the inclusion of granite within the mixed materials provides coarser and harder particles that can be expected to enhance permafrost aggradation into the WRSA by maintaining physical conditions that are more favourable to heat transfer.

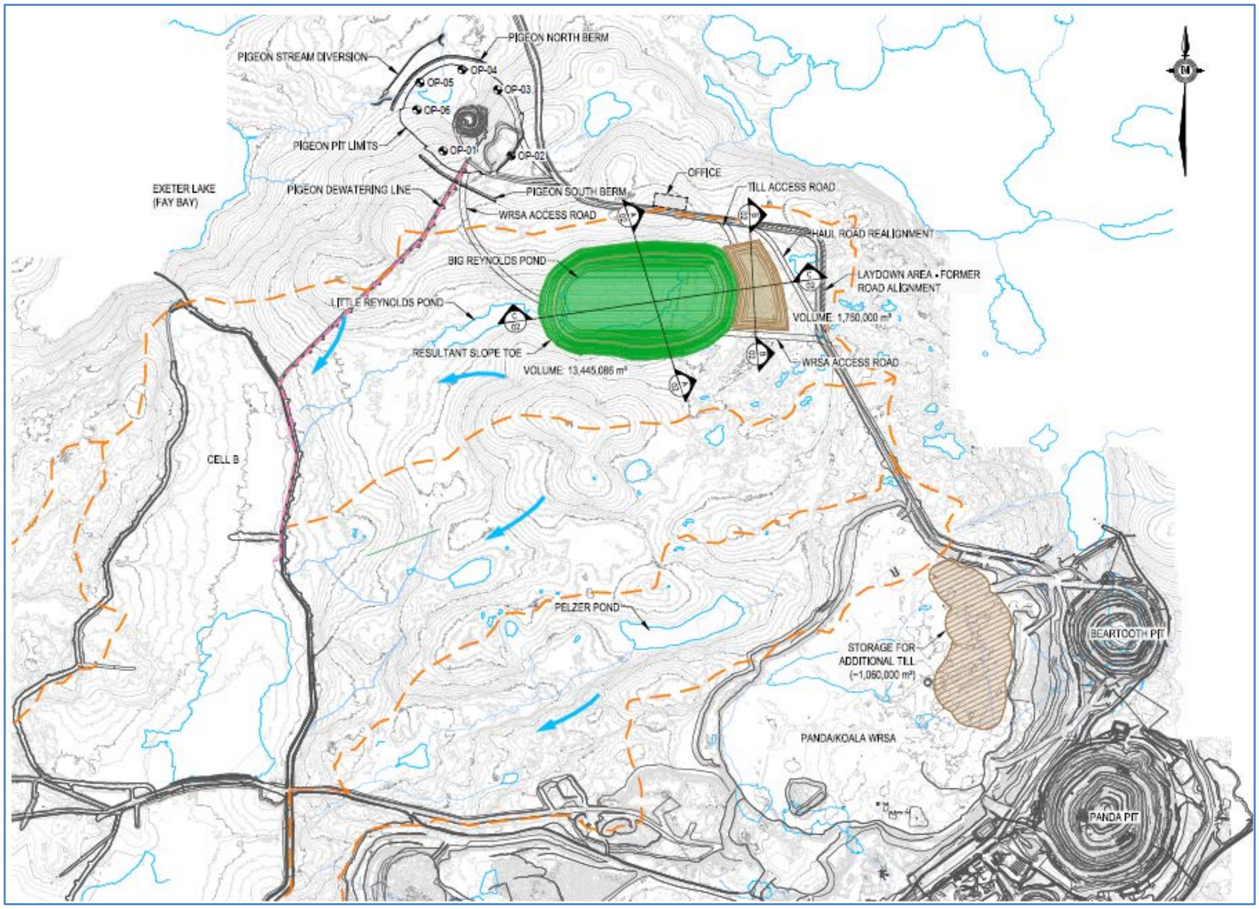
Encapsulation of the granite/metasediment mixed materials cannot readily be accomplished using a 5 m thick cover of granite because there is no granite to be mined from the Pigeon Pit. Re-mining and haulage of granite for the Panda/Koala WRSA would be cost prohibitive. A portion of the glacial till mined from the Pigeon Pit will be locally stockpiled for placement as a 3 m thick encapsulating cover over the WRSA. A final surfacing of granite rock with a nominal 1 m thickness will be placed over the glacial till for long term stability and erosion control. This approach utilizes the local materials (i.e., glacial till) to minimize the re-mining of granite from the Panda/Koala WRSA. Thermal modelling conducted by Tetratech EBA confirms that 3 m of glacial till covered by nominal 1 m of granite provides adequate long-term thermal protection. The balance of glacial till mined from the Pigeon pit that is not required for the 3 m cover will be placed in the Panda/Koala/Beratooth WRSA.

To accommodate the placement and long-term physical stability of the glacial till cover, the Pigeon WRSA is designed with continuous side slopes (rather than stepped side slopes as is the case for other WRSA's). This approach enables more efficient placement of the till and mitigates the risk of long-term soil creep (solifluction) within the cover materials. Solifluction occurs where soil placed on a sloped base creeps downwards due to gravity. Various slope angles between 2:1 and 4:1 (H:V) were considered for the Pigeon WRSA. A professional engineering analysis conducted by Tetratech EBA resulted in the selection of 3.2:1 as a reasonable and professionally sound design slope angle. A flatter slope angle (such as 4:1) would not provide a meaningful incremental decrease in long-term environmental risk, but would result in an enlarged footprint and substantive additional work on Dominion's part for construction and closure.

There is a small residual catchment area to the east of the WRSA that would naturally flow to Big Reynolds Pond under the base of the WRSA. There will be no perceivable "flow" of water through the base of the WRSA because of the limited catchment area and, importantly, because of the aggradation of permafrost in the base of the WRSA. Nonetheless, the WRSA and till stockpile are designed to discourage basal seepage in the short term and these measures may be optimized in the field during construction. The presence of glacial till abutting (or nearly so) the east side of the WRSA is likely to encourage runoff to pass to the south of the WRSA. Additionally, the shape of the southeast 'corner' of the WRSA is designed to utilize the natural topography to encourage surface runoff to pass to the south of the WRSA. These design aspects may be optimized in the field during construction of the rock pile, possibly resulting in a slight increase in footprint on the north side (remaining within the LLCF drainage area).

The Pigeon WRSA Design Plan, as prepared by Tetratech EBA, is provided as Appendix C. The Design Plan describes the construction of the WRSA, the thermal modeling of the till/granite cover, and the short-term stability of the WRSA (as required by the Ekati Mine Water Licence). The Pigeon site plan is shown below as Figure 6.4.

Figure 6.4 Pigeon Site Plan



6.8 Temporary Kimberlite Storage

Chemical interaction between seepage contacting both kimberlite and granite was discussed in recent (2011 and 2012) Annual Seepage Reports as a possible factor explaining the observed seepage quality. The seepage quality was well within Water Licence compliance but exhibited geochemical signatures of the source rocks. The case at hand was a kimberlite storage pad at the Misery site where kimberlite was exposed for an unusual extended period of time due to the suspension of operations at the Misery site from 2005 to 2011. That particular pad has since been reclaimed (2013) by relocation of unfrozen material to the active areas of the Misery WRSA and covering of the residual (frozen) pad materials by the advancing WRSA such that the residual frozen materials remain frozen as permafrost.

Temporary kimberlite storage areas are a necessary component of mine operations at some mining areas, such as Misery. At the Misery site, for example, temporary storage is required to transfer diamond-bearing kimberlite from the open pit rock trucks to the 'long-haul' road trucks that transport the kimberlite to the process plant.

The following guidelines will apply to operation of temporary kimberlite storage areas:

- The storage areas are constructed with a granite pad to create a safe operating surface for heavy equipment and to avoid the placement of kimberlite onto tundra soils which can generate naturally depressed pH.
- Where practical, storage areas will be located where seepage flows towards a managed minewater facility.
- Seepage from the kimberlite storage areas will be monitored and assessed as part of the Annual Seepage Monitoring Program.
- Remedial or adaptive management actions will be undertaken as appropriate based on seepage monitoring results.

No guideline for duration of exposure is provided as there is no laboratory or empirical information to define an appropriate timeframe based on environmental risk. Routine (minimum twice per year) monitoring of seepage from the storage areas provides the primary mechanism for assessing risks to the environment and prompting necessary response actions.

7 Verification, Monitoring and Reporting

As waste rock is stored as per the management plan, the physical and environmental performance of the WRSA's will continue to be monitored.

7.1 Physical Monitoring

The physical stability of the WRSA's will be monitored by inspections conducted once during spring freshet and once during the fall as part of the Seepage Surveys. Inspections will look for the following:

- Any changed or unusual conditions;
- Failures including slumps, slides and toppling;
- Indications of potential instabilities such as tension cracking, subsidence;
- Erosional features such as gullying or washouts; and
- Locations of seepage

In addition, WRSA's will be surveyed as necessary to verify correct slopes, footprints, volumes and heights.

7.2 Temperature Monitoring

- Thermal monitoring of the WRSA's will continue as described in Section 4, with temperature data typically recorded a minimum of four times per year and reported in an annual WRSA ground temperature monitoring report which is included as an appendix in the annual Waste Rock and Waste Rock Seepage Survey Reports submitted to the Wek'èezhìi Land and Water Board (WLWB).

7.3 Waste Rock Geochemistry Monitoring

- Monitoring of waste rock geochemistry will continue in a similar way to that described in Section 3.2.
- Waste rock mined during the Misery open pit expansion will be sampled at a rate of three samples per rock type, per bench, every year with geological mapping of the benches sampled.
- Waste rock mined in the Pigeon open pit development will be sampled at a rate of three samples per rock type, per bench, every year with geological mapping of the benches sampled.

- Waste rock in underground developments will not be sampled but rock types and volumes will be reported.
- Monitoring of tonnages mined will continue, with the figures reported in the annual Waste Rock and Waste Rock Seepage Survey Reports submitted to the WLWB.
- Waste rock volumes will be subdivided by rock type, by originating mine component and by destination WRSA and will include volumes of CKR.
- In circumstances where waste rock is mined that was not part of the initial mine plan for that area, the waste rock will be sampled according to the procedures and frequencies described above.

7.4 Coarse Kimberlite Reject Geochemistry Monitoring

- Monitoring of CKR will continue as described in the previous Geochemical Characterization and Metal Leaching Management Plan (SRK, 2007b) and Section 3.2 of this report.
- Coarse kimberlite reject will be sampled quarterly with an annual evaluation of the data.
- Results will be reported in the annual Waste Rock and Waste Rock Seepage Survey Reports

7.5 Seepage Monitoring

Seepage management will continue to be addressed as described in Section 5.2 and Section 5.3 on drainage management, and Section 2.4 describing features of WRSA design that limit seepage and encourage freezing within the WRSA’s.

- Seepage monitoring will continue to address the requirements of Part G.4 of the current Water Licence
- Seepage surveys will be conducted each year during freshet and fall
- The results will be reported and interpreted in the annual Waste Rock and Waste Rock Seepage Survey Reports, submitted the following March 31st to the WLWB
- In addition, a freshet seepage report will be issued 60 days following completion of the freshet seepage survey and will compare data from seepage that enters the receiving environment to the Water Licence criteria
- Monitoring of potentially problematic seeps will continue where necessary on a bi-weekly basis during the open water season. This currently includes SEEP-18B and

SEEP-19 at the Panda/Koala/Beartooth WRSA, SEEP-52 at the Misery WRSA and SEEP-360 and SEEP-362 at the Fox WRSA

- The detailed seepage sampling protocol is provided in Appendix B.

Seepage monitoring will detect any undesirable changes in chemistry and any unacceptably high concentrations of specific elements. Should this occur, seepage management will be revisited to determine the likely causes, and adaptive management strategies will be developed. Such strategies that have already been used are:

- Toe berm construction to limit seepage and encourage water retention and hence freezing within the WRSA's.
- Bi-weekly monitoring of potentially problematic seeps to further understand their chemistry.
- Re-location of upstream material.

7.6 Environmental Effects Monitoring Program

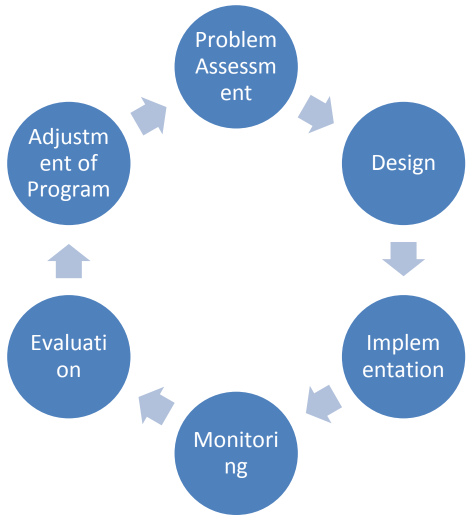
The Aquatic Effects Monitoring Program (AEMP) was designed to detect downstream effects from the Ekati Diamond Mine. Sampling stations have been established in several lakes and streams downstream of all WRSA's. Samples are collected annually during the open water season and analysed for:

- Total metals (aluminum, nickel, calcium, iron, copper, mercury)
- Ammonia, nitrate, total- and ortho-phosphate, sulphate
- pH, conductivity, total suspended solids, turbidity, hardness

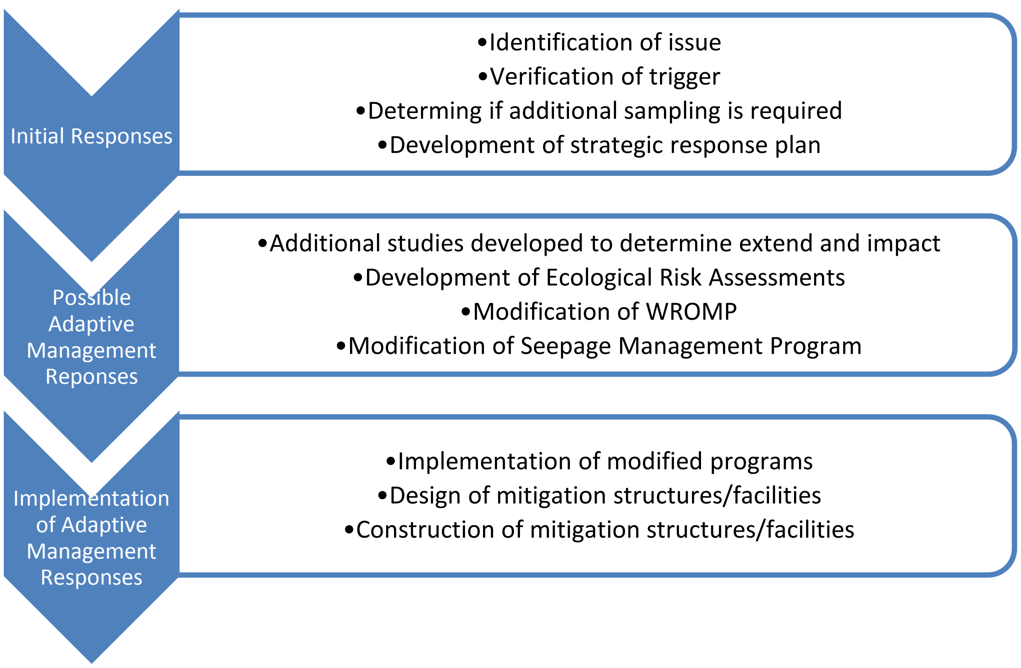
Sampling and analysis for the AEMP will continue as is currently practised.

7.7 Adaptive Management

Monitoring programs currently in place and described above will detect potential undesirable physical and environmental changes caused by waste rock and ore storage. If this occurs, the likely causes will be determined and management plans will be revisited. Adaptive management steps include:



The following chart illustrates how such information would be used to develop adaptive management strategies.



Following implementation of appropriate adaptive management responses, Dominion would continue with sampling, monitoring and evaluation of the program's trigger issues.

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DOMINION DIAMOND

Appendices

Appendix A: Detailed Geology

A Detailed Geology

This appendix addresses the geological characterization requirements of Clause G.2.a (i) of Licence W2009L2-0001 in providing a detailed geological summary (rock types, geology, and mineralogy) of each mine component. The quantities of each material mined and the resulting exposed surface area of pit walls was discussed in Section 2 of the main report and summarized in Table 2.2.

This Appendix first occurred in SRK (2007b). The information presented is based on existing information from the following previously published reports:

- *Waste Rock and Ore Storage Management Plan* reports (BHP 2000, 2002, 2003);
- *Acid/Alkaline Rock Drainage (ARD) and Geochemical Characterization Plan* (Norecol Dames & Moore 1997); and
- *Beartooth Acid/Alkaline Rock Drainage (ARD) and Geochemical Characterization Plan* (SRK 2003b).

A.1 Panda Pipe

A.1.1 Host Rock Geology

Surficial Geology

The Panda pipe had a pre-mining surface area of 3.1 hectares and was overlain by varying thicknesses of pebbles and gravel with lesser silt and sand of glacial origin. This material has been removed and deposited on the north side of the Panda/Koala Waste Rock Storage Area.

Bedrock Geology

The host rock for the Panda kimberlite pipe is granitic to dioritic intrusive rock, known as the Koala Batholith (BHP 2000). The predominant rock type is a medium-grained, medium grey quartz diorite. The rock contains approximately 60% oligoclase feldspar, 15% green biotite, 15% quartz, and lesser mafic minerals. The mafic mineral component of the rock is composed primarily of biotite with lesser amounts of amphibole and chlorite. Accessory minerals include sphene, apatite and sulphides. The sulphides are associated with or included in the epidote and biotite/chlorite. A fine-grained biotite-muscovite quartz tonalite is present but less common than the coarser material. The modal mineralogy of the biotite-muscovite tonalite is approximately 60% oligoclase feldspar, 20% quartz, 10% biotite and 3% of each K-feldspar and muscovite. Pyrite is very rare (<0.5%) and occurs as minute subhedral grains up to 40 microns in size when present.

No mineralogical effects (ie. alteration zones) from emplacement of the kimberlite have been observed in any of the host lithologies at Panda.

A.1.2 Kimberlite Geology

The Panda pipe comprises a diatreme filled with volcaniclastic kimberlite, which contains minor epiclastic kimberlite mudstone, siltstone and sandstone intervals. The epiclastic material occurs as isolated discontinuous lenses or blocks. The main volcaniclastic constituents include fine and coarse ash tuff, fine and coarse lapilli tuff, and tuff breccia. A very fine-grained fissile dark brown mudstone is present in very minor discontinuous horizons.

A.2 Koala Pipe

A.2.1 Host Rock Geology

Surficial Geology

The Koala pipe was overlain by unconsolidated sediments of glacial origin characterized by a complex interfingering of sediment lenses ranging from mud to gravel. In general, the uppermost part of the overburden sequence was comprised of well-sorted silt and mud approximately 1 to 2 metres in thickness. This material has been removed and deposited on the north side of the Panda/Koala Waste Rock Storage Area.

Bedrock Geology

The predominant rock type around the Koala pipe is a medium-grained biotite granite. Other rock types include granodiorite, granite gneiss and small patches of diorite. The granite gneiss is located about 80 m southwest of the pipe and contains up to 1% almandine garnets measuring 1 to 2 mm that form circular pods up to 3.5 cm in diameter. Also within the gneiss are rare occurrences of tabular tourmaline crystals up to 2 cm in length. Small patches of diorite are scattered throughout the area to the east of the pipe. The diorite contains trace amounts of almandine garnet and disseminated sulphides. Granodiorite is also noted on the east side of the pipe. Small patches of a fine-grained magnetic mafic rock, possibly a fine-grained diabase, were found on the ridge just east-southeast of Koala.

A.2.2 Kimberlite Geology

The stratigraphy of the Koala kimberlite pipe was complex. Several different kimberlite lithologies were encountered in the pit and are outlined in Table A.1.

Table A.1: Koala Kimberlite Stratigraphy

Unit	Composition	Matrix	Alteration	Comments
Black clay	Montmorillonite, mica, quartz carbonate, serpentine		Serpentinized	Xenoliths of small serpentinized, black rounded mudstone, biotite, epidote, granite fragments
Upper Sandy Kimberlite (quartz-rich)	Quartz, mica, olivine, serpentine mudst., silt & tuffisitic fragments	Serpentine, lesser clay minor carbonate	Serpentinized	Sharp contact with the overlying black clay Coarsing downward sequence
Olivine-rich Tuffisitic Kimberlite	Olivine content increase while quartz content decreases	Smooth homogeneous texture	White coatings and veinlets of serpentine	Granitic xenoliths in this zone are strongly altered, transition zone
Fine Lapilli Tuff (FLT) Kimberlite	Blue & yellow serpentine, talc olivine, phlogopite, zircon	Brown, microlitic serpentine and hydromica	Talc, serpentine rims	
Coarse Olivine Lapilli (COLT)Kimberlite	Fresh yellow and green Olivine rims of blue talc, brown lapilli	Soft, waxy, brown microlitic serpentine-phlogopite-clay	Olivine with rims of blue talc	Multiple coursing downward layers
Coarse Grained Tuff Breccia	Frags; granite, mudst, sandst ash, tuff/silty kimberlite, dunite			Up to 20% rock fragments, pebble to cobble size, with size increasing with depth
Upper Red-Brown Kimberlite phase	Blue serpentine after olivine fresh olivine, phlogopite	Microlitic, phlogopite serpentine, carbonate	Serpentine, carbonate	Less than 5% xenoliths in the rock
Black Muddy Tuffs	White-orange carbonate-talc after olivine, olivine, indicators	Clay rich serpentine – carbonate	Carbonate – Talc	Xenoliths 5-25%, include granite, peridotite macrocrystic kimberlite, underlying is mudst – siltstone-sandstone sequence
Coarse Olivine Tuffisitic Kimberlite Breccia	Olivine crystals, serpentine after olivine, mica, indicator minerals	Brown matrix of soft phlogopite serpentine and carbonate	Minor carbonate	Wedge shaped Unit – interbedded with Silty Kimberlite, fine lapilli tuffs interbedded with Silty Kimberlite
Lower Sandy Kimberlite	Mudst., Sandst., Siltst.	Kimberlite sandstone		Extremely variable/contacts irregular & distorted
	Organic Rich Mudstone			Organic material make up 20% of the mudstone
	Mudstone and Silty Kimberlite	Clay minerals and waxy serpentine	Talc/serpentine rims on Olivines	Interbedded with intervals of brown clay rich sandy kimberlite
Lower Coarse Olivine Lapilli Tuffs Kimberlite	Light green lapilli Tuff Kimberlite	Soft, microlitic matrix of olivine serpentine	Moderate – strong serpentinization of olivine	Granite xenoliths make up 10-15% of the rock
Tuffisitic Kimberlite/Tuffisitic Kimberlite Breccia	Dark green olivine with microcryst of minor serpentine	Olivine rich matrix	Accretionary rims	Macrocrystic Kimberlite, 25% composed of 0.5 – 4mm Olivine. Very competent

Notes: Table is reproduced from BHP (2000)

A.3 Koala North Pipe

A.3.1 Host Rock Geology

Surficial Geology

The surficial geology is similar to that of the Panda and Koala pipes. Surficial material has been removed and deposited on the north side of the Panda/Koala Waste Rock Storage Area.

Bedrock Geology

The host rock for the Koala North kimberlite pipe is a quartz diorite/biotite granite, which is generally unaltered to weakly altered. Alteration consists of minor argillic alteration of feldspars and the development of epidote and chlorite within the rock mass and along discontinuities.

A.3.2 Kimberlite Geology

The Koala North kimberlite pipe has a very regular “carrot-shaped” body with steep walls (83-88°). In plan view, the pipe is semi-circular with irregularities.

The two major kimberlite lithologies mapped within the Koala North pipe are the crater facies kimberlite: consisting of mostly ash-rich tuff with minor amounts of olivine-rich-tuff and the volcanoclastic kimberlite. A brown to black serpentized mudstone was found occasionally as erratic sand blocks in the kimberlite, and at the contact zones around the pipe. The sand blocks are weakly cemented by calcite and have a maximum dimension of a few metres. The contact zones within the kimberlite can vary from 0.5 m to approximately 7 meters in width, and commonly contain greater proportions of xenolithic material such as granite boulders.

A.4 Beartooth Pipe

A.4.1 Host Rock Geology

Surficial Geology

The Beartooth pipe was overlain by 13 to 19 metres of glacial till which consisted of boulders and gravel (50-70%) with lesser sand (10-30%), silt (0-10%) and clay (0-10%) of undifferentiated glacial origin. The sand-sized component was composed of angular to sub-rounded quartz, feldspar and flakes of biotite derived from the massive surrounding biotite granite. This material has been removed and deposited on the east side of the Panda/Koala Waste Rock Storage Area.

Bedrock Geology

The major host rock types at the Beartooth kimberlite pipe are biotite granite and diabase, and are thought to be the same rock hosting the neighbouring Panda pipe. The host rock also contains a small amount of metasediments as rafts or lenses within the granite. A description of each of these rock types is provided below.

Biotite Granite

The biotite granite is medium- to coarse-grained, weakly foliated to massive, and ranges in colour from white to grey. It has an average composition of 40% quartz, 45% feldspar and 15% biotite. In weakly altered zones, 1% to 3% pervasive epidote alteration may be present, as well as minor plagioclase alteration and localized hematite staining near fault zones, as noted by minor infilling by clay gouge. Sulphide minerals are absent or occur at trace concentrations in the biotite granite.

A hornblende-enriched phase of the biotite granite (hornblende biotite granite) occurs in the northwest corner of the pit area. This light grey, medium-grained, massive to weakly foliated rock is composed of 10 to 15% hornblende, 5 to 10% biotite, 30% quartz and 50% alkali feldspar. Fine-grained zones of more mafic rock up to 30 cm by 50 cm in size are present in places. Epidote alteration was not observed in this rock. The contact between the two granite phases is marked by a 5 to 10 m wide steep-walled gully. The adjacent biotite granite has been altered to a red color. Two to five centimetre wide quartz veins, oriented sub-parallel to the contact are present in both rocks up to 50 m from the contact.

Diabase

Delineation drilling around the pipe intersected a single diabase dyke. The dyke was intersected in drill hole BGT-28 at the downhole interval from 58.0 - 61.4 m which equates to a vertical elevation of 398-396 masl. Based on the geological fabric on the southern side of the pipe, an east-west orientation is speculated for the dyke.

Metasediments

The biotite granite host rock contained blocks of metasediments on the eastern and western sides of the pipe, and small xenoliths of metasediments in the northeast and southwestern areas. These appear to be related to preferential segregation of the biotite micas in response to a metamorphic event, such as shearing and fault movement.

These metasediments generally contain trace concentrations of sulphide minerals, but occasionally have concentrations of up to 2% at centimetre scale. BHP Billiton estimates that approximately 93,000 tonnes of metasediments will be mined from the pit (BHP, 2003b). These tonnages are considered insignificant as they represent less than 0.1% of the total quantity of waste rock to be produced from the Beartooth Pit.

A.4.2 Kimberlite Geology

The Beartooth pipe is roughly circular in plan view, with an area of 0.5 ha. Overall, the pipe is shaped similar to an upright bowling pin with the lower bulge occurring at 60-150 metres below the surface and identifiable by a unique internal stratigraphy within the kimberlite.

The crater facies of the Beartooth pipe is dominantly comprised of an olivine-rich ash tuff, generally grey-brown in colour and contains 15% to 45% glassy, pale green, partially serpentinized olivine macrocrysts. Granite, autolithic kimberlite, and mudstones compose 2% to 10% of the ash tuffs.

The majority of the remaining crater material is an ash-rich tuff characterized by fewer xenoliths and more common sorting and bedding textures. Centimetre-scale bedding is frequently well developed. Locally, the tuff contains abundant wood fragments.

The diatreme facies is mostly composed of tuffisitic kimberlite and tuffisitic kimberlite breccia. The tuffisitic kimberlite is medium-grained and contains 15-35% pale yellowish-green, 1 to 6 mm broken to sub-rounded olivine macrocrysts. The matrix locally varies in color from dark grey-green to black and is moderately serpentinized. Xenoliths (less than 15%) include mudstones, well-rounded unaltered granite cobbles, autolithic boulders to blocks of crater facies kimberlite and rare carbonized black wood fragments. Tuffisitic kimberlite breccia is defined as containing more than 15% xenoliths.

A distinctly different tuffisitic kimberlite characterized by a very competent, well crystallized greenish-black matrix has been identified at the deepest levels of the proposed pit bottom. This material hosts a predominantly sub-rounded fresh dark olive-green olivine macrocrysts and is absent of kimberlite autoliths, ash and fossil material.

A hypabyssal kimberlite occurs within the tuffisitic kimberlite but is volumetrically insignificant. The material is noticeably absent from even the deepest elevations of crater material. It is the most competent of the kimberlite units within the pipe.

A non-kimberlitic friable siltstone and conglomerate occurs as at least two erratic blocks in the crater and diatreme. The units are 4.5 and 7 metres thick respectively. Also, a dark-brown to black serpentinized kimberlitic mudstone occurs as rare discontinuous boulders to metre-scale blocks. This material is poorly indurated, laminated and fissile, generally lacking olivine and other kimberlite components.

A.5 Misery Pipe

A.5.1 Host Rock Geology

Surficial Geology

The Misery pipe was overlain by 13 m of glacial overburden and 3 m of lake sediments. The glacial overburden was composed of poorly-sorted gravel (65% to 95%) and sand (5% to 35%) derived from metasediments and granitic rocks. The lake-bottom sediments consisted of grey to black mud. This material has been removed and co-deposited in the Misery Waste Rock Storage Area. Topsoil salvaged in the advancement of Misery Pit and King Pond Dam was stockpiled on the northeast corner of the Misery Waste Rock Storage Area.

Bedrock Geology

The Misery pipe is located at the contact between Archean metagreywacke and granite (also known as two-mica granite). The granite is younger than, and intrudes into, the metasediments. A description of each of these rock types is given below.

Metasediments

The metasediments represents a metamorphosed Archean greywacke. It is weathered to a buff brown to rusty brown colour, and is commonly foliated. The metasediments contain about 40% biotite mica, 30% plagioclase feldspar, 15% quartz, and 19% sericitic mica, with the remainder made up of lesser mafic minerals. The metasediment has brown biotite and muscovite interlayered with feldspar and quartz. The micas form subhedral flakes up to 2 mm in diameter and are usually found in foliated masses that commonly contain less than 1% sulphides (pyrite, pyrrhotite, and minor chalcopyrite).

Granitic Rocks (Two-Mica Granite)

The granitic rocks generally weather white to light grey in colour and contain abundant primary muscovite. They consist mainly of intergrown plagioclase and quartz with scattered large muscovite and smaller biotite flakes. The mineralogy consists of 45-50% plagioclase feldspar (oligoclase), 25% quartz, 10-15% potassium feldspar, 10% muscovite and 3% biotite micas, with minor alteration minerals (chlorite, clay-sericite) making up the remainder. The plagioclase forms subhedral to occasionally ragged crystals up to 2.5 mm with minor clay-sericite alteration at the core and along fractures. The quartz forms subhedral to anhedral crystals up to 3 mm in diameter with textures suggestive of replacement of adjacent plagioclase at the margins. Textures vary from fine- to coarse-grained and pegmatitic, and equigranular to weakly porphyritic. There are essentially no sulphides present.

Diabase

The Misery diabase dyke trends approximately 45° and is located along the north-west edge, cross-cutting both the granite and the schist and is almost vertical with a slight dip southeast towards the kimberlite pipe.

The dyke is fine-grained with sub-ophitic textures and composed of mostly andesine, clinopyroxene and Fe/Ti oxides. The dyke consists of 45% plagioclase, 30% clinopyroxene, 10% amphibole, 5% chlorite, and 5% ilmeno-magnetite oxides. The remaining minerals are minor sericite, biotite micas, sphene and trace potassium feldspar and pyrrhotite. The plagioclase forms subhedral laths rarely over 1 mm in length and partly altered to sericite. The pyroxene forms sub- to anhedral crystals rarely over 0.75 mm and is partly altered to secondary amphibole, chlorite, and minor brown biotite. The Fe-Ti oxides form euhedral crystals less than 0.25 mm in diameter and are amassed in 0.5 mm aggregates that are partly oxidized. Minor sulphides (<0.5%) composed mostly of pyrrhotite and rare pyrite are associated with the oxides.

A.5.2 Kimberlite Geology

Misery kimberlites involve a complex, multiphase emplacement history and are comprised largely of pyroclastic fine-grained ash tuff to coarse-grained ash tuff.

The coarse-grained ash tuff has two different types of olivine; one type is subrounded to subangular, fresh to moderately serpentinized, and the other is a mass of white to cloudy-blue serpentized grains of olivines. The concentration of sulphides in the kimberlite is rarely as high as 0.5%. Thin pyritic rims commonly surround these serpentinized olivines, with more pervasive and complete pyritic replacement occurring in association with increasing degrees of olivine serpentinization. Pyrite grains up to approximately 2.5 mm to 3.0 mm are commonly observed, as is pyritic overprinting of granitic xenoliths within the pipe. Serpentinization is generally pervasive through the kimberlite groundmass and mineral grains. The kimberlite matrix is predominantly phlogopitic, with lesser disseminated wisps of sulphide and varying degrees of serpentine and clay alteration. Cr-diopside is conspicuously absent and ilmenite and chromite are rare.

Fine-grained ash tuff is mineralogically similar to the coarse ash tuff. Angular olivine exhibits varying degrees of serpentinization. Xenoliths and indicator minerals are usually rare. Garnet and chrome diopside are often angular and fragmented with less prevalent kelyphite rims.

Diatreme xenoliths include both host rock fragments (granite, biotite schist) and fragments derived from the pipe (kimberlitic mudstone and kimberlitic siltstone). The schist fragments are elongate and subparallel to schistosity. Rare potassium-rich granitic xenoliths are dissimilar to the host granite suggesting a deep source or foreign origin. The diatreme also hosts discontinuous horizons, lenses and blocks of epiclastic rocks. Crater facies sediments of Misery North consist of kimberlitic siltstone and kimberlitic mudstone. This unit consists of fine-grained silty-muds, rare serpentinized olivine and pyritic nodules. Indicator minerals are absent.

Kimberlitic dykes

Hypabyssal kimberlite dykes have been identified and are characterized by dark greenish-grey, aphanitic, phlogopite and clay matrix with pale glassy green, coarse-grained, sub-rounded to ellipsoidal olivine macrocrysts. Pyrope garnets are rare to common, and occur as broken to sub-rounded crystals. Chrome diopside is rare and occurs as broken grains and inclusions within the largest macrocrysts.

Contacts between dykes and host rocks vary in dip from vertical to 10°. Frequently, dyke margins are strongly iron stained with a serpentinized matrix. Similar alteration has moderately de-silicified, chloritized and saussuritised the host granite, and a bleached appearance is apparent over several metres adjacent to the contact with the dykes.

A.6 Fox Pipe

A.6.1 Host Rock Geology

Surficial Geology

Till veneer thickness in the Fox pipe area is generally less than 2 m and reflects the bedrock topography. The till is a compact diamicton with a silty, sandy matrix and contains pebbles, cobbles and boulders. An extensive boulder field lies to the south of Fox Lake.

Glacial sediments stripped from the bottom of Fox Lake consisted of silt and sand sized particles of quartz, feldspar, biotite, epidote, amphibole and traces of kimberlite indicator minerals. Gravel-sized rock fragments include biotite granite, hornblende granite, granodiorite and tonalite to quartz diorite, lesser amounts of biotite schist and diabase, and trace amounts of vein quartz and felsic to intermediate volcanic rocks. These materials were co-disposed with waste rock in the Fox Waste Rock Storage Area. Fine sandy and clay fraction materials were used to construct toe berms around the perimeter of the waste rock pile. Topsoil was stockpiled on the north side of the Fox Waste Rock Storage Area.

Bedrock Geology

Similar to the Koala, Koala North, Panda, and Beartooth pipes, the Fox kimberlite pipe was emplaced within the biotite granodiorite of the Koala Batholith. The main host rock types at the Fox kimberlite are a medium-grained biotite granite and diabase dykes. A description of each of these rock types is provided below.

Biotite Granite

The predominant rock type in the Fox area is a medium-grained biotite granite. The granite is generally unaltered, but weak to moderate potassic alteration occurs at the east end of the ravine near the Fox portal and also along the linear swamp subparallel to the ravine. Potassic alteration is identified by pink colouration to the rock. Green epidote also occurs in association with potassic alteration either as veinlets or pervasive alteration. Small (centimetre-scale) semi-circular black to greenish-black biotite- or chlorite-rich inclusions occur throughout the granite.

Sulphide minerals are rare in the granite occurring as small disseminated grains of pyrite, typically less than a millimetre in size. Disseminated pyrite and possibly chalcopyrite occur at higher concentrations (up to a few percent) in less than 50% of the centimetre-scale biotite-rich inclusions (on average, one inclusion is found for every 6 to 8 m of core). Carbonate minerals are rare in the granite and occur as fracture fillings of calcite.

Diabase

Three diabase dykes occur within the pit limits. The dykes are fine-grained with sub-ophitic textures and composed of mostly andesine, clinopyroxene, and Fe/Ti oxides. The dykes consist of 45% plagioclase, 30% clinopyroxene, 10% amphibole, 5% chlorite, and 5% ilmeno-magnetite oxides. The remaining minerals are minor sericite, biotite, sphene, and trace potassium feldspar and pyrrhotite. Rare pyrrhotite and very rare pyrite occur as small grains (less than millimetre-scale). Sulphide minerals are very rarely concentrated in centimetre wide segregated layers within the diabase. Carbonate minerals have not been observed in the diabase.

Like other diabase occurrences in the area, the rock does not break easily or form abundant fines when broken.

A.6.2 Kimberlite Geology

The Fox kimberlite pipe is roughly rectangular with dimensions of approximately 530 m (north-south) by 435 m (east-west). The pipe walls dip inwards with typical angles of about 75°, except the north wall which has a shallower dip.

The pipe contains distinctive crater and diatreme facies, which will be waste and ore, respectively. The crater facies is 100 to 150 m thick, defined by an assemblage of resedimented volcanoclastic kimberlites very similar to that observed in other EKATI kimberlites. The black to brown material is made up primarily of variable amounts of loosely packed, angular olivine grains set in a very fine-grained, mud-dominated matrix with lesser amounts of serpentine, phlogopite, and minor calcite. The small, altered olivine grains average 1 to 2 mm in size and comprise 25% to 35% of the kimberlite. Small mudstone clasts, granodiorite xenoliths and fresh to carbonised wood fragments are scattered throughout, but are most abundant at the top of the crater. Also, a small number (<1%) of shale lenses containing as much as 6% sulphides occur in the crater facies (Fox kimberlite typically contains <0.5% sulphides). An interval dominated by large granodiorite boulders (up to approximately 30 m) occurs in the lower part of the crater phase on the north side of the pipe. The contact between the crater facies material and the underlying diatreme phase is sub-horizontal and sharp with no evidence of intermixing.

The diatreme facies of the Fox pipe is a distinctive magmaclastic kimberlite, unique at EKATI in that it is the only phase identified to date that comprises consistently high (40% to 50%) proportions of xenolithic wall-rock materials, mostly as small fragments. The upper portion of the diatreme (upper 80 m) is a greyish-brown to brown tuffisitic kimberlite with a ground mass mineralogy similar to that of the crater facies kimberlite, but with 30% to 35% coarse olive grains (up to 5 mm). The rocks are described as highly fragmented and intensely clay-altered with a homogeneous distribution of olivine, very high concentrations (>40%) of altered, finely comminuted (<4 mm) granodiorite (mostly xenocrysts), larger (>4 mm) commonly angular granodiorite xenoliths (minimum 5% of the rock), an absence of matrix carbonate and pervasive olivine serpentinization. The intensely clay-altered Fox kimberlite contains high percentages of clay dominated by sodium and potassium enriched smectite/montmorillonite clays. Processing of this material requires addition of $CaCl_2$ to overcome issues of low slurry viscosity and clay entrainment (BHP 2005b).

Approximately 80 m below the base of the crater phase, the lower diatreme zone is a tuffisitic kimberlite breccia similar to the upper diatreme material, but with >15% xenolithic material and greenish-grey to light grey in colour due to a greater proportion of serpentine (up to 30%). Large granodiorite boulders (up to 30 m) occur sporadically throughout the diatreme facies to the limit of drilling (approximately 550 m depth). An interval dominated by the large boulders also occurs between the two diatreme zones.

DOMINION DIAMOND

Appendix B: Seepage Sampling Protocol

Ekati Diamond Mine™
Seepage Sampling Protocol

Revision 05

Report Prepared for

BHP Billiton Canada Inc.

Report Prepared by

SRK Consulting
Engineers and Scientists

January 2011

Ekati Diamond Mine^{TM}
Seepage Sampling Protocol

Revision 05

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1 Background

This protocol describes sampling of surface water seeps at the BHP Billiton Canada Inc EKATI Diamond Mine^{TM}. This is the fifth version of the protocol prepared originally by SRK Consulting in August 2001 based on a previous BHP memorandum dated August 9, 2001.

In the event of uncertainty or questions regarding this protocol, contact the Superintendent of Environment Operations (867-880-2232).

2 Equipment Checklists

- Meters
  - pH (including calibration solutions)
  - Electrical Conductivity (EC) (including calibration solutions)
  - Oxidation-Reduction Potential (ORP) (including calibration solutions)
  - Thermometer
- Back-up meters
  - Pocket pH
  - pH strips
  - Pocket Electrical Conductivity
  - Thermometer
- Sampling Equipment
  - Disposable plastic syringes
  - Sample Bottles (as per Surveillance Network Program protocols)
  - Ziplock bags
  - Sample preservative vials
- Filtration Equipment
  - Disposable sterile Nalgene filtration units
  - Vacuum hand pump
- Flow Measurement Equipment
  - Tape measure
  - Stopwatch
  - 1 L plastic beaker with graduated markings
  - Bucket for seeps with high flow
- Other
  - Field data sheets printed on waterproof paper
  - Waterproof field notebook
  - Digital camera

- GPS with coordinates of previous monitoring locations
- Extra batteries (AA and 1.5V)
- Flagging tape
- Aluminum station tags
- Coolers
- Ice packs
- Permanent marker pens
- Pencils
- Paper towels
- List and maps of previous monitoring locations
- Wooden stakes
- Small white board or laminated piece of paper
- White board marker
- Cloth for wiping off white board
- Glass or plastic jar
- Watch
- Compass
- Rebar (for measuring permafrost)
- Disposable latex gloves
- Deionized water from the lab

3 Preparation for Sampling

3.1 Meter Calibration

1. Calibrate both the pH meter and pocket pH meter with pH 4 and 7 buffers using the meter manufacturer's instructions. Pocket meters should be calibrated in the field.

2. Calibrate both the EC meter and pocket EC meter with two low level EC solutions using the meter manufacturer's instructions.

3. Check calibration of the ORP meter using the meter manufacturer's instructions.

4. Record calibration information on Daily QA Checklist form.

5. Check declination on compass.

3.2 Bottle Preparation

1. If printing labels from the EKATI database program, print labels each day for the samples expected to be collected that day, including blanks. For duplicates, and samples collected at

new locations, print and apply labels at the end of the day. Use blank labels until proper labels can be printed.

2. If using blank sample labels provided by the laboratory, apply labels to bottles and fill in the general information. Sample ID should be marked at the sample station. Include the date in DD-MMM-YYYY format (e.g. 04May2001).

3. Place each bottle set and the necessary number of preservative vials in a Ziplock bag. A bottle set typically consists of the following bottles:

- a 1 L plastic bottle for general parameters
- a 250 mL bottle for total metals
- a 250 mL bottle for dissolved metals
- two preservative vials of nitric acid for the metals samples

Additional parameters (THP and BTEX) must be collected at stations located on the south and west sides of the Coarse Kimberlite Rejects Storage Area (CKRSA). The following sampling bottles will be needed in addition to those listed above:

- two 500 mL amber glass bottles for TPH.
- two 50 mL glass vials with pre-injected $CuSO_4$ preservative for BTEX.

4 Identification of New Seeps

1. While walking the perimeter of the waste rock piles check for new seeps.

2. If a new flowing seep is identified, use a wooden stake and flagging to identify the location and record the GPS co-ordinates. Write a new seep number on a metal tag and attach to the stake (e.g.SEEP-363). Record and sample as in sections 5.3 to 5.7 below.

5 At the Sampling Location

5.1 Selecting the Sampling Location

1. If the location has been monitored previously, identify the exact sampling location using the previous field notes or stakes marking the sites. If water is flowing, select this location for sampling and tie a new piece of flagging to the stake. If water is not flowing, record the condition of the old sampling location, and determine a new sampling location using the following criteria.

2. Monitor a 30-metre radius from the staked SEEP location (see Figure 1 below). Choose the nearest location that is along the same flow path (ie. surface water can be seen to flow toward the new location). New locations at a sampling station along the flow path are to be labeled

with a letter after the sample station ID (e.g. SEEP-002A). If the new station is not definitively along the same flow path, a new ID should be used (e.g. SEEP-098).

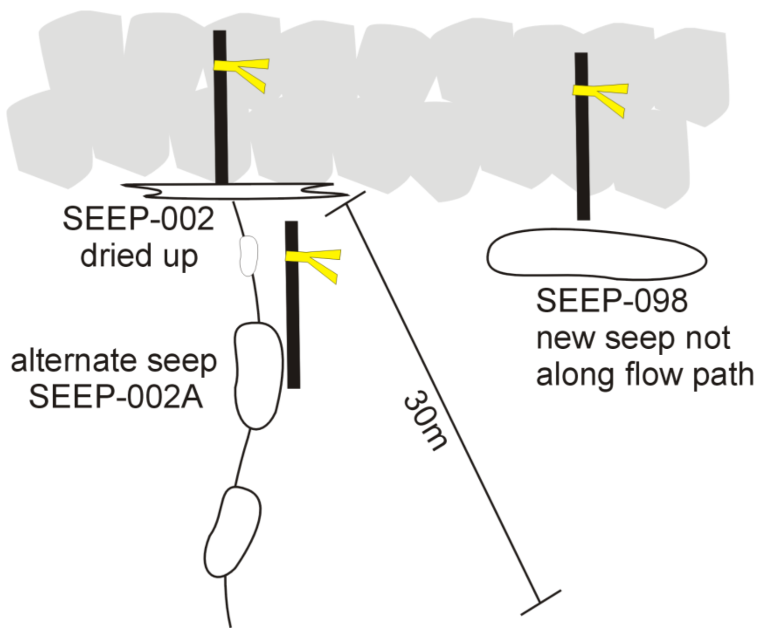

Figure 1: Selection of Alternate Sample Locations for Dried Up Seeps

3. If there are multiple locations of water flowing, select the largest flowpath for sampling.

4. Record the distance and compass direction to the new location in the field notes.

5. Use a wooden stake and flagging to identify the new location. Write the SEEP number and sampling date on the flagging

6. For all subsequent sampling rounds, return to the original sampling location. In the example above, this would be location SEEP-002. If water is not flowing, sample the most frequently sampled secondary sampling location. Note in the above example, SEEP-002 and SEEP-098 are separate seeps.

7. Prepare a sketch map showing the seep location and the stake.

5.2 Seep Identification Numbers

5.2.1 Locations Covered by Waste Rock or Other Types of Fill

If the station was covered by waste rock give the new station an alternate ID (e.g. A or B etc.) if it can be determined that the new station is on the same well-defined flow path as the original station and is within 30 m from the original station. If not, the location should be given a new number (see Figure 2) regardless of the distance to the old location.

5.2.2 Groups of Seeps

When several seeps are established in close proximity, they should each receive unique sample ID's.

If the original seep has dried up follow the procedures outlined in Section 5.1 (Figure 1).

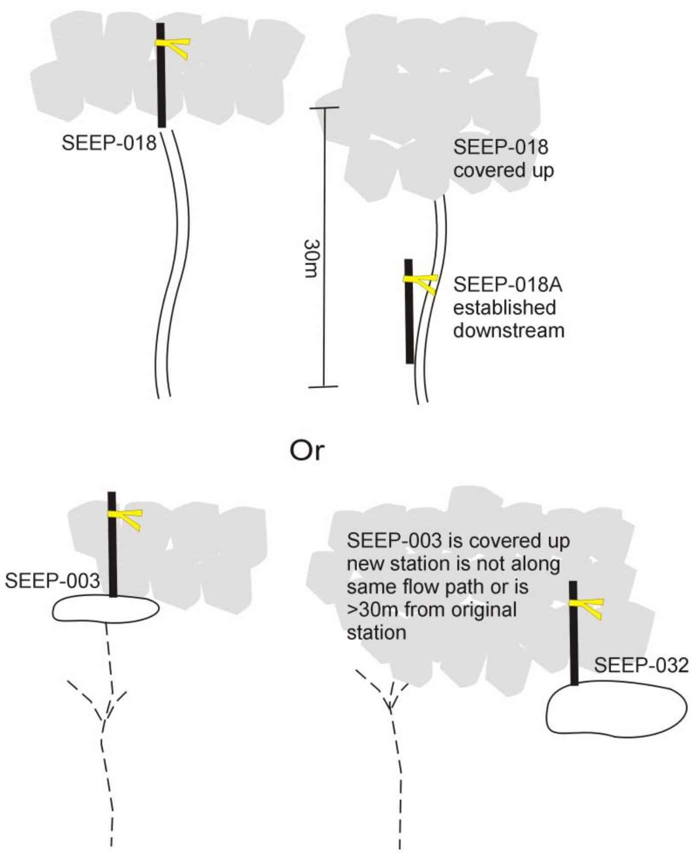

Figure 2: Naming Seeps Covered by Waste Rock

5.3 General Field Observations

1. Record the proportion of ground covered by snow.

2. Record the general weather conditions (overcast, sunshine, rainfall, snowfall, windy or calm).

3. Note precipitation/snowmelt from the previous week.

4. Record the depth to permafrost using established methods (rebar driven into ground).

5.4 Chemistry and Related Measurements

1. All field measurements of water should be conducted by placing the probe directly in the flow. If the water is not deep enough to adequately submerge the probe do not push the probe into the soil. Transfer sufficient water from the seep into a glass jar using a plastic syringe.

2. Record the pH, EC and ORP (in-situ measurement) of the water. In the event that the reading is unstable, note the reading obtained after two minutes.

3. Record the water temperature.

4. Record the air temperature.

5. Note the approximate colour of the water by filling the glass jar and observing a piece of white paper through the water. Typical colours are colourless, yellow, brown. Descriptors such as slight, dark etc. need not be provided.

6. Note the absence or presence of cloudiness.

7. Record the colour of any coatings or precipitates observed on rocks or vegetation in the seep.

8. Record any odours.

9. If flow is absent, record nv (none visible), nm (not measureable) ie. flow is too slow or diffuse to measure, or du (dried up).

10. For a pool, measure the depth of the deepest part of the pool.

11. Take three photographs.

    a. The immediate sampling location (including an object for scale and a white board showing the location name in bold lettering). Use an angle that allows the color of the seep to be shown (avoid reflections)

    b. Upstream (try to show the feature the water is coming from).

    c. Downstream.

12. Note any other conditions that may affect results, ie. dusty conditions, deviation from sampling procedures, meter malfunction, disturbance of sediment, etc.

5.5 Flow Measurement

1. If flow is apparent, estimate the flow by the most appropriate method (described in point 2, 3 and 4 below).

2. Flow should ideally be obtained by measuring flow velocity through a measured cross-section of the channel.

3. For low flows in irregular channels, identify the location where the flow is best defined. Measure the width and typical depth of the flow. Estimate the flow by taking three measurements of the time taken to travel a fixed distance by floating object (such as toothpick).

4. If the flow can be directed into a container of known volume (ie. 1 L plastic beaker) record time it takes to fill beaker using a stopwatch. Repeat two more times.

5. Record method used to obtain flow.

5.6 Water Sample Collection

5.6.1 General Guidelines

1. Always stand downstream of the sampling location and point the mouth of the bottle upstream.

2. Water samples are collected upstream of the location used for field measurements to avoid possibly disturbed sediments.

3. If the water is deep enough to allow the bottle to be placed in the water without disturbing sediments. Rinse bottles and caps 3 times using water to be sampled. Fill the bottles using standard SNP protocols.

4. If the water is shallow, use a disposable plastic syringe (rinsed 3 times) to withdraw water from the flow and transfer the sample to the bottle.

5. A sample should not be collected if the water is stagnant.

6. For quality control purposes, the team collecting the samples should remain the same for the entire seepage survey.

7. For quality control purposes, note which person is collecting the sample from each seep.

8. Note when and where any field blanks were collected.

5.6.2 Collection of Filtered Samples for Dissolved Metals

1. Label the bottles.

2. Samples are to be filtered and preserved following the protocol described below:

   a. Obtain the sample to be filtered using the "total metals" bottle following the general procedure described in Section 5.5.2. If it is possible to filter in the field, follow Steps b through k at the sample site. If it impractical due to cold temperatures, excessive wind or insects, or samples that clog the filter easily, fill two extra "total metals" bottles to the rim, eliminating as much air as possible, and complete steps b) through k) in the field laboratory on the same day as they are collected.

b. Carefully open the sealed bag containing the filtration unit and place the unit on clean flat surface (eg. clipboard).

c. Attach the hand pump to the filtration unit. Ensure that the pump is set to "Vacuum".

d. Decant approximately 50 mL of the water sample into the upper filter cup. Swirl the water around the cup, and discard without applying a vacuum. Repeat two additional times.

e. Decant an additional 50 mL of the water sample into the upper filter cup and apply a vacuum using the pump. Wait for the water to be drawn through as a steady stream. Do not over-pump, otherwise the filter membrane may rupture.

f. Gently release the vacuum using the release valve on the side of the pump.

g. Unscrew the filtrate vessel, swirl the filtrate and use to rinse the sample bottle. Repeat steps e) through g) a total of 3 times.

h. Re-attach the cup and filtrate vessel and add water to the upper cup. Apply a vacuum again and filter the sample.

i. Release the vacuum and transfer the filtrate to the "Dissolved Metals" bottle. Repeat until sufficient volume of dissolved filtrate is obtained.

j. Preserve the filtrate as directed by the analytical laboratory.

k. Record the colour of the filtrate and any sediment trapped on the filter.

5.6.3 Collection of Unfiltered Samples for General Parameters and Total Metals

1. Fill the appropriate bottles using standard SNP protocols. Always rinse the bottles three times prior to filling.

2. Preserve the total metals sample as directed by the analytical laboratory.

5.6.4 Collection of Unfiltered Samples for BTEX and TPH

1. For TPH, rinse the appropriate bottles three times prior to filling, and fill the bottles using standard SNP protocols.

2. For BTEX, do not pre-rinse the sample vials, as the vials contain a liquid preservative (copper sulphate) that will be lost if rinsed. Do not submerse the vials in the flow stream, as this may also cause the preservative to be lost. Use a syringe or the total metals bottle to fill the vials. If

using the total metals bottle, ensure not to touch the lip of the bottle to the lip of the vial, as this may cause copper contamination of the total metals bottle. Fill the vials completely and avoid air bubbles (i.e., leave no head space).

5.7 Completion of Sampling

1. Enclose each sample set in individual ziplock plastic bags. For stations with BTEX and TPH, enclose the BTEX and TPH sample containers in a separate ziplock bag.

2. Place samples in cooler as soon as possible.

3. Discard all disposable items.

4. Record list of samples collected at the station and note preservatives used (this serves as a checklist).

5. At the end of the day, check pH meter against calibration standards and note any drift.

6 Quality Control Samples

Quality control consists of samples collected to assess the cleanliness of equipment (sample blanks) and the reproducibility of results (duplicate samples).

6.1 Blanks

1. The types of blanks required are shown in Table 1.

Table 1: Quality Control Blanks

Type of Blank	Label	Description and Purpose	Collection Frequency	Preparation
Travel	SEEP-2n1	Bottles of deionized water are provided by the laboratory to monitor possible effects from the bottle materials	One per pair of samplers per sample shipment	1. The bottles must not be opened 2. The bottles are taken into the field.
Field blank	SEEP-2n2	Bottles of deionized water, provided by the lab, are taken into the field and used to prepare field blank samples. The purpose of the field blank is to monitor possible contamination from airborne particulate and contamination which occurs during the filling of sample bottles and the preparation of the dissolved metals blank.	One set per pair of samplers per day (see note).	1. The total metals and routine parameters bottles are rinsed 3 times and then filled with deionized water. 2. The dissolved metals sample is prepared in the same way as the seepage station samples, i.e. is filtered in the field, as per protocol, or back at the lab at the end of the day. 3. Both the total and dissolved metal field blank are preserved as for the seeapage station samples.
Laboratory site blank	SEEP-2n3	Bottles are filled with deionized water to monitor possible contamination from sampling equipment under site conditions.	One set per sampling round	1. Repeat the same procedure as the "Field Blank" in the mine environmental laboratory.

1. One field blank for every batch of ten samples (or part thereof) is required.
2. Blank samples should be indistinguishable from conventional samples. The label should not contain the word "Blank". The date must also be recorded on the sample bottle.
3. The sample label is shown in Table 1. Each sampler will receive an identifier "n" which is to be inserted as shown into the sample label.

6.2 Duplicate Samples

1. Each pair of samplers should collect one duplicate sample for every batch of ten samples (or part thereof).

2. Duplicates should be taken at stations with a reasonable amount of flow such that two sets of samples can be extracted easily.

3. The duplicate sample site is sampled exactly the same way as other sites. All activities including field measurements are completed at the site and then repeated.

4. Table 2 shows the labeling for the sample site to be used. For example, if location SEEP-001 is being sampled and a duplicate sample is collected, the duplicate sample is labeled SEEP-165. The word "DUPLICATE" must not appear on the sample label.

Table 2: Duplicate Sample Labelling Key

Location	Duplicate Label	Location	Duplicate Label	Location	Duplicate Label	Location	Duplicate Label
REF-001	SEEP-116	SEEP-014	SEEP-111	SEEP-304	SEEP-458	SEEP-354	SEEP-467
REF-002	SEEP-133	SEEP-014A	SEEP-109	SEEP-305	SEEP-488	SEEP-355	SEEP-427
REF-003	SEEP-155	SEEP-015	SEEP-153	SEEP-306	SEEP-466	SEEP-356	SEEP-463
REF-004	SEEP-138	SEEP-015A	SEEP-135	SEEP-307	SEEP-484	SEEP-357	SEEP-405
REF-005	SEEP-124	SEEP-016	SEEP-137	SEEP-308	SEEP-499	SEEP-358	SEEP-457
REF-006	SEEP-142	SEEP-017	SEEP-156	SEEP-309	SEEP-487	SEEP-359	SEEP-431
REF-007	SEEP-145	SEEP-018	SEEP-103	SEEP-310	SEEP-489	SEEP-360	SEEP-496
REF-008	SEEP-125	SEEP-018B	SEEP-130	SEEP-311	SEEP-418	SEEP-361	SEEP-476
REF-009	SEEP-118	SEEP-019	SEEP-157	SEEP-312	SEEP-446	SEEP-362	SEEP-441
REF-010	SEEP-158	SEEP-022	SEEP-101	SEEP-313	SEEP-414	SEEP-363	SEEP-497
REF-011	SEEP-107	SEEP-022A	SEEP-183	SEEP-314	SEEP-402	SEEP-364	SEEP-495
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REF-019	SEEP-141	SEEP-050	SEEP-194	SEEP-322	SEEP-481	SEEP-372	SEEP-444
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REF-029	SEEP-112	SEEP-060	SEEP-171	SEEP-332	SEEP-469	SEEP-382	SEEP-464
REF-030	SEEP-166	SEEP-061	SEEP-187	SEEP-333	SEEP-450	SEEP-383	SEEP-477
REF-031	SEEP-143	SEEP-062	SEEP-174	SEEP-334	SEEP-452	SEEP-384	SEEP-493
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SEEP-001	SEEP-165	SEEP-066	SEEP-172	SEEP-338	SEEP-491	SEEP-388	SEEP-436
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SEEP-013	SEEP-144	SEEP-303	SEEP-400	SEEP-353	SEEP-462		

7 Sample Submission and Clean-up

Back at the EKATI Diamond Mine™ lab:

1. Pack samples for shipping.
2. Log sample/station information and field measurements into the database.
3. Complete the Chain of Custody and Analytical Request form (prints from data base program).
4. Complete vendor slip for shipping.
5. Clean field equipment.
6. Place probes (e.g. pH) in storage solutions.
7. Make metal tags for any new stations and attach to location stakes on the next trip out (if not already done so while at the station).
8. Order more bottles, ice packs, travel and field blanks, and preservatives if necessary.
9. Download new GPS waypoints onto server.

This report, "**Ekati Diamond Mine™ - Seepage Sampling Protocol – Revision 05**", has been prepared by SRK Consulting (Canada) Inc.

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Stephen Day, P.Geo.
Principal

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

DOMINION DIAMOND

Appendix C: Pigeon Pit Waste Rock Storage Area Design

Tetratech EBA, April 2014

PIGEON PIT WASTE ROCK STORAGE AREA DESIGN – REVISION 1
EKATI DIAMOND MINE, NT

PRESENTED TO

DOMINION DIAMOND EKATI CORPORATION

APRIL 2014
ISSUED FOR USE
FILE: E14103068-02

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EXECUTIVE SUMMARY

Dominion Diamond Ekati Corporation is undertaking development of the Pigeon Pit at the Ekati Diamond Mine. Waste rock generated during pit development will be placed in a land-based waste rock storage area (WRSA), consistent with existing practice on site.

A site overlying Big Reynolds Pond has been chosen as the preferred storage area for Pigeon waste rock. The WRSA is contained within a catchment area which drains to the north end of the Long Lake Containment Facility. The WRSA has been designed to minimize ponding adjacent to the pile, directing runoff around it.

A portion of the overburden soil generated during initial pit development will be stockpiled to the east of the WRSA for use in future capping of the WRSA as part of reclamation activities. The remaining overburden will be placed in the Panda/Koala WRSA.

The waste rock from Pigeon Pit is expected to be composed primarily of potentially acid generating (PAG) material, including mixed granitoid and metasediment rock that cannot be easily differentiated from non-acid generating (NAG) granite. As a result, all waste rock from Pigeon Pit is planned to be treated as PAG material. The proposed cover for the WRSA comprises till overburden soil overlain by clean granite. This will provide thermal cover while reducing the required quantity of clean (NAG) granite.

Thermal analyses were carried out to predict the behaviour of potential unfrozen zones within the WRSA pile and the proposed WRSA cover. Both 1D and 2D models were simulated through the WRSA pile. Global warming, potential internal heat generation due to sulphur oxidation, and progressive waste rock placement were considered in the modelling.

Modelling indicates that a 3 m till cover overlain by 1 m of granite waste rock will provide sufficient cover to maintain the active layer within the cover material. Freeze back of the waste rock material is expected to occur with eight to 12 years depending on the degree of internal heat generation from the PAG material.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Dominion Diamond Ekati Corporation and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Dominion Diamond Ekati Corporation, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by Dominion Diamond Ekati Corporation (DDEC) to develop a design to manage waste materials generated from Pigeon Pit development.

Waste rock and overburden soil generated during pit development will be managed in a land-based storage facility. Big Reynolds Pond has been selected by DDEC as the preferred storage location for the waste rock storage area (WRSA) (Figure 1). The use of Big Reynolds Pond as a waste rock storage area was previously proposed and permitted as part of the environmental impact assessment (EIA) for the Sable, Beartooth, and Pigeon pits (BHP 2000). A portion of the overburden soil will be stored adjacent to the WRSA for use in future cover construction. The remaining overburden will be disposed of in the Panda/Koala WRSA.

The waste rock from Pigeon Pit is expected to be composed primarily of potentially acid generating (PAG) material, including mixed granitoid and metasediment. The PAG material cannot be easily differentiated from non-acid generating (NAG) granite. As a result, all waste rock from Pigeon Pit is planned to be treated as PAG material. There is insufficient clean granite to act as an encapsulation rock material, as is planned at the Misery waste rock storage area (WRSA).

Thermal analyses were completed to predict the behaviour of potential unfrozen zones within the WRSA pile and the proposed WRSA cover. Both 1D and 2D thermal models were simulated through the WRSA pile. Global warming, potential internal heat generation due to sulphur oxidation, and progressive waste rock placement were considered in the modelling.

Based on the thermal analyses' results, DDEC has chosen to cover the WRSA with a 3 m thick overburden till layer covered by a 1 m Waste Rock cap.

2.0 WASTE ROCK VOLUME

The waste rock volumes were provided to Tetra Tech EBA in an XPAC model generated by DDEC. The cumulative quantities are shown in Table 1.

Table 1: Pigeon Pit materials and volumes

Material	In Situ Volume (m^3)
Mixed Metasediment*	7,767,831
Overburden	2,313,037
Xenolith	18,956
Kimberlite	3,639,945
Diabase	338,751
Waste Kimberlite	37,595
Note: *Identified as granite in the XPAC model	

The total waste rock volume was calculated by adding the expected production of mixed metasediment and diabase. Kimberlite and till volumes were excluded from the volume calculations because the till will be used as waste rock cover or disposed of in an existing WRSA, and the kimberlite will be processed. A waste rock bulking factor of 1.48 was provided by DDEC; however, for modelling, Tetra Tech EBA has assumed a more conservative value of 1.6 and estimated the total Pigeon Pit waste rock volume to be 13.0 million m^3.

An extraction schedule was included as part of the XPAC model provided by DDEC. The extraction schedule is shown graphically in Figure 4. This schedule was used as part of the thermal modelling discussed in Section 4.0.

The total in situ overburden till material available for a cap is approximately 2.3 million m^3. At a bulking factor of 1.2, this volume increases to approximately 2.8 million m^3. The overburden material that is necessary to cap the Pigeon WRSA will be stored in the overburden till pile, located east of the Pigeon WRSA, until it is required to cap the Pigeon WRSA. Storage for the excess overburden material is proposed to be on top of the Panda/Koala WRSA as shown in Figure 1.

3.0 PILE GEOMETRY AND LAYOUT

3.1 Design Inputs

The proposed waste rock and till piles have been modelled with the following constraints and design assumptions:

- Pile footprint, cap material, and distance to Pigeon Pit should be minimized;
- The piles should be located in a single catchment or sub-catchment to route any potential seepage to a single location and to simplify discharge monitoring;
- Drainage from the piles should be directed towards the LLCF;
- The total height should not exceed 50 m above ground (including cap) measured from the edge of the pile or an elevation of 520 m corresponding to the height of the Panda/Koala WRSA;
- The waste rock is assumed to have an angle of repose of 37 degrees;
- Bench heights should not exceed 15 m;
- Bench widths should be spaced to ease final grading to a 3.2H:1V slope; and
- Till material is assumed to have a conservative slope angle of 2H:1V.

At closure, the existing Ekati waste rock piles have been designed to a slope angle steeper than 2H:1V; however, for the Pigeon waste rock pile, a combined till and waste rock cap is designed to reduce the requirement for clean granite. This will require final grading to a 3.2H:1V slope to provide stability for the till cap.

The pile geometries for the waste rock and till storage areas are described below. The footprints are shown in Figure 1 and the profiles during operation and closure are shown in Figures 2 and 3, respectively. For ease of construction, the piles will be constructed with benches, which will then be smoothed out to give resultant 3.2H:1V slopes at closure.

3.2 Big Reynolds Pond Waste Rock Pile

A WRSA design for Big Reynolds Pond was prepared as part of the 2000 EIA (BHP 2000) ; however, its size has been adjusted based on the most recent volume estimate and cover material restrictions. A layer of granite will be used as a base for the WRSA to encourage permafrost aggradation into the waste rock material. Three benches of waste rock, with maximum heights of 15 m and bench widths of 14 m, 24 m, and 28 m from the bottom up, have been modelled. The pile reaches 40 m above ground surface (before 4 m of cover), as measured from the edge of the pile. The pile dimensions are presented in Table 2.

The proposed pile location is within the catchment draining towards Little Reynolds Pond and eventually the north end of Cell B in the LLCF. The pile shape has been designed to promote surface flow around the pile to the maximum extent possible. However, some pooling may occur on the east side of the pile, and at isolated locations along its length.

The designed WRSA footprint is approximately 482,000 m^2, roughly half the size of the originally proposed pile in the EIA. This is primarily due to the decreased material estimate.

3.3 Overburden Till Storage Pile

The volume of overburden till material needed to cap the designed waste rock pile was calculated to be approximately 1.5 million m^3, based on a 3 m cover thickness (see Section 4.0 for further discussion on design cover thickness). Assuming a bulking factor of 1.2, the volume of overburden till material to be stored for future capping will need to increase to approximately 1.74 million m^3.

The designed overburden till material pile is located just east of the designed WRSA (see Figures 1 and 2). The designed pile does not require a base layer and its height is modelled at approximately 30 m above the lowest ground elevation. The area surrounding the pile eventually drains into Cell C of the LLCF. The pile dimensions are presented in Table 2.

The pile is modelled from the top down with three 10 m high benches with the bottom bench graded to the ground surface at the angle of repose. The material in the till pile will be used to cover the Pigeon WRSA at closure.

Storage of the approximately 1.06 million m^3 of excess till material not used to cap the Pigeon WRSA is proposed to be on top of the Panda/Koala WRSA as shown in Figure 1.

Table 2: Pile Dimensions

Pile	Height (m)	Length (m)	Width (m)	Surface Area (m^2)	Volume (m^3)
Big Reynolds Pond Pile	45	1000	600	482,000	13,445,000
Overburden Till Material Storage Pile	30	250	450	100,500	1,750,000

3.4 Cap Rock Volume

Thermal modelling has determined that 1 m of additional waste rock is required on top of the 3 m thick till layer in order to keep the active layer within the cover material and provide protection against erosion. The additional waste rock volume needed to cap the till material is approximately 493,000 m^3. The rock cover is expected be non-acid generating rock, probably from the Panda/Koala WRSA.

3.5 Site Access

Two access roads will service the Big Reynolds Pond WRSA: one from Sable Haul Road to the east and the other from Pigeon Pit to the northwest. The overburden till storage pile will be serviced by one access road from Sable Haul Road to the north. The approximate locations of the access roads are presented in Figure 1. Tie-ins to the piles will be developed by DDEC as part of pile construction.

4.0 THERMAL MODELLING

The preliminary Misery WRSA design utilizes 5 m of clean (non-PAG) granite waste rock as a cap; however, a different cap design is required for the Pigeon WRSA. Since the PAG rock at Pigeon Pit cannot be easily differentiated from non-PAG material, there is an insufficient supply of clean waste rock to encapsulate the pile. As a result, Pigeon Pit till overburden is proposed as an alternative capping material. To verify the adequacy of till cover, thermal modelling was carried out to investigate the influence of the till overburden on pile freeze-back and its ability to keep the waste rock in a permafrost state.

4.1 GEOTHERM Software

Geothermal analyses were carried out using Tetra Tech EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, one-dimensional, and two-dimensional (or three-dimensional axisymmetric) heat conduction with phase change for a variety of boundary conditions. Boundary conditions include conductive or convective heat flux, ground to air heat exchange, and temperature boundaries. As opposed to other commercial FEA software packages, GEOTHERM also models heat exchange at the ground-air interface, which considers the effects induced by climate conditions including air temperature, wind speed, snow density and thickness, solar radiation, evaporation, and even the long-term influence of global warming. GEOTHERM also accounts for progressive latent heat release during freezing and thawing in both fine-grained and saline soils.

GEOTHERM results are checked with closed form solutions and field observations. The software has been used successfully for thermal design and evaluations in a large number of projects in the arctic and subarctic, including tailings, dykes, dams, foundations, pipelines, utilidor systems, landfills, and ground freezing systems, as well as the design of several structures at Ekati including: Panda Diversion Dam, Long Lake Outlet Dam, the Misery Site dams, Bearclaw Diversion Dam, Panda/Koala, and Misery WRSAs (EBA, 1997a; 1997b; 2000; 2002; 2006).

4.2 General Subsurface Conditions

Borehole data was adopted from the nearby Pigeon Pit site investigation completed by Tetra Tech EBA in August 2012 (EBA, 2013). A total of 6 boreholes (OP-01, OP-02, OP-03, OP-04, OP-05, and OP-06) were drilled.

Lithology and ground conditions from borehole OP-01 were selected for the basis of the thermal model due to the adjacent thermistor cable and relative proximity to the proposed pile locations. The overburden thickness at OP-01 was 7.5 m, which consisted of 2 m of thawed till, 1 m of ice-rich frozen till, and 4.5 m of frozen till. This lithology may be different from the proposed WRSA locations, but is used as a best estimate of expected ground conditions.

4.3 Ground Temperature and Permafrost Conditions

Ekati is located in a zone of continuous permafrost with permafrost thicknesses reaching approximately 300 m to 400 m (EBA, 2006).

The latest ground temperature readings were taken on June 23, 2013, approximately 15 months after installation. Temperatures are expected to have equilibrated to the in situ ground conditions. Temperature profile 2334 from cable PGGT-16 in borehole OP-01 was used as the starting point for the thermal analyses.

The average permafrost ground temperatures range from -4°C to -5°C at depths of approximately 15 m below the ground surface.

4.4 Climatic Data Input for Thermal Modelling

Thermal analyses require climatic data input consisting of average monthly air temperature, wind speed, snow cover, and solar radiation. Table summarizes the mean climatic data used in the thermal analysis.

Average Monthly Air Temperature

The average measured monthly air temperatures from September 1993 to June 2008 were taken from a previous Tetra Tech EBA report focused on the thermal impacts of filling Beartooth Pit at Ekati (EBA, 2009).

Wind Speed and Snow Cover

Monthly wind speed and depth of snow cover at Ekati was interpolated from monthly data from Fort Reliance and Contwoyto Lake/Lupin for the climate normal period of 1961 to 1990 (EBA 2006). Fort Reliance is located approximately 220 km south of Ekati and Contwoyto Lake/Lupin is situated approximately 100 km north of Ekati.

Solar Radiation

Daily solar radiation values were used from Baker Lake as it has a similar latitude, located approximately 700 km east of Ekati, for the climate normal period of 1951 to 1980 (Environment Canada, 1982).

Table 3: Mean Climatic Conditions Used in Thermal Analyses

Month	Monthly Air Temperature (°C)	Estimated Monthly Wind Speed (km/h)	Estimated Monthly Snow Cover (m)	Daily Solar Radiation (W/m^2)
January	-28.2	18	0.39	9.1
February	-27.2	12	0.47	38.7
March	-23.5	13	0.54	119.5
April	-13.9	14	0.56	206.4
May	-4.0	15	0.38	259.7
June	7.8	14	0	252.0
July	13.3	15	0	226.4
August	10.0	17	0	160.8
September	3.4	21	0	124.9
October	-6.8	19	0.07	41.3
November	-18.3	16	0.19	14.4
December	-23.9	15	0.31	3.7

4.5 Climate Change Projection

Global warming was integrated into the model to help predict long-term thermal effects. Environment Canada's 2009 report from Adaptation and Impacts Research Section (AIRS) (Environment Canada 2009) reviewed the most recent modelling assessment for the Arctic. An ensemble approach (multi-model means/medians) was adopted by AIRS to reduce the uncertainty associated with any individual model. Model validation over the historical period from 1971 to 2000 was first used to identify those models which best reproduced the mean annual temperature of this period against the National Centre for Environmental Prediction global gridded dataset. Subsequently, only the four best-agreement models were used to produce the final ensemble projections. The four best-ranking models within each sector were then used as an ensemble to produce projections of temperature changes in the 2020s, 2050s, and 2080s for both the A1B (balanced emission emphasis), and A2 (high emission) scenarios. CSA (2010) adopted the climate change projections from Environment Canada (Environment Canada, 2009). A moderate A1B greenhouse gas emission scenario was adopted in the thermal analyses, which represents a reasonably conservative case.

Ekati (64°43`N 110°37`W) is located in Arctic Sector C1 as classified in Environment Canada (Environment Canada, 2009) and CSA (CSA, 2010). The predicted mean temperature changes from 1971 to 2000 baseline under the moderate greenhouse gas emission scenario at the Arctic Sector C1 (CSA, 2010) are presented in Table 4. These rates of the predicted temperature change were applied in the thermal analyses.

Table 4: Predicted Seasonal Air Temperature Changes in Arctic Sector C1 (CSA, 2010)

Period	Predicted Seasonal Air Temperature Changes from 1971-2000 Baseline under the Moderate (A1B) Green-house Gas Emission Scenario (°C)			
	Winter	Spring	Summer	Autumn
2011 to 2040	1.9	1	0.8	1.3
2041 to 2070	4.2	2.1	1.8	2.7
2070 to 2100	6.2	2.8	2.4	3.4

5.0 CALIBRATION OF THERMAL ANALYSES

Material properties used in the analyses are presented in Table 5. The index soil properties were estimated from borehole logs and past experience with similar soils. The soil thermal properties were determined indirectly from well-established correlations with published soil index properties (Farouki, 1986; Johnston, 1981).

Table 5: Material Properties Used in Thermal Calibration Analysis for OP-01

Material	Water Content (%)	Bulk Density (Mg/m^3)	Thermal Conductivity (W/m°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m^3)
			Frozen	Unfrozen	Frozen	Unfrozen	
Till, Thawed	8.90	2.29	2.43	1.98	0.84	1.10	62
Till, Ice Rich, Frozen	37.70	1.84	2.53	1.28	1.10	1.67	166
Till, Frozen	10.25	2.33	2.23	1.85	0.86	1.05	67
Bedrock	1.00	2.54	3.00	3.00	0.75	0.77	8

The geothermal gradient was assumed to be approximately 1.52°C /100 m (EBA, 2009).

Table 6 compares predicted ground temperatures from the 1D thermal model with actual data. There is good agreement between predicted and measured temperatures, suggesting that the input parameters and model are reasonable for this application.

Table 6: Measured and Predicted Ground Temperatures

Depth below Ground Surface (m)	Measured (°C)	Predicted (°C)
-1.7	-1.8	-2.8
-3.4	-5.4	-6.0
-5.1	-6.8	-6.7
-6.8	-6.9	-6.2
-13.7	-4.8	-4.6
-15.4	-4.6	-4.6
-25.6	-4.6	-4.8
-34.1	-4.9	-4.9
-42.7	-5.1	-5.0

6.0 THERMAL EVALUATION OF TILL COVER DESIGN

6.1 General

Thermal analyses aimed to investigate the influence of till overburden on the potential unfrozen zones within the cover and pile. Modelling considered the progressive dumping schedule and the long-term climate change influence. Both 1D and 2D models were conducted for the simulations.

The thermal model elevation was controlled by the XPAC extraction schedule provided by DDEC (Figure 4). These elevations were modelled in daily increments from July 2014 to June 2019. The cover material placement was assumed to occur over two weeks in October 2019.

Two scenarios were considered for thermal analyses. A base case consisting of a 5 m clean granite waste rock cap was analyzed for reference purposes. The second scenario (case 1) considered a total cover thickness of 4 m, consisting of 3 m of overburden till overlain by 1 m of clean waste rock. This scenario was intended to reduce the requirement for clean granite while containing the active layer within the cover material. The two cases are presented in Table 7. The initial temperature of the waste rock material was assumed to be 5°C.

Table 7: Cases of Cover Design

Case Name	Composition	
	Overburden Till	Clean Waste Rock
Base Case	0 m	5 m
Case 1	3 m	1 m

6.2 Material Properties

The soil profile used for calibration was adopted for the cover design thermal evaluation. The material properties used are summarized in Table 8.

Table 8: Material Properties Used in the Cover Design Thermal Evaluation

Material	Water Content (%)	Bulk Density (Mg/m³)	Thermal Conductivity (W/m°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Clean Waste Rock	2.00	2.04	1.07	1.27	0.76	0.80	13
Overburden Till	8.00	2.16	1.87	1.72	0.83	0.99	53
Waste Rock	2.00	2.04	1.07	1.27	0.76	0.80	13
Till, Thawed	8.90	2.29	2.43	1.98	0.84	1.10	62
Till, Ice Rich, Frozen	37.70	1.84	2.53	1.28	1.10	1.67	166
Till, Frozen	10.25	2.33	2.23	1.85	0.86	1.05	67
Bedrock	1.00	2.54	3.00	3.00	0.75	0.77	8

6.3 Internal Heat Generation

The total heat generated by the oxidation of sulphide within the waste rock impoundment was calculated based on a waste rock total volume of 8,106,582 m^3. The waste rock within the impoundment is approximately 95.8% of mixed metasediment and 4.2% of diabase based on the current mine plan, with specific gravities of 1.91 and 2.10, respectively. These specific gravities were developed to account for material bulking and resulting porosity in the waste rock pile. Acid-Base Accounting (ABA) results of the waste rock yielded a mean sulphur content of 0.052% in the mixed metasediment and 0.05% in the diabase material. Assuming that all sulphur is present as sulphide within pyrite, the following reaction is widely accepted as the general oxidation reaction of sulphide and yields 2.19×10^4 kJ per kg sulphur:

$$FeS_2 + 3.5\ O_2 + H_2O = Fe^2+ + 2\ SO_4^2- + 2\ H$$

For the purposes of this calculation, it has been assumed that all sulfur within the waste rock is reactive. This is a conservative approximation since sulphur within the interior of the rock rarely reacts in non-acid generating systems. Based on this assumption, the mixed metasediment material would generate 2.08×10^4 kJ/m^3, and the diabase would generate 966 kJ/m^3, yielding a total heat generation of 2.18×10^4 kJ/m^3 in the waste rock blend. Assuming the sulphur oxidation is completed within 40 weeks (which is a typical timeframe in non-acid generating systems), the average rate of heat generation is estimated to be 0.900 J/(m^3·sec).

The thermal model conservatively assumed sulphur oxidation over 40 weeks with an average heat generation of 0.900 J/(m^3·sec).

6.4 Results and Discussion of the Thermal Modelling

6.4.1 Maximum Depth of Active Layer

Both 1D and 2D thermal analyses were completed to compare the maximum active layer cover thickness under mean air temperature conditions (Figure 5) and A1B climate change scenarios of 50 years and 100 years (Figures 6 and 7, respectively). The results are presented in Table 9.

Table 9: Summary of Results in Thermal Analyses

	Maximum Thickness of Active Layer (m) (no internal heat)		Maximum Thickness of Active Layer (m) (with internal heat)	
Air Temperature Condition	**Base Case**	**Case 1**	**Base Case**	**Case 1**
Mean Air	3.2	2.4	3.3	2.4
Mean Air + Climate Change at 50 years	3.8	3.0	4.2	3.0
Mean Air + Climate Change at 100 years	4.6	3.6	5.0	3.6

Models that contained internal heat generation due to sulphur oxidation within the waste rock pile were found to have almost the same active layer thickness as those without internal heat. This means the active layer thickness may not see significant influence from the possible internal heat generation due to sulphur.

6.4.2 Unfrozen Zones Within the Pile

The thermal model predicts the creation of unfrozen zones within the Pigeon WRSA. These zones are created when the waste rock placement rate exceeds the rate of permafrost aggradation. Similar zones have been observed in practice at Ekati WRSAs (EBA, 2006).

Figures 8 and 9 show the modelled 0°C isotherm history, with and without internal heat. The unfrozen zones are visible in both figures. The required time to freeze the waste rock pile differs in these scenarios. The scenario without internal heat generation takes approximately 8 years, while the scenario with internal heat takes approximately 12 years.

7.0 PIGEON WASTE ROCK PILE STABILITY EVALUATION

7.1 Analyses Methodology

Limit equilibrium stability analyses were carried out to evaluate the stability of the Pigeon waste rock pile using a commercial computer program, SLOPE/W, GeoStudio 2007, Version 7.19 (Geo Slope International). The Morgenstern-Price method with a half-sine interslice force assumption was adopted in the analyses. The analyses were conducted to evaluate the waste rock slope stability during the stage-construction and under long-term post-construction conditions. Potential post-construction seismic loading was modelled as pseudo-static with a design horizontal peak surface acceleration in the analyses.

The principle underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength in terms of factor of safety; and
- The slip mechanism with the lowest factor of safety is determined through iteration.

A factor of safety is used to account for the uncertainty and variability in the strength and pore water pressure parameters and to limit deformation.

7.2 Cases Evaluated

Various cases were evaluated for the most critical section through the Pigeon waste rock pile, including:

- Waste rock slope stability during stage-construction;
- Waste rock slope stability under post-construction conditions (stepped slopes; both static and seismic); and
- Waste rock slope stability for mine closure reclamation (uniform slope; both static and seismic).

Basic geometry of the Pigeon waste rock pile that was evaluated in the cases for stage-construction and the stage before the closure cover placement consists of the following:

- A total of four lifts (first lift of granite base layer of up to 5 m; second lift waste rock of up to 10 m; third lift waste rock of 15 m; and final lift waste rock of 11 m);
- Side slope of 1.33H:1V (37°) for each lift during construction and before final reclamation; and
- Bench widths of 14, 24, and 28 m for the three benches from the bottom to the top, respectively.

For the final closure stability analyses, it was assumed that the closure cover consists of 1 m thick rockfill over 3 m thick contacted till over the final re-sloped surface of the waste rock pile. The final re-sloped waste rock pile for the final mine reclamation would have a uniform side slope of 3.2H:1V before the cover material is placed.

7.3 Soil Profile and Analysis Input Parameters

No geotechnical site investigation was conducted in the Pigeon waste rock storage area for the stability analyses in this study. The foundation soil profile for the stability analyses was developed based on a preliminary air photo interpretation and ground conditions in the nearby areas (Pigeon Pit and Long Lake area) at Ekati. The profile consisted of a layer of 2 m of unfrozen till or lakebed sediment (below the Big Reynolds Pond), a layer of 2 m of ice-rich till and a layer of 6 m of ice-poor till overlying bedrock. This profile is generally conservative for the stability evaluation since a continuous layer of ice-rich till was assumed. No shear strength tests were conducted for any of the soils in this study; therefore, most of the soil input parameters for the analyses were estimated or assumed based on published data in the literature for similar soils and past experience. Table 10 presents the key soil parameters adopted in the stability analyses.

Table 10: Key Soil Parameters for Stability Analyses

Soil Type	Cohesion (kPa)	Internal Angel of Friction (°)	Excess Pore Pressure Parameter $\overline{B}$ Assumed during Construction	Bulk Unit Weight (kN/m³)
Waste Rock and Granite Base	0	46 for Zone 1 or Newly Placed Lift (within a depth range of 0 to 15 m); 41 for Zone 2 (within a depth range of 15 to 30 m); and 38 for Zone 3 (within a depth range of 30 to 45 m).	0	20
Lakebed Sediment	0	26	0.2	18
Unfrozen Till	0	30	0.2	19
Warm Frozen Ice-Rich Till	80 (long-term)	0	N/A	17
Thawing Ice-Rich Till	0	28	0.2	17
Ice-Poor Till	0	32	0	20
Compacted Till for Cover	0	33	0	19

Potential post-construction seismic loading was modelled as pseudo-static with a design horizontal peak ground acceleration (PGA) of 0.036 *g* in the analyses. This is the value estimated from the 2010 National Building Code of Canada seismic hazard website (http://earthquakescanada.nrcan.gc.ca) for a 2% in 50 years probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the Ekati area.

7.4 Stability Analysis Results

Table 11 summarizes the stability analysis results. Selected stability analyses are illustrated in Figures 10 to 15.

Table 11: Summary of Selected Stability Analysis Results

Conditions	Minimum Calculated Factor of Safety	Comments
Stage Construction	1.47 (Stage 1 or Stage 2) ; 1.40 (Stage 3)	Figure 10; considering potential excess pore water pressure generated in unfrozen till and lakebed sediment due to placement of waste rock
Post Construction (Stepped Slopes); Static Loading	1.40	Figure 11; slip surface through warm frozen ice-rich till; higher factors of safety for slip through lakebed sediment or thawing ice-rich till
Post Construction (Stepped Slopes); Seismic Loading	1.21	Same as above; a peak horizontal ground acceleration of 0.036 g
Post Construction with Closure Cover (3.2H:1V Slope); Static Loading	1.38	Figure 12; slip surface through warm frozen ice-rich till; higher factors of safety for slip through lakebed sediment or thawing ice-rich till
	1.91	Figure 13; slip surface through thawing ice-rich till
	2.42	Slip surface through lakebed sediment
	1.24	Figure 14; slip through bottom of till cover; fully saturated till and hydrostatic water on top of the till cover assumed (conservative)
	1.73	Figure 15; slip through bottom of till cover; hydrostatic water at the half depth of the till cover assumed
Post Construction with Closure Cover (3.2H:1V Slope); Seismic Loading with Peak Horizontal Ground Acceleration of 0.036 g	1.13	Slip surface through warm frozen ice-rich till; higher factors of safety for slip through lakebed sediment or thawing ice-rich till
	1.68	Slip surface through thawing ice-rich till
	2.13	Slip surface through lakebed sediment
	1.10	Slip through bottom of till cover; fully saturated till and hydrostatic water on top of the till cover assumed
	1.53	Slip through bottom of till cover; hydrostatic water at the half depth of the till cover assumed

7.5 Design Factor of Safety for Pigeon Waste Rock Pile

To ensure reasonable safety of earthworks, a safety factor is usually introduced in geotechnical stability analyses. The normal factor of safety for earthworks against shearing failure is from 1.3 to 1.5 under long-term static loading conditions (CGS 2006; PAE 1991). Generally, the selection of a design factor of safety for an earth structure depends on the importance of the structure, potential failure consequences, uncertainties involved in design loads and soil parameters (especially shear strength parameters), the additional cost associated with a higher factor of safety, and the risk that the owner of the structure is willing to take.

The proposed Pigeon waste rock pile is situated in an isolated basin away from major infrastructures. Therefore, the consequence of potential slope stability failure is relatively low. In addition, relatively conservative assumptions were adopted in the stability analyses. The following minimum design factors of safety for the waste rock pile are adopted in this study:

- 1.3 for a potential deep-seated slip surface through the overburden soils under static, long-term, normal post-construction conditions;
- 1.2 for a potential failure during stage-construction stages with active monitoring or a shallower slumping failure; and
- 1.1 for a potential failure under a remote design seismic event.

The results in Table 11 indicate that the calculated factors of safety meet or exceed the design criteria.

8.0 CONCLUSIONS

The following conclusions are taken from the geometric and thermal models:

- The Big Reynolds WRSA will accommodate the Pigeon Pit waste rock;
- A 4 m combination of overburden till and clean waste rock may be used to encapsulate the WRSA;
- There is sufficient overburden material to be used in the 4 m encapsulation options;
- The active layer thickness may not be significantly influenced by internal heat generation due to sulphur; and
- The WRSA is estimated to freeze back in eight years without internal heat generation due to sulphur. Adding internal heat generation extends the freeze-back process to 12 years.

9.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Sincerely,
Tetra Tech EBA Inc.

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PERMIT TO PRACTICE
TETRA TECH EBA INC.
Signature
Date APRIL 14, 2014
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

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/tm

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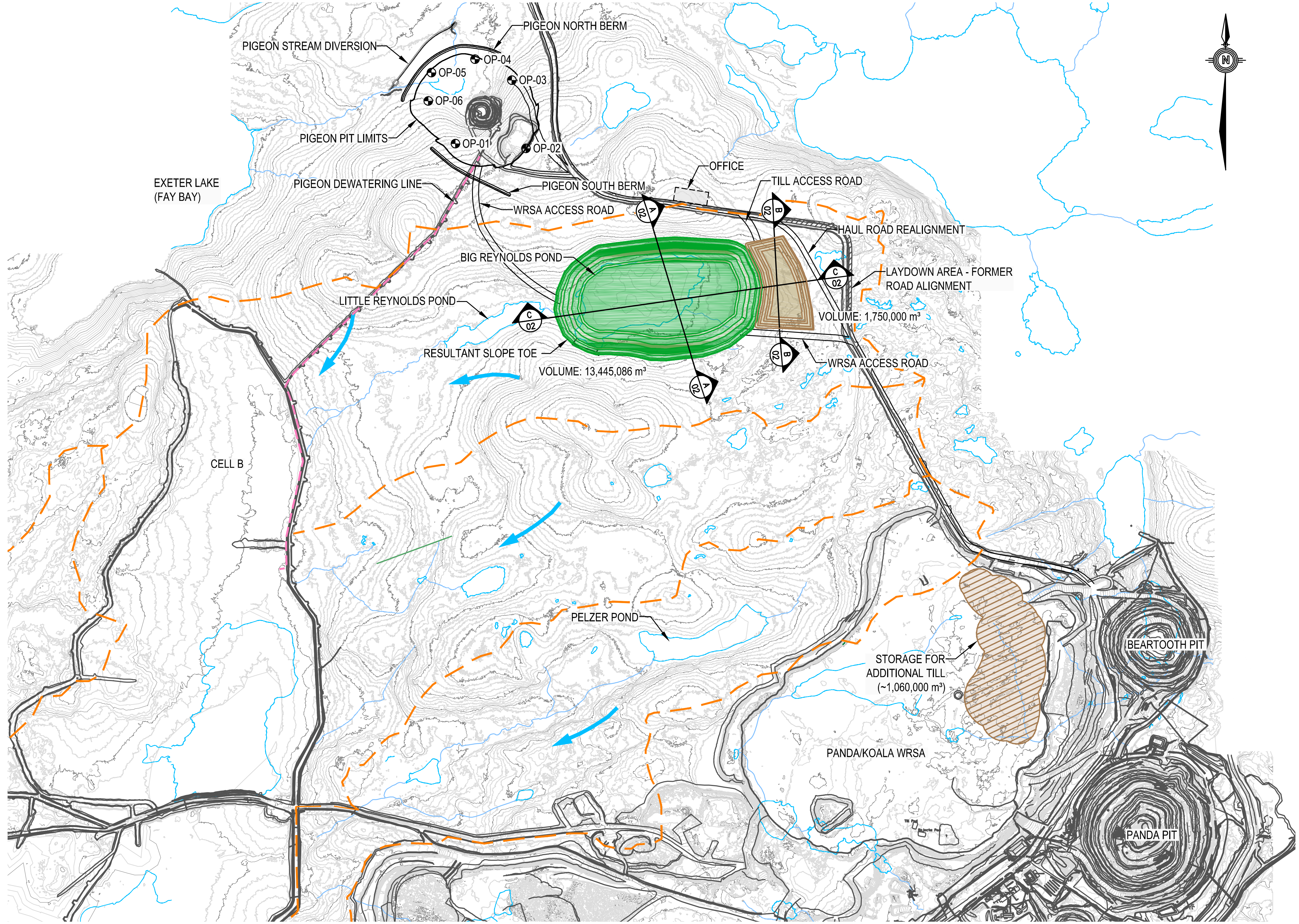
FIGURES



LEGEND:

- CATCHMENT BOUNDARY
- SURFACE FLOW
- PIGEON DEWATERING LINE
- WASTE ROCK STORAGE AREA
- TILL STORAGE AREA FOR WASTE ROCK COVER
- ADDITIONAL TILL STORAGE AREA
- BOREHOLE

0 — 1 000 m

Scale: 1: 20 000

NOTES
CONTOURS BASED ON 2010 LIDAR DATA

STATUS
ISSUED FOR USE

CLIENT
DOMINION DIAMOND CORPORATION

TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE

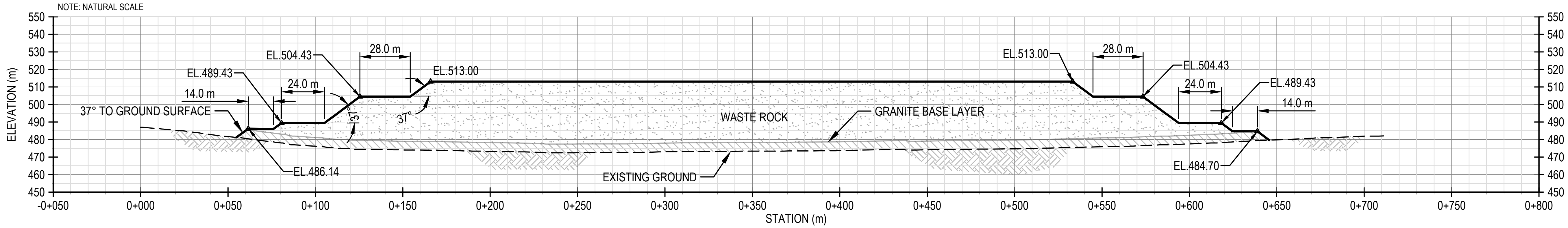
PIGEON WASTE ROCK AND TILL PILE LOCATIONS

PROJECT NO.	DWN	CKD	REV
E14103068-02	EP/DBD	GDK	0

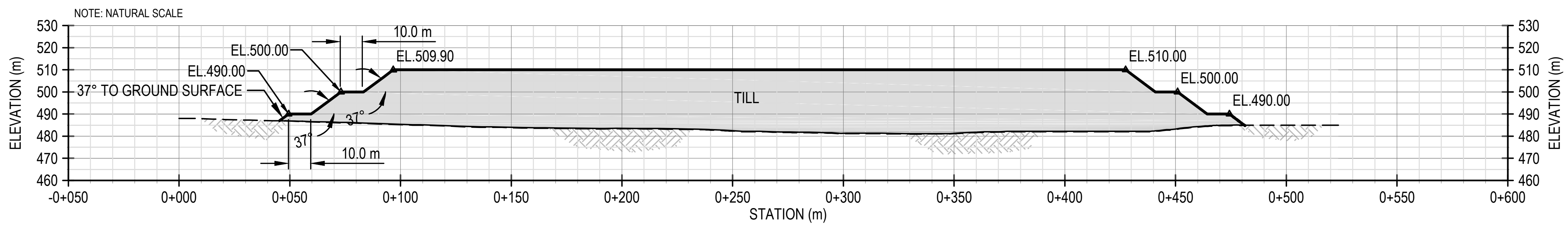
OFFICE	DATE
EDM	March 2014

Figure 1

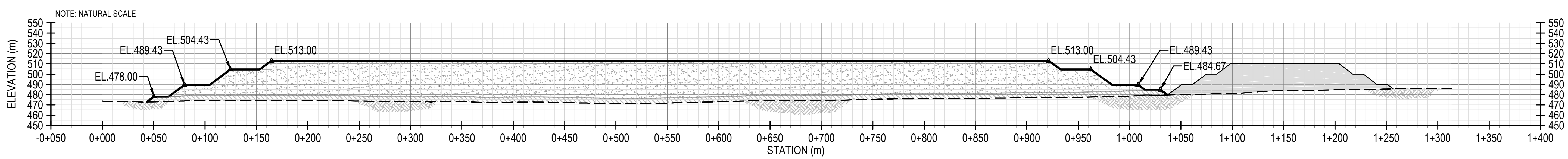
Q:\Edmonton\Engineering\E141\Projects_EKATI\E14103068-01 (Pigeon WRSA)\Project Drawing (2.8,1 slopes) 3.28.2014.dwg [FIGURE 1] April 14, 2014 - 9:44:57 am (BY: PALCZEWSKI, ERNEST)



SECTION - AA



SECTION - BB



SECTION - CC

LEGEND:

- TILL
- WASTE ROCK
- GRANITE BASE LAYER
- ORIGINAL GROUND

STATUS: ISSUED FOR USE

CLIENT: DOMINION DIAMOND CORPORATION

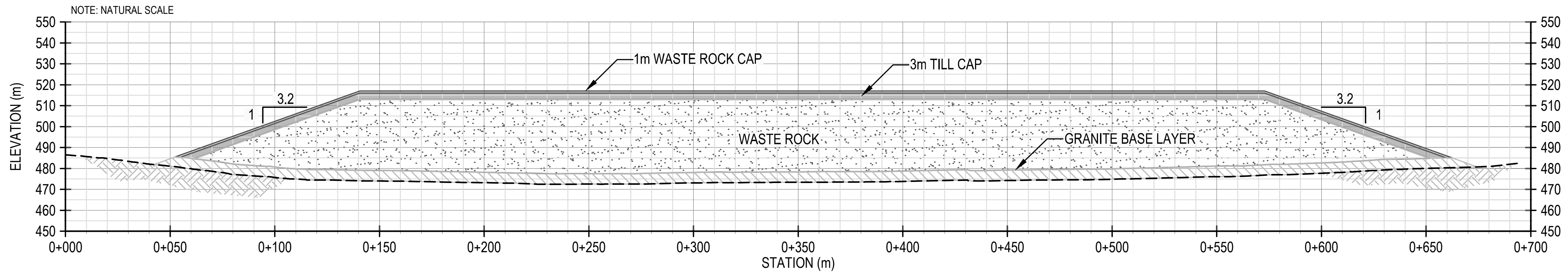
TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE

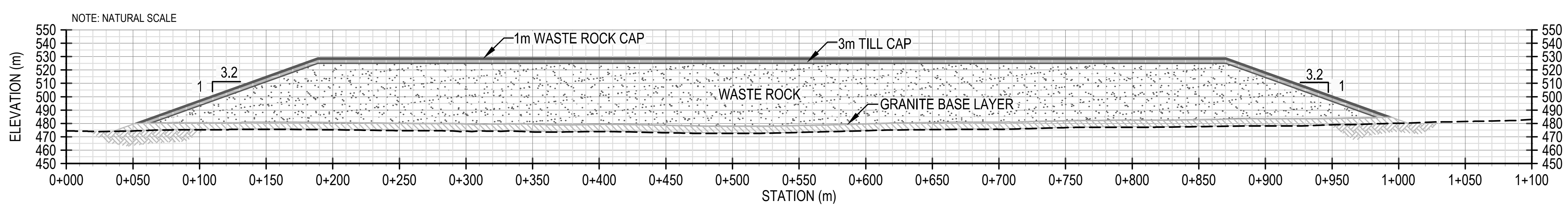
CROSS SECTIONS OF PROPOSED PIGEON WASTE ROCK AND TILL PILE (OPERATION)

PROJECT NO.	DWN	CKD	REV
E14103068-02	EP/DBD	GDK	0
OFFICE	DATE		
EDM	March 2014		

Figure 2



SECTION - AA



SECTION - CC

LEGEND:

- TILL
- WASTE ROCK
- GRANITE BASE LAYER
- ORIGINAL GROUND

STATUS: ISSUED FOR USE

CLIENT: DOMINION DIAMOND CORPORATION

TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE

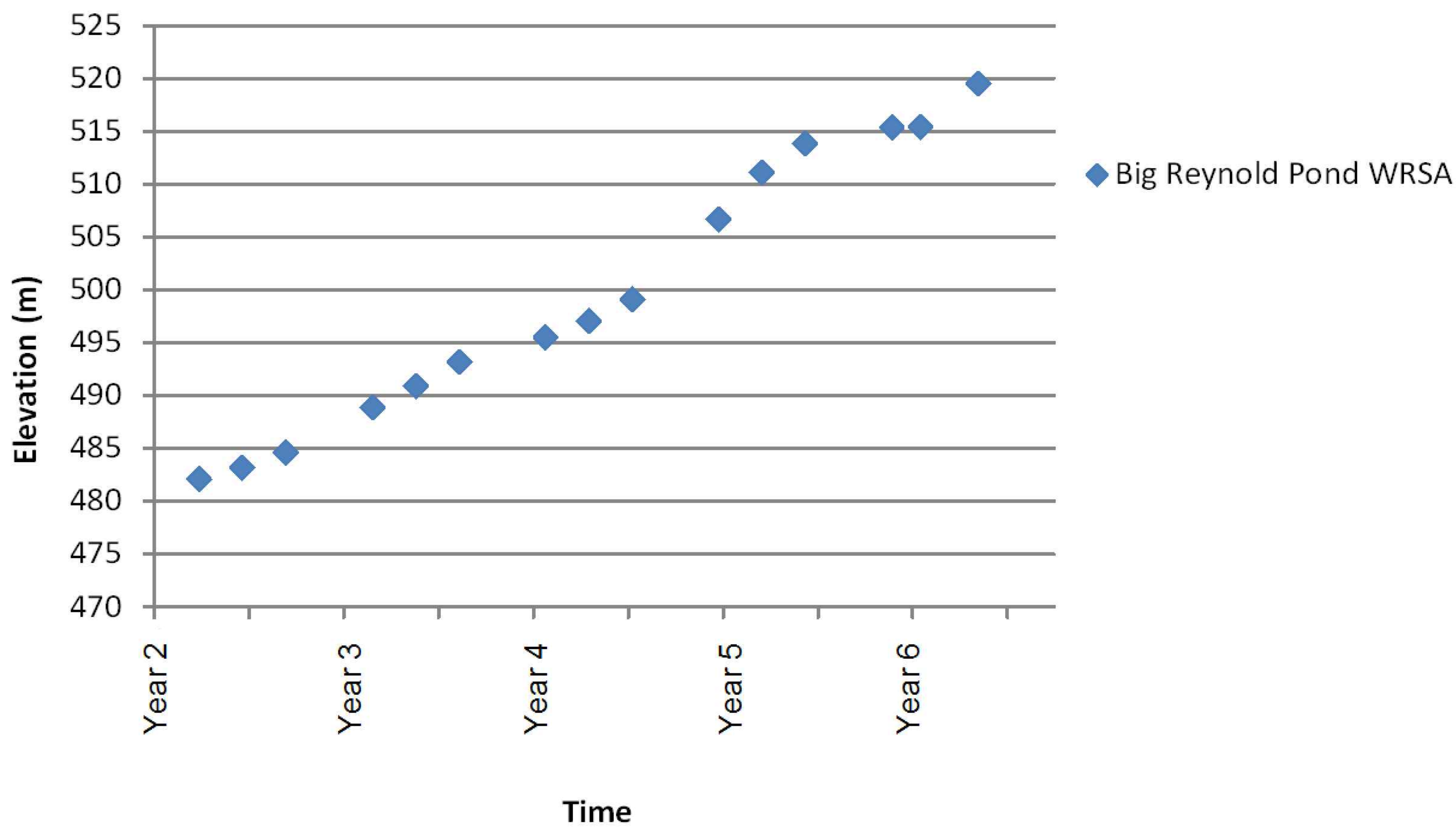
CROSS SECTIONS OF PROPOSED PIGEON WASTE ROCK AND TILL PILE (CLOSURE)

PROJECT NO.	DWN	CKD	REV
E14103068-02	EP/DBD	GDK	0

OFFICE: EDM
DATE: March 2014

Figure 3

Q:\Edmonton\Engineering\E141\Projects_EKATI\E14103068-01 (Pigeon WRSA)\Project Drawing (2.8,1 slopes) 3.28.2014.dwg [FIGURE 3] April 14, 2014 - 9:35:54 am (BY: PALCZEWSKI, ERNEST)



STATUS
ISSUED FOR USE

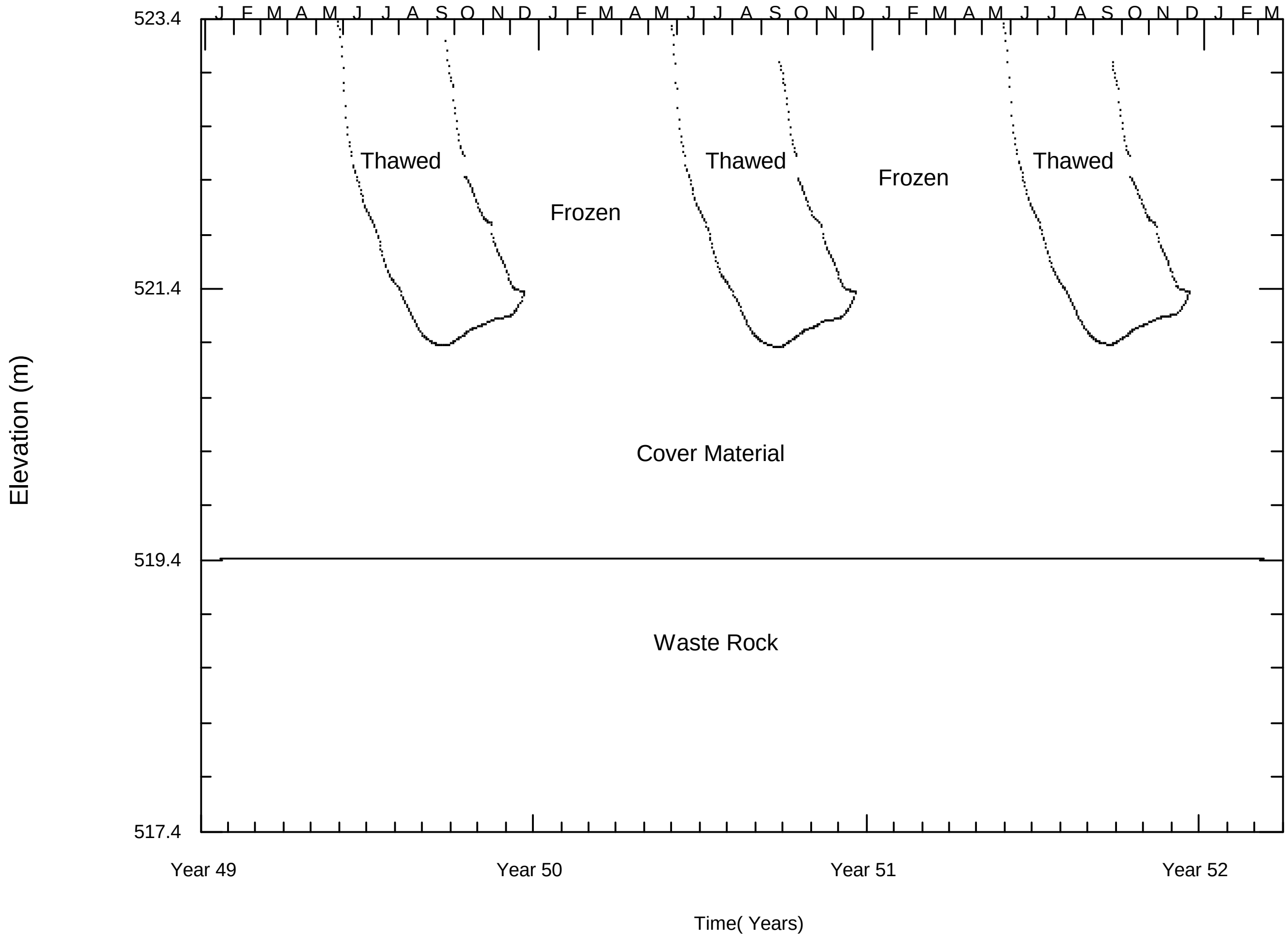
CLIENT
DOMINION DIAMOND CORPORATION

TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE, NT

PROGRESSIVE WASTE ROCK ACCUMULATION FOR THE MODELLED PILE

PROJECT NO.	DWN	CKD	REV	
E14103068-02	EP	RZ	0	**Figure 4**
OFFICE	DATE			
EDM	November 2013			



ASSUMPTIONS

-Cover material contains 3 m till and 1 m clean waste rock and is placed in Winter 2019 (Year 0)

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

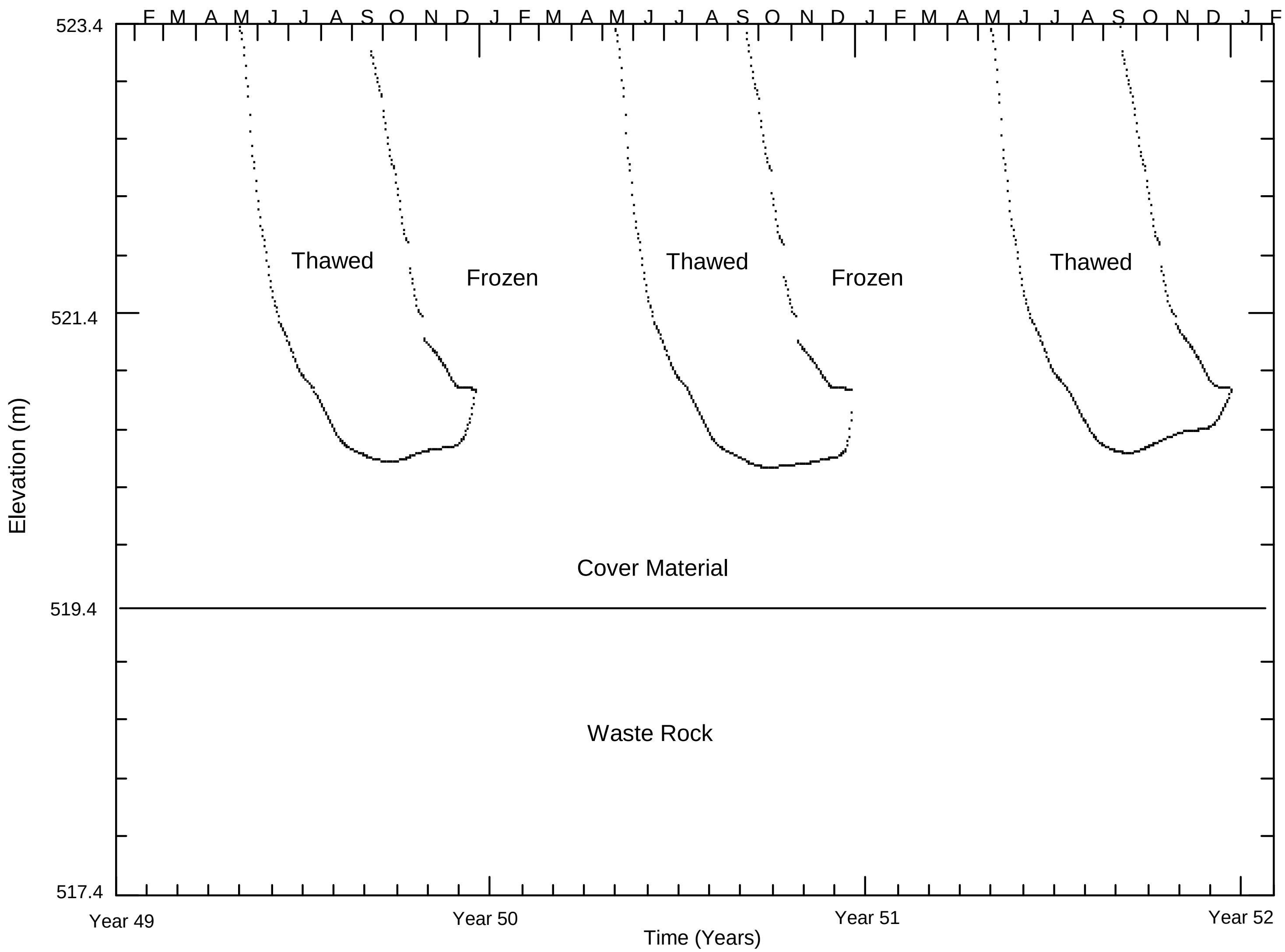
PIGEON WRSA
EKATI DIAMOND MINE, NT

TYPICAL ACTIVE LAYER IN THE COVER ASSUMING MEAN AIR TEMPERATURE AFTER 30 YEARS

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	VL	HX		

OFFICE	DATE
EBA-EDMONTON	JULY 19, 2013

Figure 5



ASSUMPTIONS

-Cover material contains 3 m till and 1 m clean waste rock and is placed in Winter 2019 (Year 0)

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

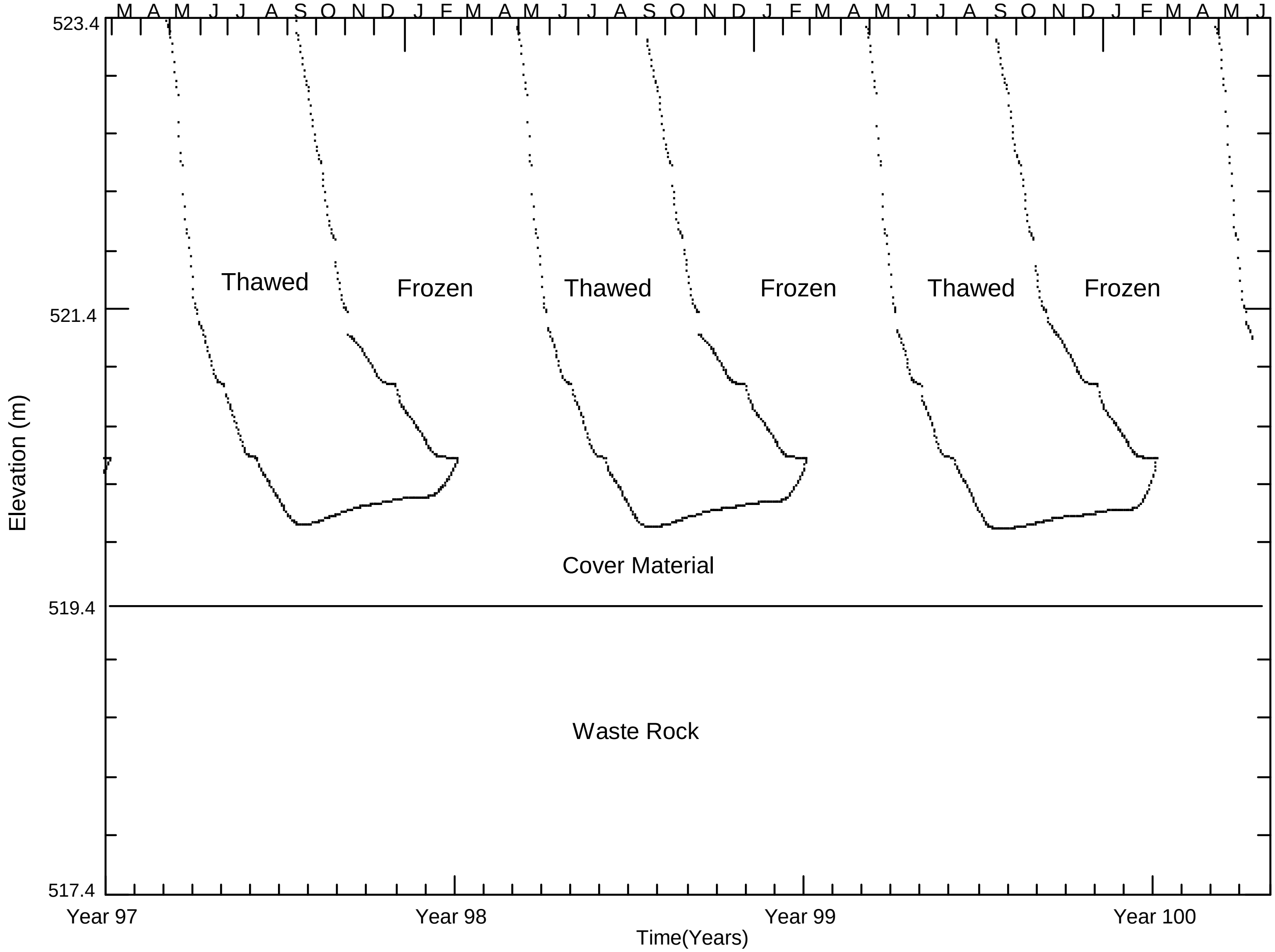
PIGEON WRSA
EKATI DIAMOND MINE, NT

TYPICAL ACTIVE LAYER IN THE COVER ASSUMING MEAN AIR TEMPERATURE PLUS 50 YEARS GLOBAL WARMING

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	VL	HX		

OFFICE	DATE
EBA-EDMONTON	JULY 19, 2013

Figure 6



ASSUMPTIONS

-Cover material contains 3 m till and 1 m clean waste rock and is placed in Winter 2019 (Year 0)

STATUS
ISSUED FOR USE

CLIENT
DOMINION DIAMOND

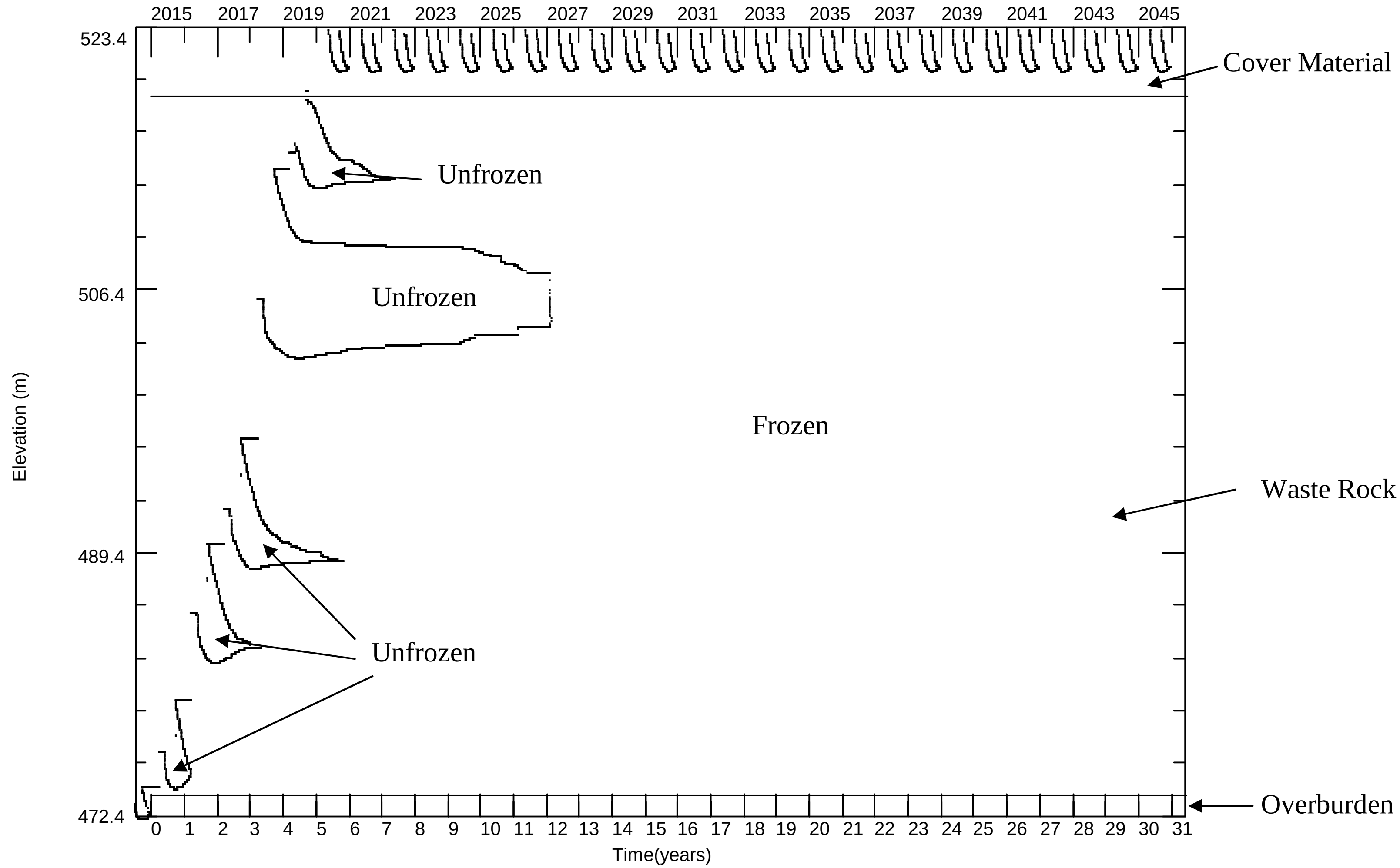
TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE, NT

TYPICAL ACTIVE LAYER IN THE COVER ASSUMING MEAN AIR TEMPERATURE PLUS 100 YEARS GLOBAL WARMING

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	VL	HX		
OFFICE	DATE			
EBA-EDMONTON	JULY 19, 2013			

Figure 7



ASSUMPTIONS

-Cover material contains 3 m till and 1 m clean waste rock and is placed in Winter 2019

STATUS

ISSUED FOR USE

CLIENT

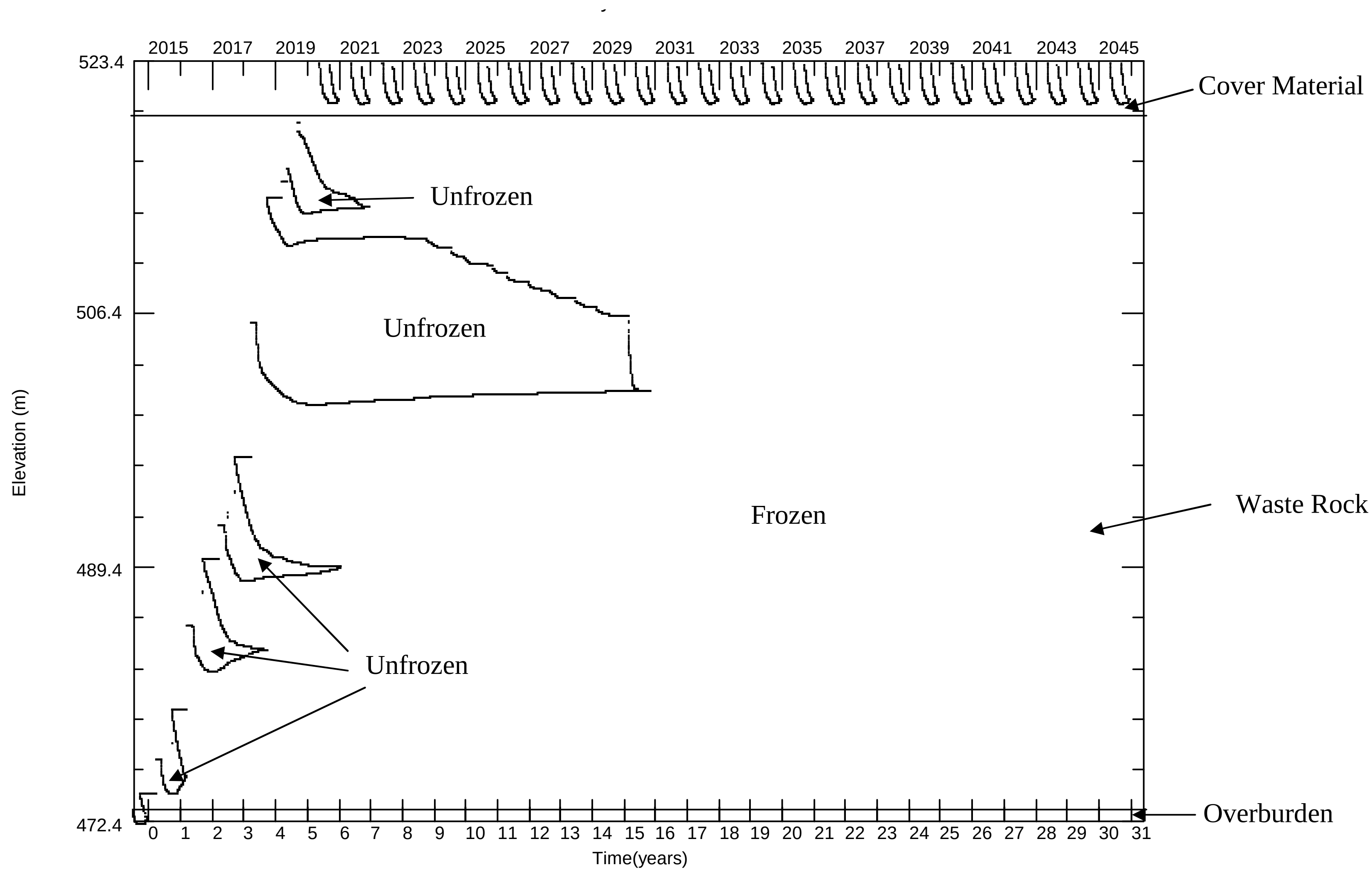
DOMINION DIAMOND

TETRA TECH EBA

PIGEON WRSA
EKATI DIAMOND MINE, NT

TYPICAL 0°C ISOTHERM HISTORY WITHOUT INTERNAL HEAT GENERATION DUE TO SULPHUR

PROJECT NO.	DWN	CKD	APVD	REV	
E14103068-02	VL	HX			**Figure 8**
OFFICE	DATE				
EBA-EDMONTON	JULY 19, 2013				



ASSUMPTIONS

-Cover material contains 3 m till and 1 m clean waste rock and is placed in Winter 2019

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

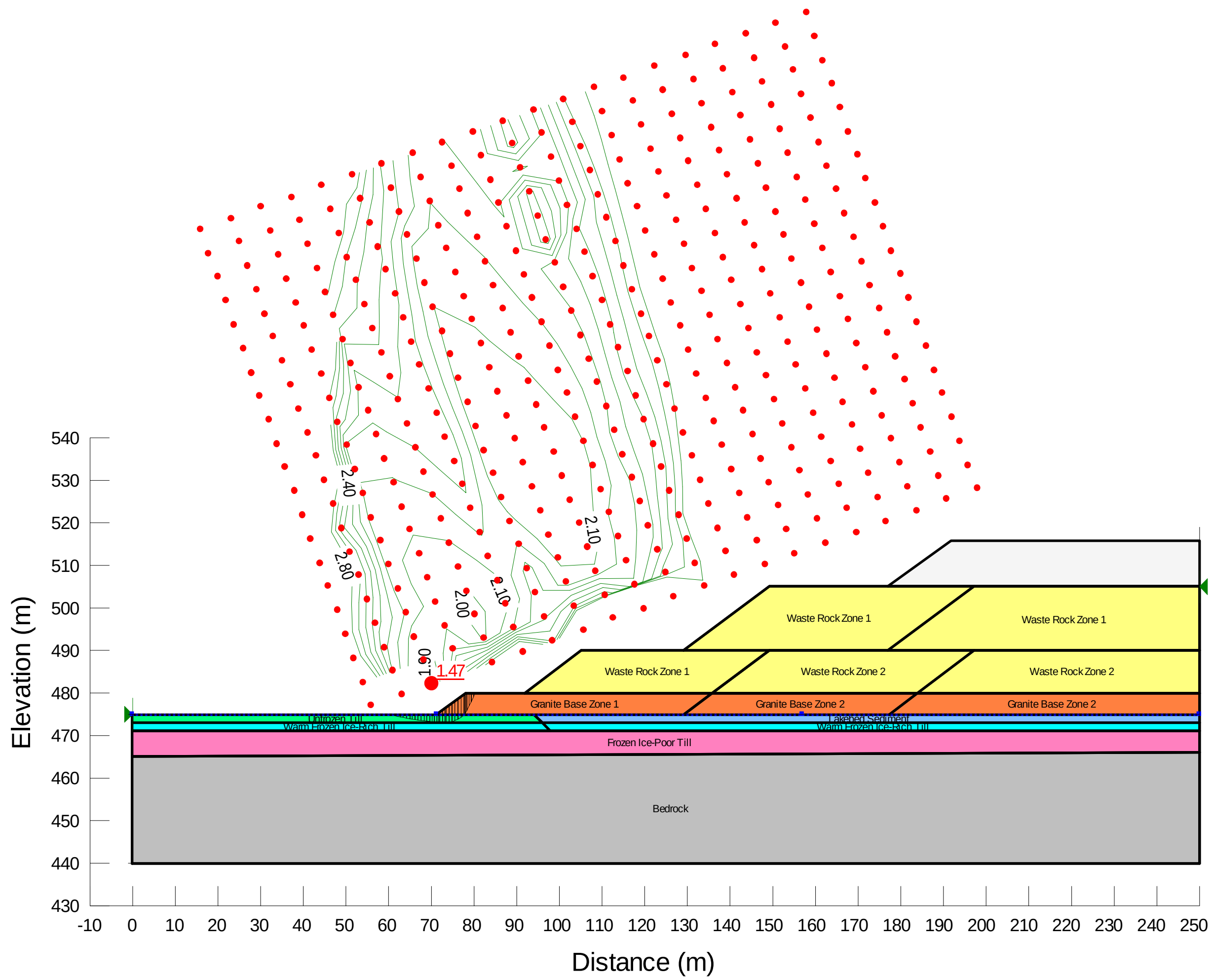
PIGEON WRSA
EKATI DIAMOND MINE, NT

TYPICAL 0°C ISOTHERM HISTORY WITH INTERNAL HEAT GENERATION DUE TO SULPHUR

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	VL	HX		

OFFICE	DATE
EBA-EDMONTON	JULY 19, 2013

Figure 9



ASSUMPTIONS

1) Static loading with considering potential excess pore water pressure generated in unfrozen till and lakebed sediment due to placement of waste rock and granite base layers

2) Warm frozen ice-rich till assumed below the unfrozen till and lakebed sediment

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

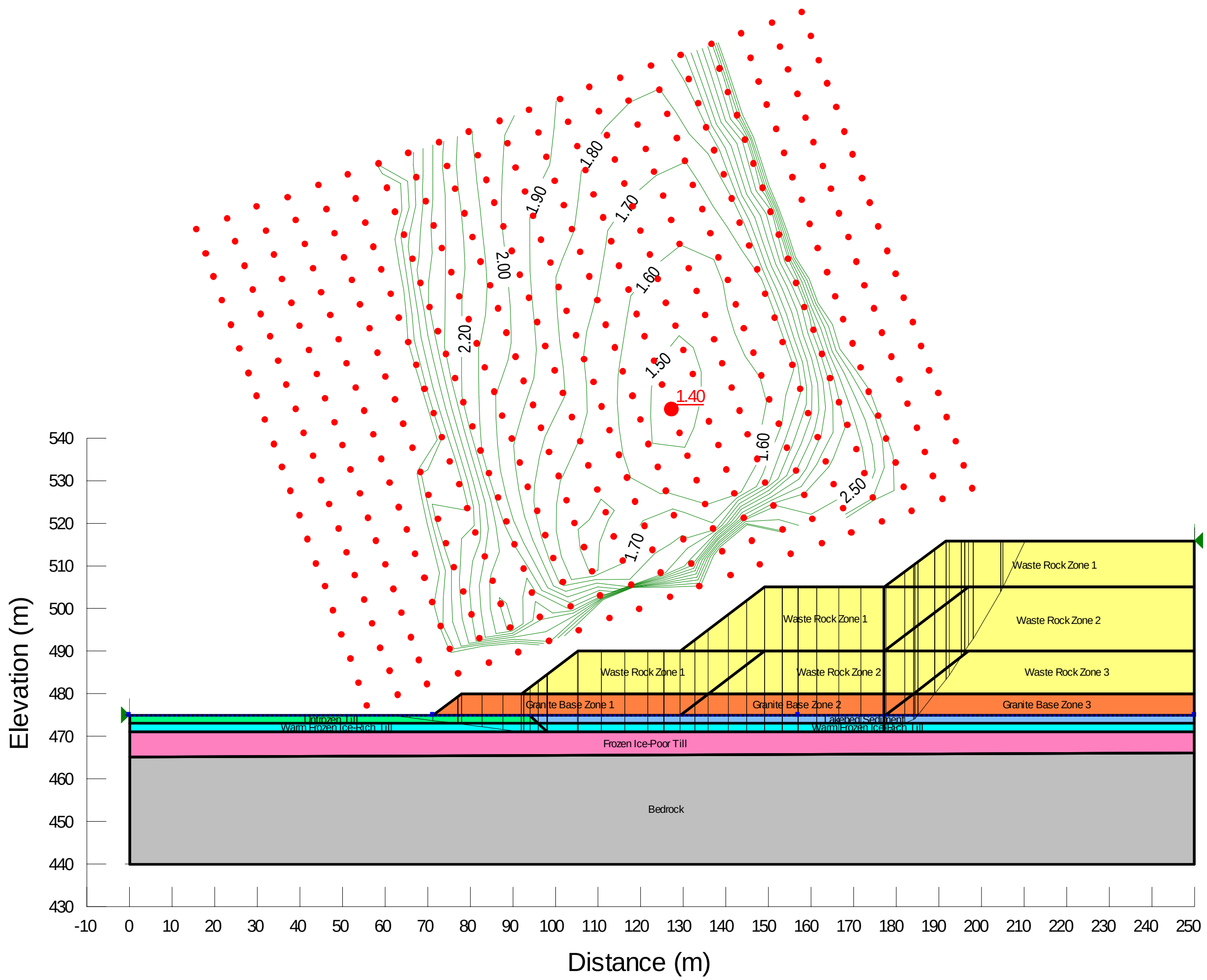
PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Stage Construction, Static Loading

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 10



ASSUMPTIONS

1) Static loading during post-construction stage before final closure
2) Warm frozen ice-rich till assumed below the unfrozen till and lakebed sediment

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

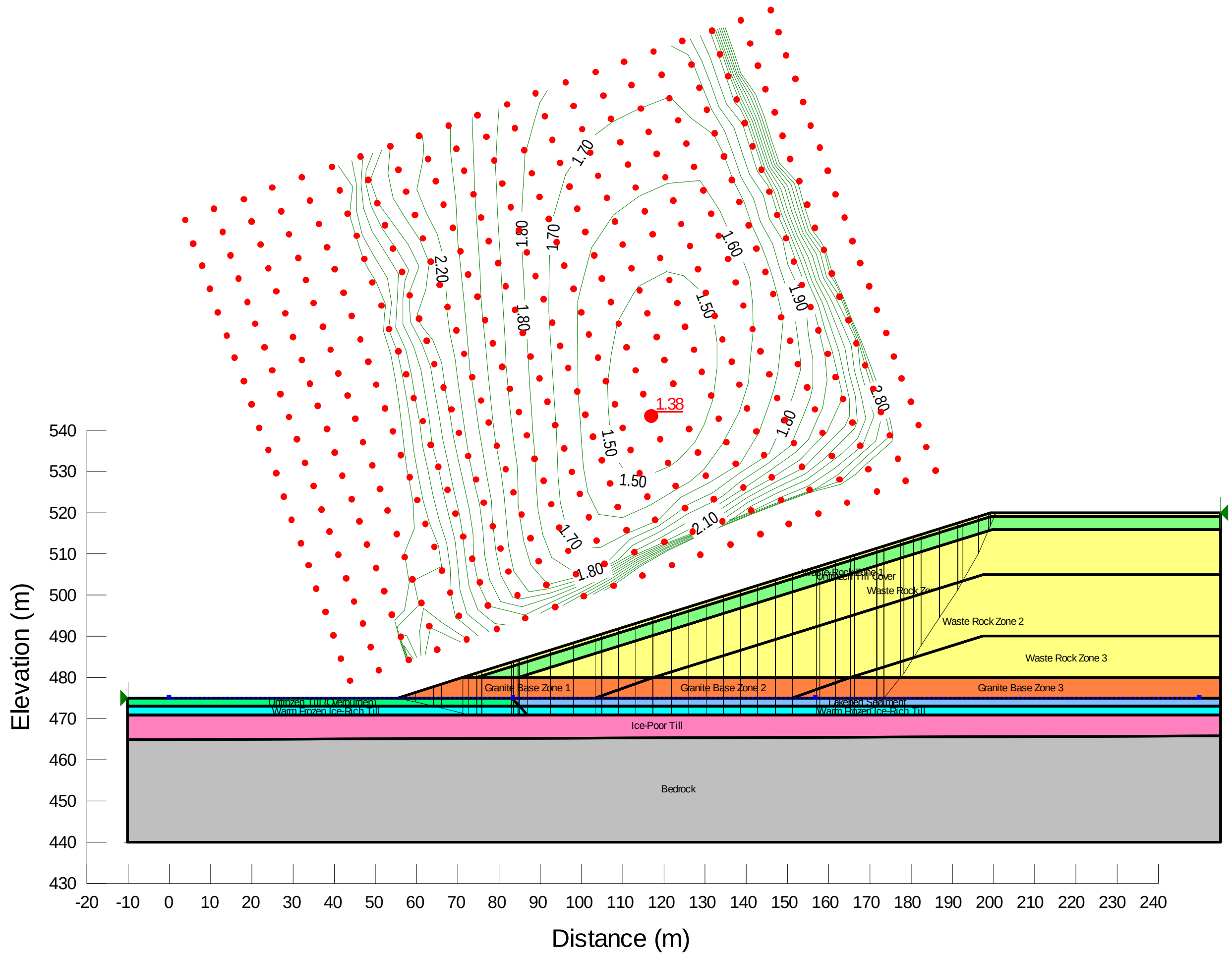
PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Before Closure, Static Loading

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 11



ASSUMPTIONS

1) Long-term static loading after final closure
2) Warm frozen ice-rich till assumed below the unfrozen till and lakebed sediment

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

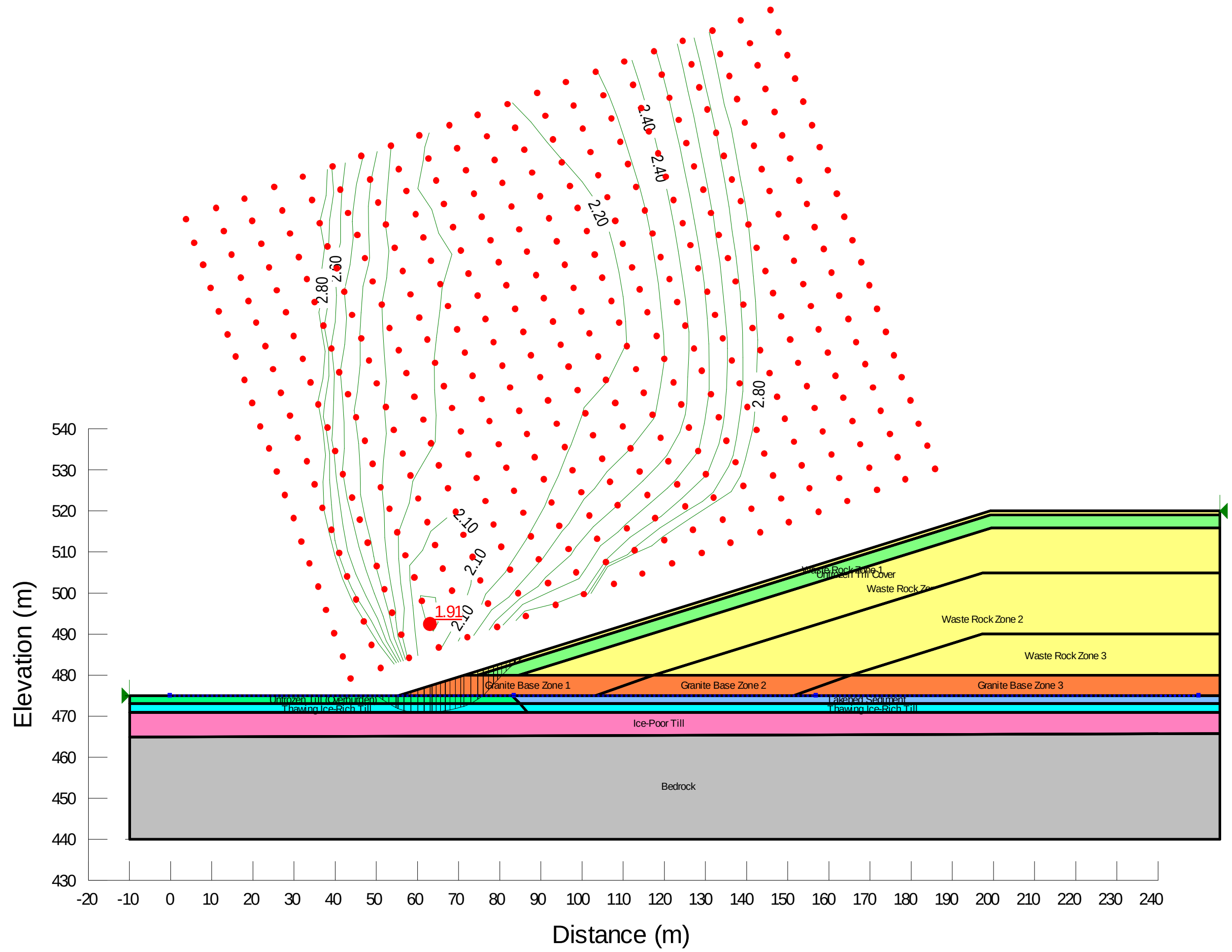
PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Final Closure, Slip through Warm Frozen Ice-Rich Till

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 12



ASSUMPTIONS

1) Long-term static loading after final closure
2) Thawing ice-rich till assumed below the unfrozen till and lakebed sediment

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

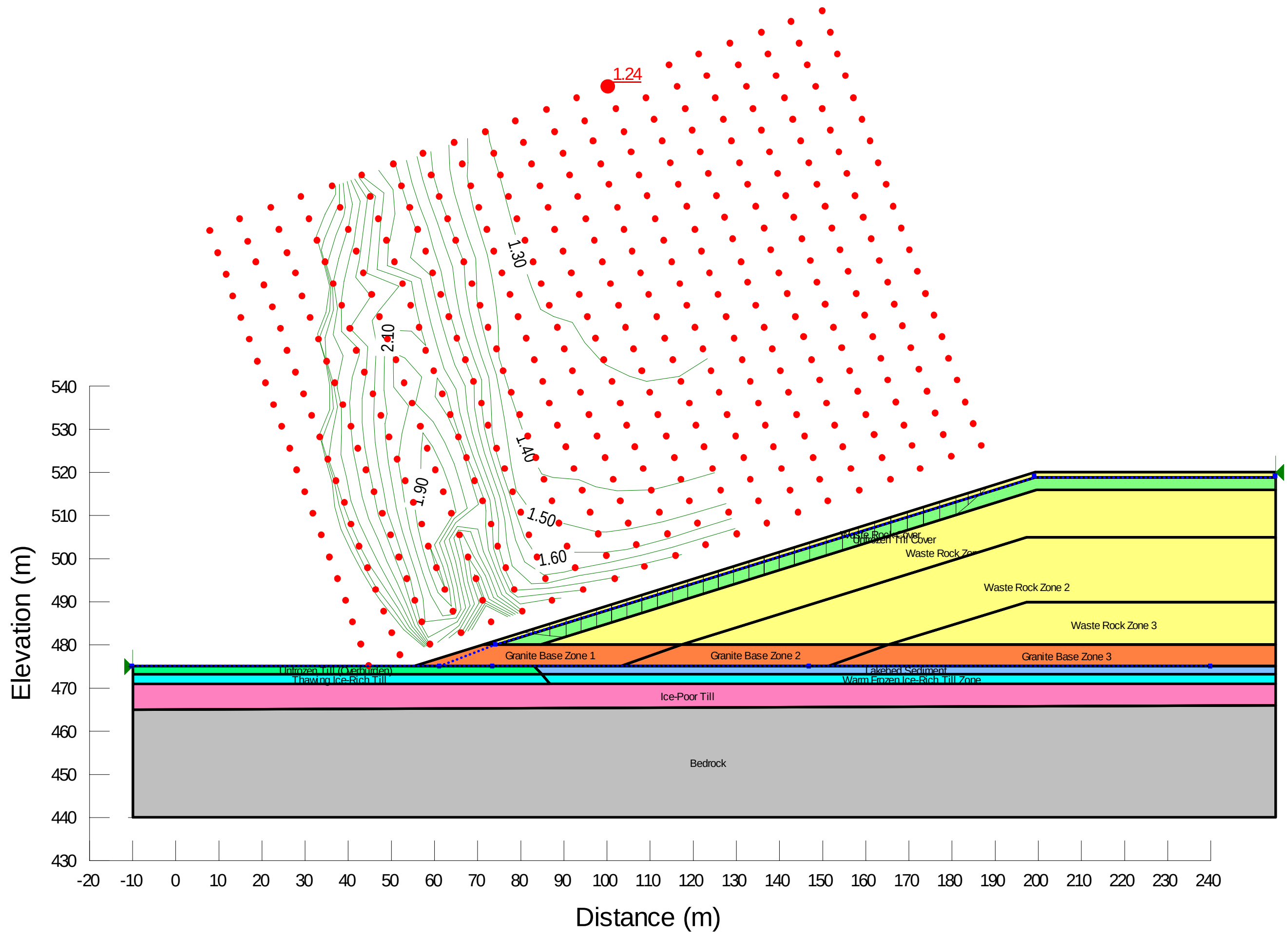
PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Final Closure, Slip through Thawing Ice-Rich Till

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 13



ASSUMPTIONS

1) Long-term static loading after final closure

2) Fully saturated conditions assumed for till cover; hydrostatic water on top of till cover for the till cover layer

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

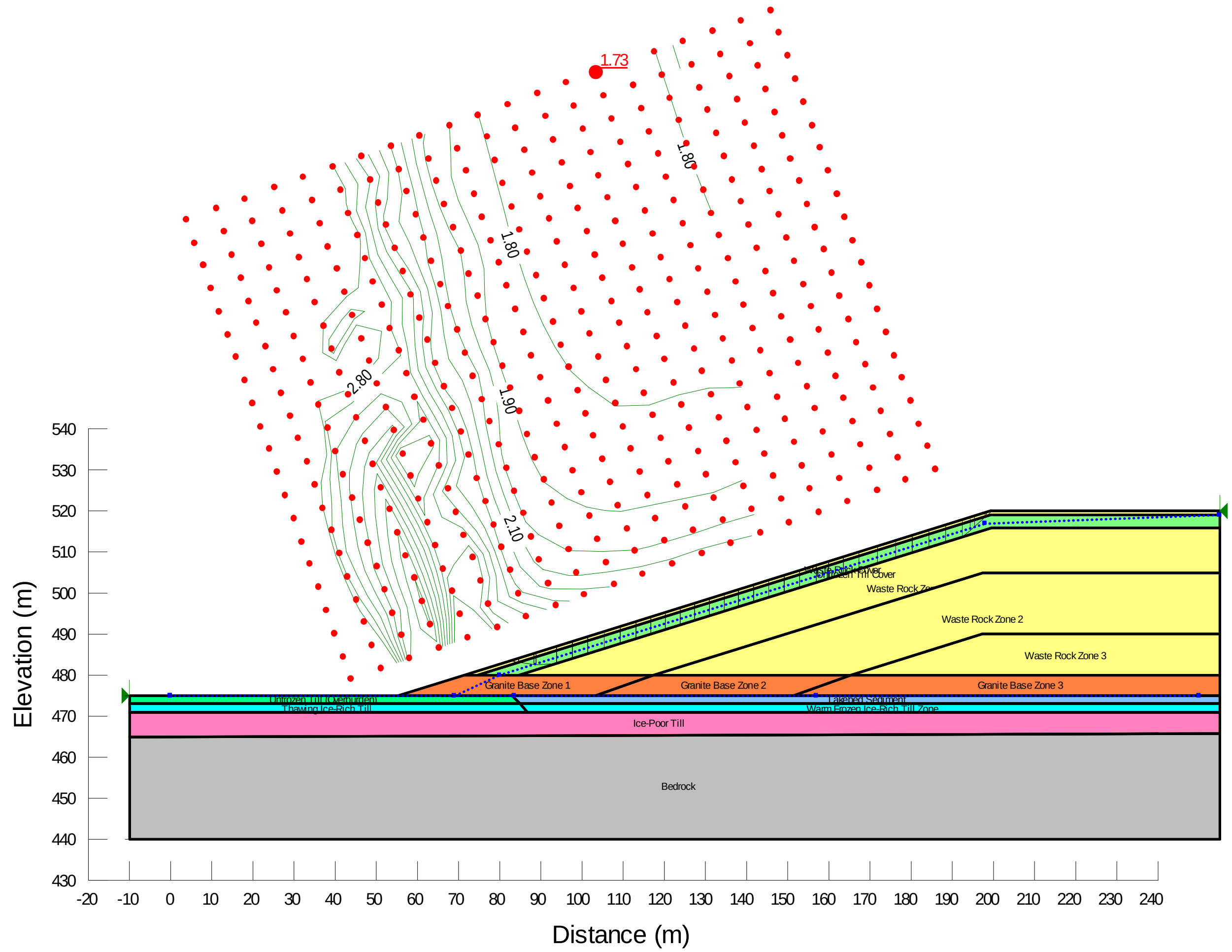
PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Slip through Till Cover, Fully Saturated Till Cover

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 14



ASSUMPTIONS

1) Long-term static loading after final closure

2) Fully saturated conditions assumed for the bottom half of the till cover; hydrostatic water in the middle depth of till cover for the till cover layer

STATUS

ISSUED FOR USE

CLIENT

DOMINION DIAMOND

TETRA TECH EBA

PIGEON PIT WASTE ROCK STORAGE AREA DESIGN, EKATI DIAMOND MINE, NT

Stability Analysis – Slip through Till Cover, Bottom Half Till Cover Fully Saturated

PROJECT NO.	DWN	CKD	APVD	REV
E14103068-02	GZ	GZ		

OFFICE	DATE
EBA-EDMONTON	March 27, 2014

Figure 15

APPENDIX A

TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

Appendix D: 2013 Summary of Ground Temperature Conditions in Waste Rock Storage Area

Ekati Diamond Mine, NT

Tetratech EBA, March 2014

TETRA TECH EBA

March 26, 2014

ISSUED FOR USE
FILE:E14103036-02

Dominion Diamond Ekati Corp.
1102, 4920 – 52 Street
Yellowknife, NT, X1A 3T1

Attention: Andrew Howton, B.Sc.
Environmental Advisor - Operations

Subject: 2013 Summary of Ground Temperature Conditions in Waste Rock Storage Area
EKATI Diamond Mine, NT

1.0 INTRODUCTION

1.1 General

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by Dominion Diamond Ekati Corp. (DDEC) to review the 2013 ground temperature data and provide a summary of the ground temperature conditions within the waste rock storage areas (WRSAs) at the EKATI Diamond Mine (EKATI), NT.

Tetra Tech EBA typically measures ground temperatures in the WRSAs a minimum of four times annually, using ground temperature cables (GTCs) installed at various locations. The locations and current operating status of the GTCs are shown in Figures 1 through 3, and summarized in Table 1 (in Tables Section).

Ground temperature data is presented in Figures 4 through 27. This data is presented in two formats:

- Profiles showing ground temperature versus depth; and
- Plots displaying ground temperature versus time for selected depths within the WRSAs and toe berms. These Figures are denoted by the suffix “a” in the Figure number.

Typically, only ground temperatures from the spring and late fall have been plotted on these figures. This allows for easier interpretation of cooling or warming trends as these are usually the times of the year when ground temperatures are at their coolest (spring) or warmest (late fall).

1.2 Climate Condition

As part of the ground temperature summary, historical monthly air temperatures at EKATI were reviewed to assist with interpreting the measured waste rock temperatures. Air temperatures do not exclusively influence ground temperatures (other factors such as snow cover, wind speed, and solar radiation also play a role); however, they do provide some help in understanding the currently observed temperature change and future trends.

Historical air temperature data at EKATI is available from September 1993 to present; however, significant portions of the data set prior to 2002 are incomplete and were not included as part of this analysis. Table 2 (in Tables section) summarizes the historical air temperatures and calculated freezing index at EKATI. The freezing index provides a measure of how cold a winter is, and allows for relative comparison between years (higher

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values indicate colder winter temperatures or longer season duration). It is determined by summing the mean daily temperatures for those days when air temperatures are below 0°C.

The data shows that the winter of 2009/2010 was considerably warmer than the previous two winters, although slightly above the temperatures observed in the winter of 2005/2006 (the 2005/2006 winter was particularly warm with a reduced winter road season due to elevated temperatures). The winter temperatures of 2010/2011 show a cooling compared to the winter of 2009/2010, and the winter temperatures of 2011/2012 showing a slight warming compared to the winter of 2010/2011. The most recent winter temperatures (2012/2013) show a cooling compared to the winter of 2011/2012, and are the coldest temperatures measured over the past four years.

2.0 GROUND TEMPERATURE DATA

2.1 Panda/Koala WRSA and Toe Berms

Ten GTCs were installed in the Panda/Koala WRSA and adjacent toe berms as shown in Figure 1 and summarized in Table 1. Ground temperature data for this WRSA is presented in Figures 4 through 8, while the toe berm data is presented in Figures 9 through 13. Spring GTC data in 2013 was not available for GTC 1534. However, sufficient data exists for several observations to be made concerning ground temperatures.

2.1.1 Panda/Koala WRSA

Ground temperature data from the Panda/Koala WRSA (GTCs 1534, 1377, 1378, 1379, and 1380) shows that the waste rock pile continues to be in a permafrost condition, with the exception of the seasonal active layer. Temperature conditions in the Panda/Koala WRSA are summarized in Table 3 and discussed below.

Table 3: Panda/Koala WRSA Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature in WR (°C)	Fall 2013 Temperature in WR (°C)	Fall 2013 Temperature at Original Ground (°C)	Figures
1377	3.8	-6.2 to -14.5	0 to -6.7	-5.0	6 & 6a
1378	2.2	-7.9 to -15.0	0 to -11.7	-11.6	4 & 4a
1379	< 2.0	-10.1 to -18.1	-0.7 to -11.6	-11.0	5 & 5a
1380	2.2	-9.5 to -18.9	0 to -11.1	-10.7	7 & 7a
1534	N/A[a]	N/A[a]	(0 to -3.8)[a]	-3.8[a]	8 & 8a

Note: WR refers to Waste Rock
[a] Ground temperature cable malfunction suspected

With the exception of GTC 1534, the measured active layer thickness ranges from approximately 2 to 4 m, consistent with observations from previous years. Ground temperature data from GTC 1534 suggests that there is a deeper active layer at this location; however, readings from this GTC are suspect as discussed below. Ground temperatures around the perimeter of the WRSA (Figures 4 through 7) range from -5°C to -11°C at the pile base which is well below typical permafrost temperatures observed at EKATI (typically around -3°C to -5°C). Temperatures around the perimeter of the WRSA are significantly colder than near the centre of the pile (Figure 8). These cooler temperatures are thought to be the result of convective cooling cells developing around the WRSA perimeter, which provides enhanced cooling for the pile.

Figures 4a through 7a show a general warming trend at the base of the WRSA up to approximately 2010, possibly as a function of reduced convective cell efficiency with time. In recent years a slight cooling has been observed in basal temperatures, possibly as a result of colder winters or changes to the cover conditions. It should be noted that the basal temperatures in the Panda WRSA are still well below typical permafrost temperatures at EKATI. It is expected that the ground temperatures are trending towards typical ground temperatures and not indicative of thaw in the piles.

The spring 2013 measured data at GTC 1378 and 1377 (Figure 4 and 6) shows an overall cooling of ground temperatures in the upper 20 m of the pile when compared to the 2012 data, with temperatures approximately 0.1 to 2.4°C cooler than previous measurements. Fall temperature measurements also show a general decrease in the ground temperature of up to 1.4°C.

Ground temperatures in GTC 1380 (Figure 7) show a similar cooling behavior compared to 2012 measurements with a maximum decrease in temperature of 5.0°C at 12 m. This cooling is expected to be a function of seasonal temperature fluctuations (i.e. colder winter in 2012/2013 at EKATI).

GTC 1379 (Figure 5) is located in a known area of crusher feed excavation (excavation began sometime in 2010). The thermal cover was removed, which disturbed the thermal balance in the area. Fall readings in 2011 were approximately 3°C to 8°C warmer than the measurements taken in 2010. The fall 2012 and 2013 readings show that the ground temperatures are starting to stabilize in response to the new ground conditions; however, the time required for the thermal equilibrium is unknown. Waste rock temperatures at this location continue to be well below typical permafrost temperatures at EKATI.

One cable was installed in the central portion of the pile (GTC 1534, Figure 8). Since 2006, several beads on the cable have malfunctioned and only partial readings were available. In January 2008, the cable was buried during waste deposition. The cable was exposed and subsequent readings have either fluctuated from previous readings or could not be obtained. The most recent readings from July 2013 show a slight warming of up to 0.8°C when compared to the July 2012 readings. The basal temperature is approximately -4°C, consistent with permafrost temperature at EKATI.

The cable will continue to be monitored in subsequent inspections, in an attempt to obtain ground temperature measurements; however, temperature measurements should be interpreted with some caution.

Overall, the Panda WRSA remains in a permafrost condition with many temperatures well below typical permafrost temperatures at EKATI. There are no immediate issues or concerns with thermal conditions in the pile. WRSA GTCs will continue to be read in 2014 to monitor thermal behaviour of the piles and any temperature variations observed in 2013. The ground elevations at the GTC locations should be measured to quantify the amount of cover material which was removed and to update the temperature figures.

2.1.2 Panda/Koala Toe Berm

Ground temperature conditions in the Panda/Koala toe berms are summarized in Table 4 and discussed below.

Table 4: Panda/Koala Toe Berm Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature through Fill Material (°C)	Fall 2013 Temperature through Fill Material (°C)	Fall 2013 Temperature at Original Ground (°C)	Figures
1482	2.3	-8.4 to -11.0	-6.9 to -8.9	-8.9	11 & 11a
1483	3.3	-6.1 to -8.4	-2.0 to -4.1	-5.2	9 & 9a
1484	3.4	-4.5 to -5.3	-3.7 to -4.7	-4.7	10 & 10a
1485	2.2	-9.8 to -11.4	-7.6 to -9.5	-9.4	12 & 12a
1746	2.0	-9.8 to -15.5	-1.3 to -6.0	-6.0	13 & 13a

In 2010, excavation occurred around the northeast portion of the Panda/Koala WRSA, in the vicinity of the Bearclaw and Panda Toe berms, and removed some of the thermal cover over the toe berms. Significant warming of the ground temperatures were observed in 2010 in some of the toe berm GTCs (GTC 1482 and GTC 1485) due to the impact of the construction activities coupled with the warmer winter season in 2009/2010. The 2013 temperature measurements generally show that the grounds at depth are starting to stabilize in response to the new cover conditions.

The review of the ground temperature data for the GTCs installed in the toe berms shows the following:

- The toe berms remain in a permafrost condition with similar active layer depths to those measured in 2012 (generally 2.0 to 3.4 m).
- Spring readings in GTC 1483 and 1484 (Figure 9 and 10) show a cooling of ground temperatures compared with 2012 readings of up to 1.5°C. The 2013 temperature measurements show that the ground at depth is now stabilizing from the crusher feed excavation in 2010.
- Spring readings in GTC 1482 (Figure 11) show a cooling of ground temperatures when compared with 2012 readings with temperatures approximately 0.2°C to 3.3°C cooler than previous measurements. Fall readings show a slight cooling of 0.5°C to 1.0°C when compared to 2012 readings.
- Spring readings in GTC 1485 (Figure 12), similar to GTC 1482, show a general cooling compared to the 2012 readings of 0.7°C to 3.3°C. Fall readings show a slight cooling when compared to the 2012 ground temperatures.
- GTC 1746 (Figure 13), in the Bearclaw toe berm, shows a general cooling when compared to the 2012 measured ground temperatures.

2.2 Fox WRSA and Toe Berms

A total of six GTCs were installed in and around the Fox WRSA and toe berms, with locations provided in Figure 2 and cable conditions summarized in Table 1. Ground temperature data for the waste rock storage area is provided in Figures 14 through 16, while toe berm data is presented in Figures 17 through 19.

2.2.1 Fox WRSA

Ground temperature conditions in the Fox WRSA are summarized in Table 5 and discussed below.

Table 5: Fox WRSA Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature in WR (°C)	Fall 2013 Temperature in WR (°C)	Fall 2013 Temperature at Original Ground (°C)	Figures
1931	4.8	-6.0 to 3.0	-0.9 to 2.9	0.9	14 & 14a
1932	N/A	N/A	0 to 5.3	2.8	15 & 15a
1933	6.0	-7.5 to 4.4	-1.6 to 4.1	-0.3	16 & 16a
Note: WR refers to Waste Rock					

The data set for the ground temperatures in the Fox WRSA is somewhat smaller than data from other WRSA. However, the data does permit some observations to be made. With the exception of an active layer that displays period freezing behaviour; large portions of the waste rock pile continue to be unfrozen. This is likely a function of placing warm (above-freezing) waste rock and/or placing waste rock in above-freezing temperatures. The base of the waste rock pile at GTC 1933 remains frozen, as in previous years.

The 2013 temperatures show slight variations from those observed in 2012. Overall, the temperature fluctuations within the pile appear to be stabilizing. Freeze back of the WRSA is expected; however, the time required for this to occur is unknown. Specific observations are presented as follows:

- GTCs 1932 (Figure 15) and 1933 (Figure 16) show slightly colder temperatures mid-depth when compared with the 2012 measurements. Temperature data in GTC 1931 (Figure 14) shows slightly warmer temperatures mid-depth, which may be a function of heat transfer from the base of the pile.
- For GTC 1933, the original ground elevation remains unfrozen, consistent with observations in the previous year.
- The base of GTC 1931 (Figure 14), located 1.6 m above the original ground, remains in an unf rozen condition, but has progressively cooled since 2007 (from 2.0°C in 2007 to 0.9°C in 2013); however, the rate of cooling has slowed since 2011.
- GTC 1931 shows that the central portion of the pile has warmed slightly from the 2011 measurements, and approximately 1°C from the 2010 temperatures. This may be a function of heat transfer from the pile base.
- The original ground elevation and the base of GTC 1933 (Figure 16) remains in a frozen condition in 2013 as observed in 2012.

2.2.2 Fox Toe Berms

Ground temperature conditions in the Fox toe berms are summarized in Table 6 and discussed below.

Table 6: Fox Toe Berm Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature through lacustrine material (°C)	Fall 2013 Temperature through lacustrine material (°C)	Fall 2013 Temperature at Original Ground (°C)	Figures
1743	1.5	-8.2 to -12.7	-8.7 to -9.0	-7.7	17 & 17a
1744	2.8	-5.8 to -9.0	-4.5 to -6.4	-6.6	18 & 18a
1745	4.0	N/A	-0.6 to -5.6	-5.6	19 & 19a

Ground temperature data has been collected for the Fox toe berms since their construction in 2004. In all cases, the low permeable lacustrine materials remain in a permafrost condition with temperatures ranging from -0.6°C to -12.7°C. A review of the ground temperatures indicates the following:

- The active layer thickness ranges from 1.5 to 4.0 m.
- GTC 1743 (Figure 17) shows a slight warming in ground temperatures when compared to the spring 2012 readings. Fall readings show a cooling with a maximum decrease of 4.9°C at an 8.0 m depth when compared to previous measurements.
- The spring and fall 2013 measured data at GTC 1744 (Figure 18) shows a slight cooling when compared with the 2012 readings.
- Fall readings in GTC 1745 (Figure 19) show a slight cooling of ground temperatures when compared to 2012 readings. Spring GTC data in 2013 was not available for GTC 1745.

2.3 Misery WRSA

GTCs have been installed at six locations in the Misery WRSA, as shown in Figure 3 and summarized in Table 1. GTCs at Misery were installed over several years, from June 2001 to May 2005. Ground temperature data for the WRSA is presented in Figures 20 through 25. Table 7 summarizes the ground temperature conditions in the Misery WRSA. Discussion pertaining to the ground temperatures is provided below.

Table 7: Misery WRSA Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature in WR (°C)	Fall 2013 Temperature in WR (°C)	Fall 2013 Temperature at Pile Base (°C)	Figures
1541 / 1466	13[a]	N/A	N/A	N/A	20 & 20a
1542 / 1467	9.9	-1.0 to -3.3	0 to -3.4	-3.7	21 & 21a
1606	4.3	N/A	0 to -6.1	-5.7	22 & 22a
1772	14.0	-3.7 to -7.0	0 to -5.4	-3.5	24 & 24a
1773	2.5	N/A	0 to -10.0	-8.1	23 & 23a
1774	N/A	N/A	N/A	N/A	25 & 25a

Note: WR refers to Waste Rock
[a] active layer thickness is based on 2007 fall measurements

GTCs 1606 and 1466/1541, located in the central portion of the Misery WRSA, were reported as being damaged in 2008, but GTC 1606 started supplying readings again in July 2009. Readings from 2013 suggest that GTC 1606 is providing accurate readings for the lower 25 m of the pile. Previous readings from the damaged GTC 1466/1541 are included with the figures for reference. Spring and fall GTC data in 2013 was not available for GTC 1774 as the cable was buried under waste rock during waste rock pile expansion.

A review of the ground temperature data from the GTCs installed in the Misery WRSA shows the following:

- The waste rock storage area below the active layer is in a permafrost state.
- The thickness of the active layer remains quite variable in the Misery WRSA, ranging from 2.5 to 14.0 m in 2013.
  - GTC 1772 (Figure 24) has consistently demonstrated the thickest active layer since 2007. The late fall readings in 2013 indicated that the thickness of the active layer is approximately 14.0 m.
  - The active layer thickness in GTC 1542/1467 (Figure 21) is consistent with the 2012 measurements, at approximately 10 m respectively.
  - GTC 1773 (Figure 23) could not be located in spring at the time of measurement readings. The late fall readings in 2013 indicate that the thickness of the active layer can be approximated as 2.5 m. The readings taken in late November show that at the time of the readings the waste rock was already in a frozen condition.
  - The thermistor beads in the upper portion of GTC 1606 (Figure 22) appear to be malfunctioning. As such, the active layer thickness could not be evaluated at this location. Historical measurements indicate the active layer to be in the order of 4 m at this location. This cable was previously damaged and difficulties reading thermistor beads in the central portion of the cable remain.
- The large active layer thicknesses in the Misery WRSA are likely a function of the proximity of some cables to the side slopes and the accumulation of snow, which acts as a thermal blanket reducing heat transfer from the waste rock at some locations.

2.4 Coarse Processed Kimberlite Storage Pile

GTCs 1468 and 1469 were installed in the Coarse Processed Kimberlite Storage Pile (CPKSP). Their locations are shown in Figure 1 and summarized in Table 1. Both cables were installed in the summer of 2001. GTC 1468 was damaged and no data was recorded after the fall of 2005, although the ground temperature condition in the CPKSP continued to be monitored by GTC 1469. Ground temperature data for the CPKSP is presented in Figures 26 and 27 and summarized in Table 8.

Table 8: Coarse PK Storage Pile Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2013 Temperature in CPK Pile (°C)	Fall 2013 Temperature in CPK Pile (°C)	Fall 2013 Temperature at Pile Base (°C)	Figures
1468	3.6[a]	N/A	N/A	N/A	26 & 26a
1469	3.9	0 to -0.3	0 to -0.3	-0.3	27 & 27a
Note: CPK refers to Coarse Processed Kimberlite [a] active layer thickness is based on 2005 fall measurements					

The materials making up the storage pile at the GTC locations are shown on Figures 26 and 27. The thickness of coarse processed kimberlite (CPK) at installation was 6 m and 8.5 m at the locations of GTCs 1468 and 1469, respectively. At the time of GTC installation, the surface of the CPKSP was roughly equal to the ground elevation at the cables. Since that time, considerably more material has been placed on the top of the pile and GTC 1469 is now between 10 m and 15 m below the surrounding CPK.

A review of the ground temperature data from the GTCs installed in the CPKSP shows the following:

- Ground temperatures in the CPKSP continued to stay warm compared to the normal ground temperatures in the native ground at EKATI (typically around -3°C to -5°C). Temperatures were also warmer than those measured in the Panda/Koala WRSA.
- Temperatures in the CPKSP are slightly warmer in the upper 4 m compared with 2009 measured data. Below 4 m, the temperatures remain consistent with those observed in previous years.
- The current temperature of the CPK remains slightly below 0°C. However, the freezing temperature is expected to be somewhat lower because of some salinity in the CPK pore water and the CPK mineralogy. Therefore, the CPK is likely unfrozen.
- The CPK has high moisture content and, as such, contains a large amount of latent heat that must be liberated before freezing will occur. Freezing of the pile is expected; however, it will take a considerable amount of time.

3.0 DISCUSSION AND RECOMMENDATIONS

Ground temperatures within the EKATI WRSAs and toe berms generally show similar temperature trends to those observed last year. It is recommended that ground temperature readings continue to be obtained four times per year, keeping consistent with past practice.

The Panda / Koala WRSA and toe berms remain in a permafrost condition, consistent with previous years. Some fluctuations in ground temperatures were observed in response to the removal of cover material for use as crusher feed. Ground temperatures appear to be stabilizing; however, the time required to achieve thermal equilibrium is unknown. There are no immediate concerns or issues with respect to thermal conditions in the Panda/Koala WRSA and toe berms, but it is recommended that the ground surface around the GTC locations be surveyed to evaluate the quantity of cover material which was removed for crusher feed.

Large portions of the Fox WRSA remain unfrozen, as in previous years. Temperature measurements indicate that ground temperatures are equilibrating and trending towards freezing in GTC 1931 and 1933; however, the time for freeze back is unknown. At GTC 1931 ground temperature measurements indicate some warming in the central portion of the pile (up to 1°C) when compared to the 2011 and 2012 measurements, and a slowing of the rate of cooling at the pile base. The precise reason for this is unknown. GTC 1931 is located in the low grade kimberlite storage area, and the increasing temperature may be a function of seasonal temperature variations, thermal conductivity of the kimberlite material, dark surface conditions or chemical reactions within the pile. The thermal conditions in the Fox WRSA are recognized as a possible issue with respect to long-term waste rock pile performance. In the short term, ground temperature conditions in the Fox WRSA should continue to be monitored in conjunction with WRSA seepage monitoring, and this data used to develop long-term planning for the Fox WRSA. Thermal conditions in the Fox WRSA should continue to be monitored to evaluate pile freeze back.

The Fox toe berms remain in a permafrost condition, consistent with previous years. The active layer is contained within the waste cover and the minimum temperature of the lacustrine core material is -0.6°C. There are no immediate concerns or issues with respect to thermal conditions in the Fox toe berms.

The Misery WRSA remains in a permafrost condition, consistent with previous years. Active layer thicknesses vary significantly within the Misery WRSA as was also observed in previous years. Although not an immediate cause for concern, the variability in active layer thickness (causes and mitigation) should be further evaluated in subsequent studies.

Temperatures in the coarse PK pile show little change from 2010 measurements. Freeze back of the pile is expected; however, the time required for this to occur is unknown. There are no immediate issues or concerns with respect to the ground temperatures in the coarse PK pile.

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Dominion Diamond Ekati Corp. and their agents. Tetra Tech EBA Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Dominion Diamond Ekati Corp., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA Inc.'s Services Agreement. Tetra Tech EBA Inc.'s General Conditions are provided in Appendix A of this report

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Sincerely,
Tetra Tech EBA Inc.

REGISTERED PROFESSIONAL ENGINEER
G.D. KOOP
LICENSEE
March 26
NWT/NU

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/tm

PERMIT TO PRACTICE
TETRA TECH EBA INC.
Signature ____________
Date MARCH, 26, 2014
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

TABLES

Table 1: Ground Temperature Cable Installation Summary

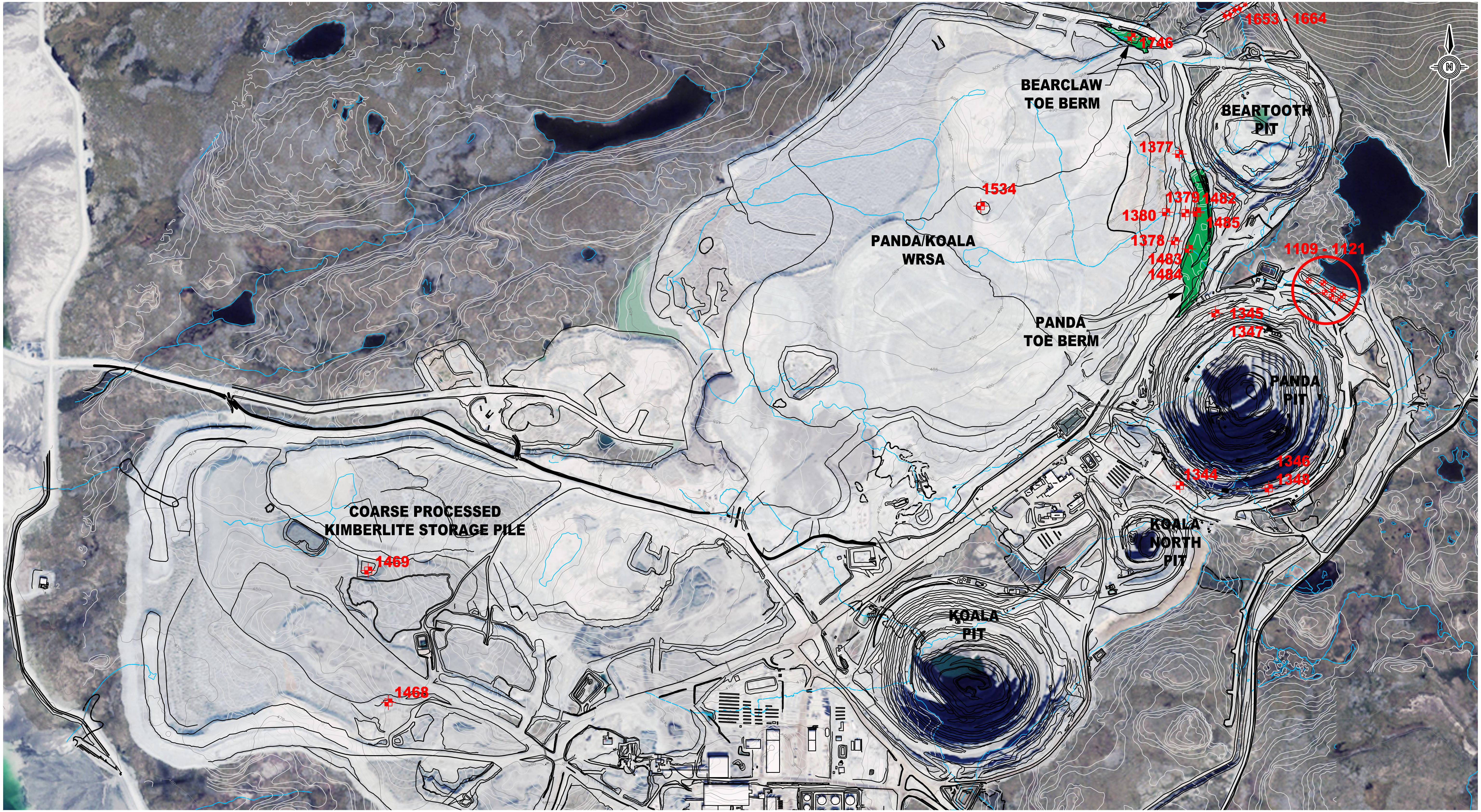
Cable ID	Date Installed	Location	Comments
1378	2000-08-30	Panda/Koala WRSA – Site 1 – 15 m Bench	Installed by BBCI with design input from EBA
1379	2000-08-30	Panda/Koala WRSA – Site 2 – 15 m Bench	Installed by BBCI with design input from EBA
1377	2000-08-30	Panda/Koala WRSA – Site 3 – 15 m Bench	Installed by BBCI with design input from EBA
1380	2000-08-30	Panda/Koala WRSA – Site 4 – 30 m Bench	Installed by BBCI with design input from EBA
1534	2002-02-16	Panda/Koala WRSA – Site 4 – centre of pile	
1482	2002-01-31	Panda Toe Berm	
1483	2002-01-31	Panda Toe Berm	
1484	2002-01-31	Panda Toe Berm	
1485	2002-01-31	Panda Toe Berm	
1468	2001-07-08	CPKSP	Cable destroyed in 2005
1469	2001-07-08	CPKSP	
1746	2004-11-30	Bearclaw Toe Berm	
1931	2006-10-19	Fox Low Grade Kimberlite Dump	Installed by BBCI
1932	2006-10-14	Fox Waste Granite Dump	Installed by BBCI; not found in April 2009
1933	2006-10-23	Fox Waste Kimberlite Dump	Installed by BBCI; not read in warm season in 2008
1743	2004-11-28	Fox Toe Berm – Southeast Valley	
1744	2004-11-28	Fox Toe Berm – 3 Hump Lake Streams	
1745	2004-11-30	Fox Toe Berm – Fox Lake Trail	
WRP#1 – 1466 / 1541	#1466 – 2001-06-05 #1541 – 2002-03-07	Misery WRSA	WRP#1 consists of two cables. Second cable installed to coincide with additional waste rock placement. Cable damage during mining and could not be read.
WRP#2 – 1467 / 1542	#1467 – 2001-06-13 #1542 – 2002-03-06	Misery WRSA	WRP#2 consists of two cables. Second cable installed to coincide with additional waste rock placement
WRP#3 - 1606	2002-06-13	Misery WRSA	Started supplying readings in July 2009
WRP#4 - 1773	2005-04-26	Misery WRSA	
WRP#5 - 1772	2005-04-26	Misery WRSA	
WRP#6 - 1774	2005-04-26	Misery WRSA	Cable buried under waste rock in 2013

Note: BBCI refers to BHP Billiton Canada Inc., now Dominion Diamond Ekati Corp. (DDEC)

Table 2: Summary of Monthly Air Temperature at EKATI Diamond Mine, NT

	Month												Mean (°C)	Freezing Index (°C·day)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.		
2002	-25.9	-28.2	-24.1	-18.9	-7.0	8.5	12.9	9.2	3.4	-8.6	-16.4	-19.2	-9.5	
														4370
2003	-26.5	-31.6	-24.9	-12.3	-3.6	6.6	14.4	11.0	4.4	-3.0	-17.6	-23.5	-8.9	
														4835
2004	-32.8	-27.2	-27.4	-18.1	-10.1	6.1	13.1	7.8	1.8	-9.2	-20.4	-29.7	-12.2	
														4757
2005	-29.9	-28.3	-22.3	-10.2	-7.2	6.4	10.6	9.4	1.0	-5.7	-15.8	-19.3	-9.3	
														3599
2006	-24.7	-22.5	-17.1	-11.5	1.4	11.4	14.2	11.5	4.9	-4.9	-20.0	-18.9	-6.3	
														4279
2007	-24.4	-27.5	-26.5	-12.0	-3.8	6.9	14.2	7.7	-0.1	-5.7	-20.5	-20.6	-9.4	
														4875
2008	-28.6	-30.8	-28.0	-15.5	-2.5	7.4	13.5	10.3	1.1	-4.6	-17.3	-28.7	-10.3	
														4670
2009	-26.7	-26.6	-27.3	-12.8	-8.9	5.8	11.8	9.9	6.0	-8.4	-16.3	-24.3	-9.8	
														3792
2010	-26.3	-21.2	-16.3	-7.0	-6.9	7.6	14.3	11.0	3.5	-4.1	-15.8	-22.5	-7.0	
														4208
2011	-28.6	-25.6	-23.3	-17.9	-0.5	7.7	15.8	12.2	5.8	-3.0	-18.8	-22.8	-8.3	
														4047
2012	-28.5	-21.8	-22.4	-13.8	2.4	11.2	15.2	12.5	7.8	-5.4	-19.9	-28	-7.6	
														4516
2013	-31.6	-26.2	-24.9	-17.7	-3.2	12.3	11.3	12.6	5.4	-2.8	-20.1	-23.1	-9.0	

FIGURES



LEGEND:
- GROUND TEMPERATURE CABLE LOCATION
- TOE BERM LOCATION

0 500
Scale: 1: 12 500 (metres)

NOTES
1. CONTOURS ARE ORIGINAL GROUND CONTOURS PRIOR TO MINE DEVELOPMENT
2. FIGURE BASED ON 2006 SATELLITE IMAGE

STATUS
ISSUED FOR USE

CLIENT
DOMINION DIAMOND
TETRA TECH EBA

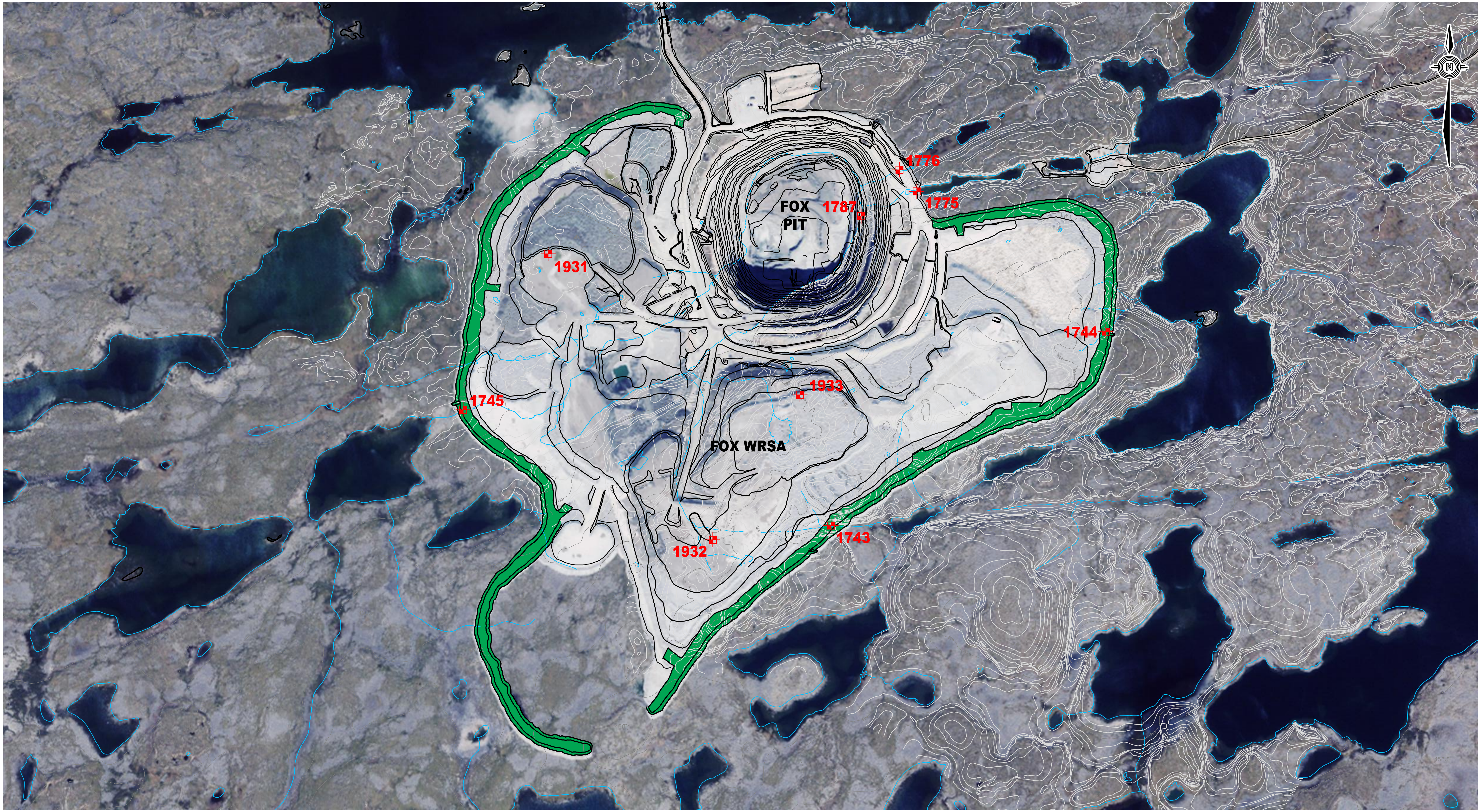
WRSA Ground Temperature Summary
EKATI DIAMOND MINE, NT

PANDA / KOALA WRSA AND CPKSP GROUND TEMPERATURE CABLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
E14103036-02	EL/MM	JS	0
OFFICE	DATE		
EDM	March 5, 2014		

Figure 1

Q:\Edmonton\Drafting\PROJECTS\E141\E14103036-01\AutoCAD\E14103036-02_FIG 1_R0.dwg [FIGURE 1] March 05, 2014 - 12:53:38 pm (BY: RICHMOND, BOB)



LEGEND:

- GROUND TEMPERATURE CABLE LOCATION
- TOE BERM LOCATION

0 50 000

Scale: 1: 100 000 (metres)

NOTES
1. CONTOURS ARE ORIGINAL GROUND CONTOURS PRIOR TO MINE DEVELOPMENT
2. FIGURE BASED ON 2006 SATELLITE IMAGE

STATUS
NOT FOR CONSTRUCTION

CLIENT
DOMINION DIAMOND

TETRA TECH EBA

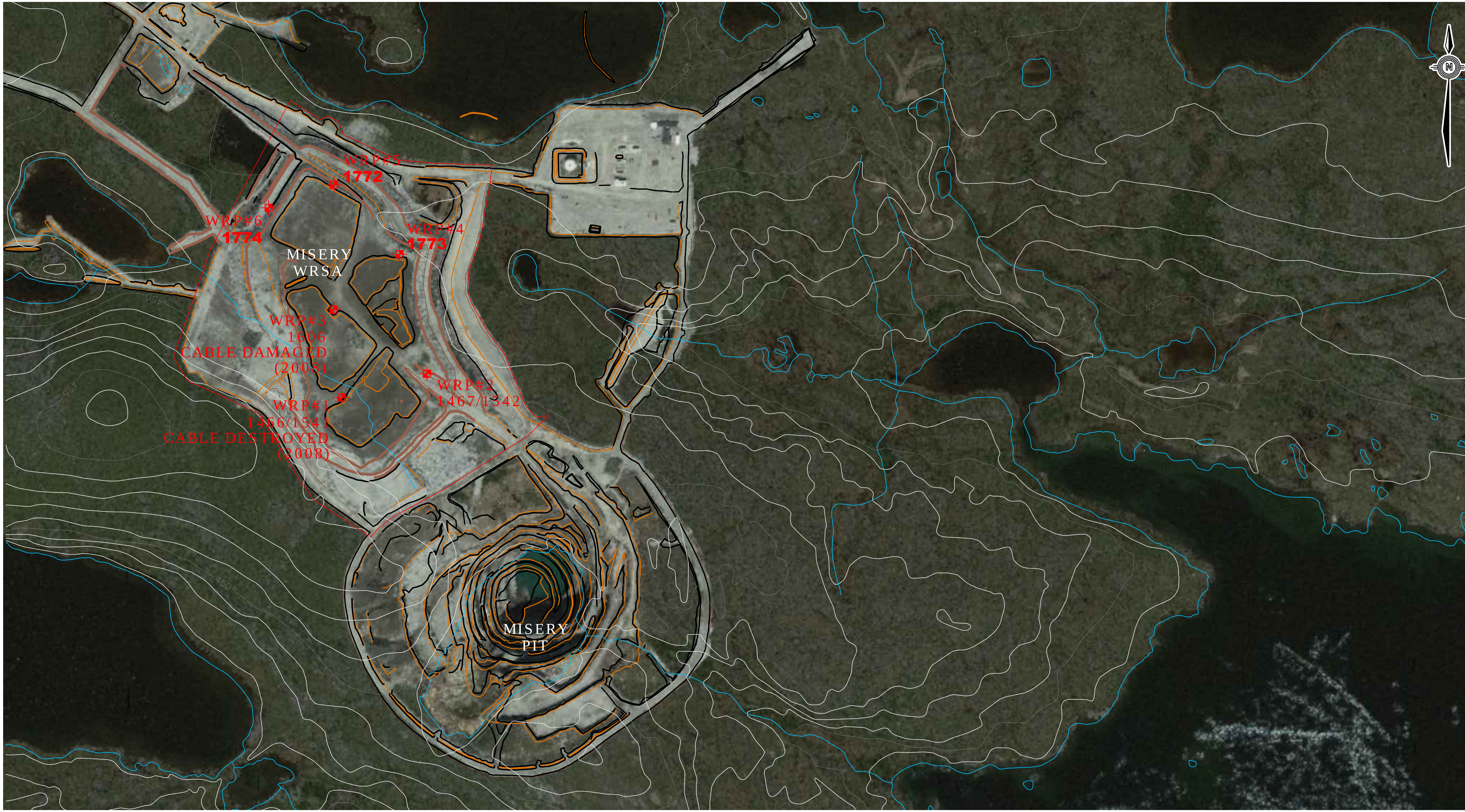
WRSA Ground Temperature Summary
EKATI DIAMOND MINE, NT

FOX WRSA GROUND TEMPERATURE CABLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
E14103036-02	EL / MM	JS	0
OFFICE	DATE		
EDM	March 5, 2014		

Figure 2

Q:\Edmonton\Drafting\PROJECTS\E141\E14103036-01\AutoCAD\E14103036-02_FIG 2_R0.dwg [FIGURE 2] March 05, 2014 - 12:54:46 pm (BY: RICHMOND, BOB)



LEGEND:

- GROUND TEMPERATURE CABLE LOCATION

0 — 500

Scale: 1: 10 000 (metres)

NOTES

1. CONTOURS ARE ORIGINAL GROUND CONTOURS PRIOR TO MINE DEVELOPMENT
2. FIGURE BASED ON 2009 SATELLITE IMAGE

STATUS
NOT FOR CONSTRUCTION

CLIENT
DOMINION DIAMOND

TETRA TECH EBA

WRSA Ground Temperature Summary
EKATI DIAMOND MINE, NT

MISERY WASTE ROCK STORAGE AREA GROUND TEMPERATURE CABLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV	
E14103036-02	EL/MM	JS	0	Figure 3
OFFICE	DATE			
EDM	March 5, 2014			

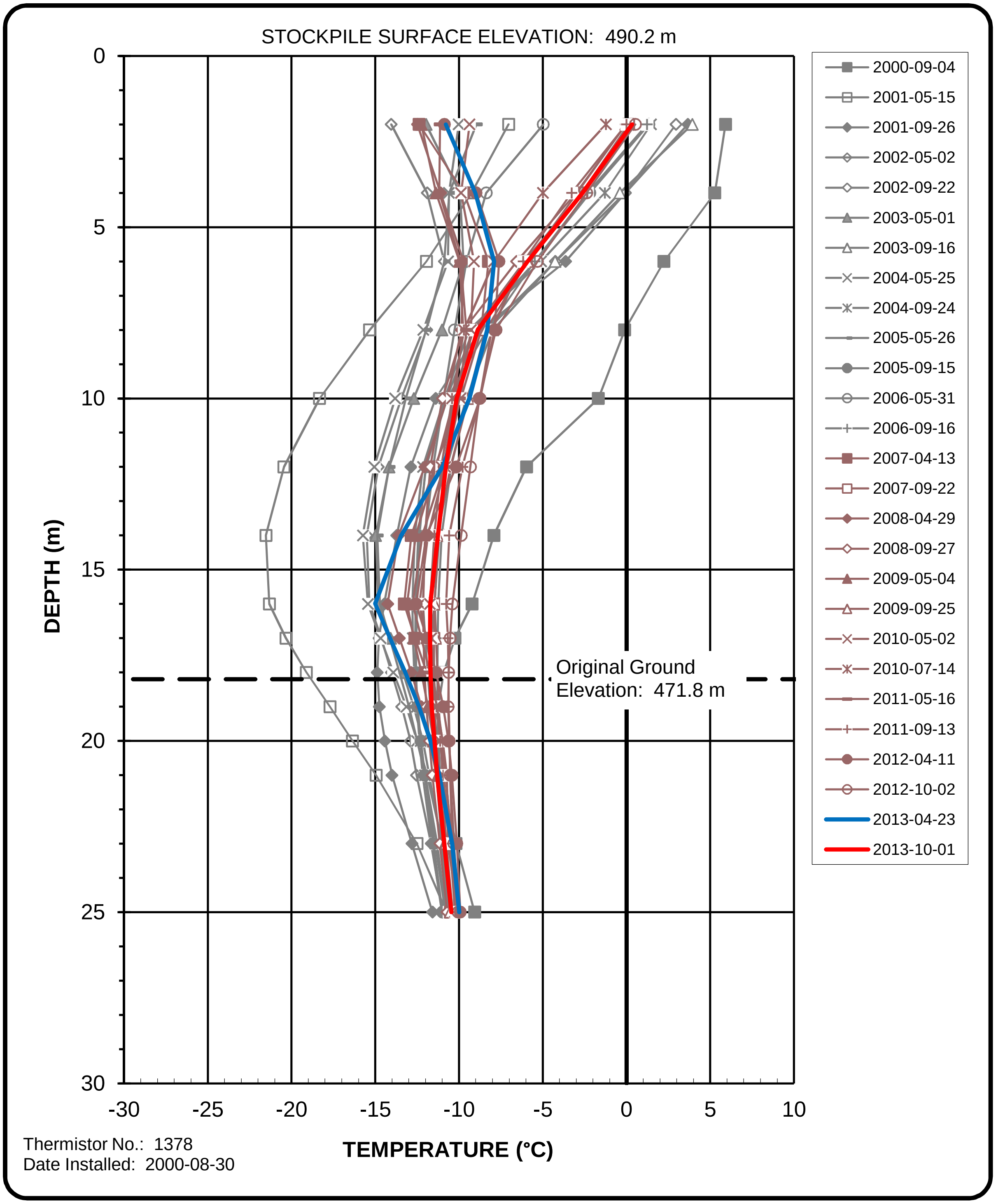


Figure 4
Ground Temperature Profile
Site 1 (15 m Bench)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

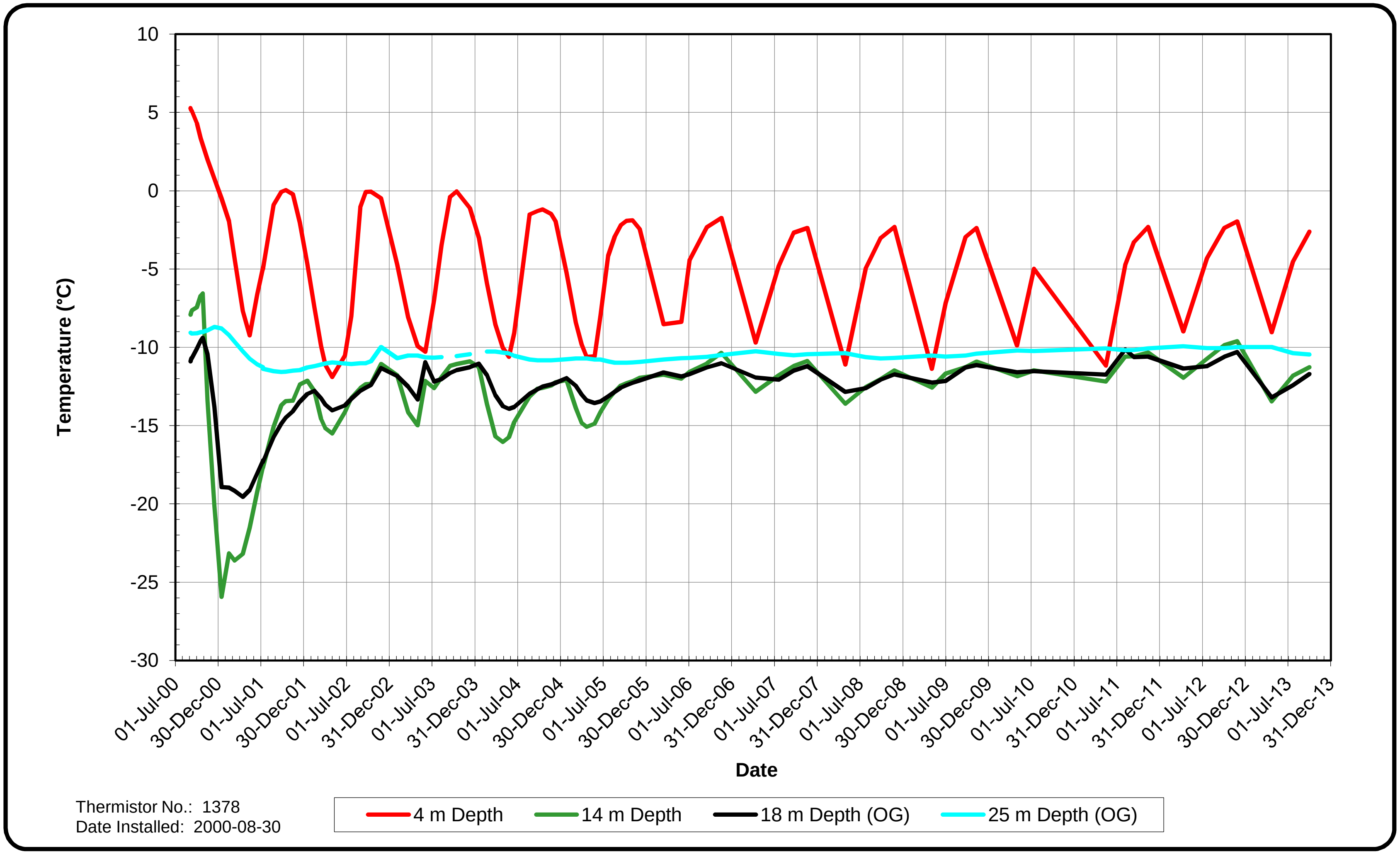


Figure 4a
Ground Temperature History
Site 1 (15 m Bench)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

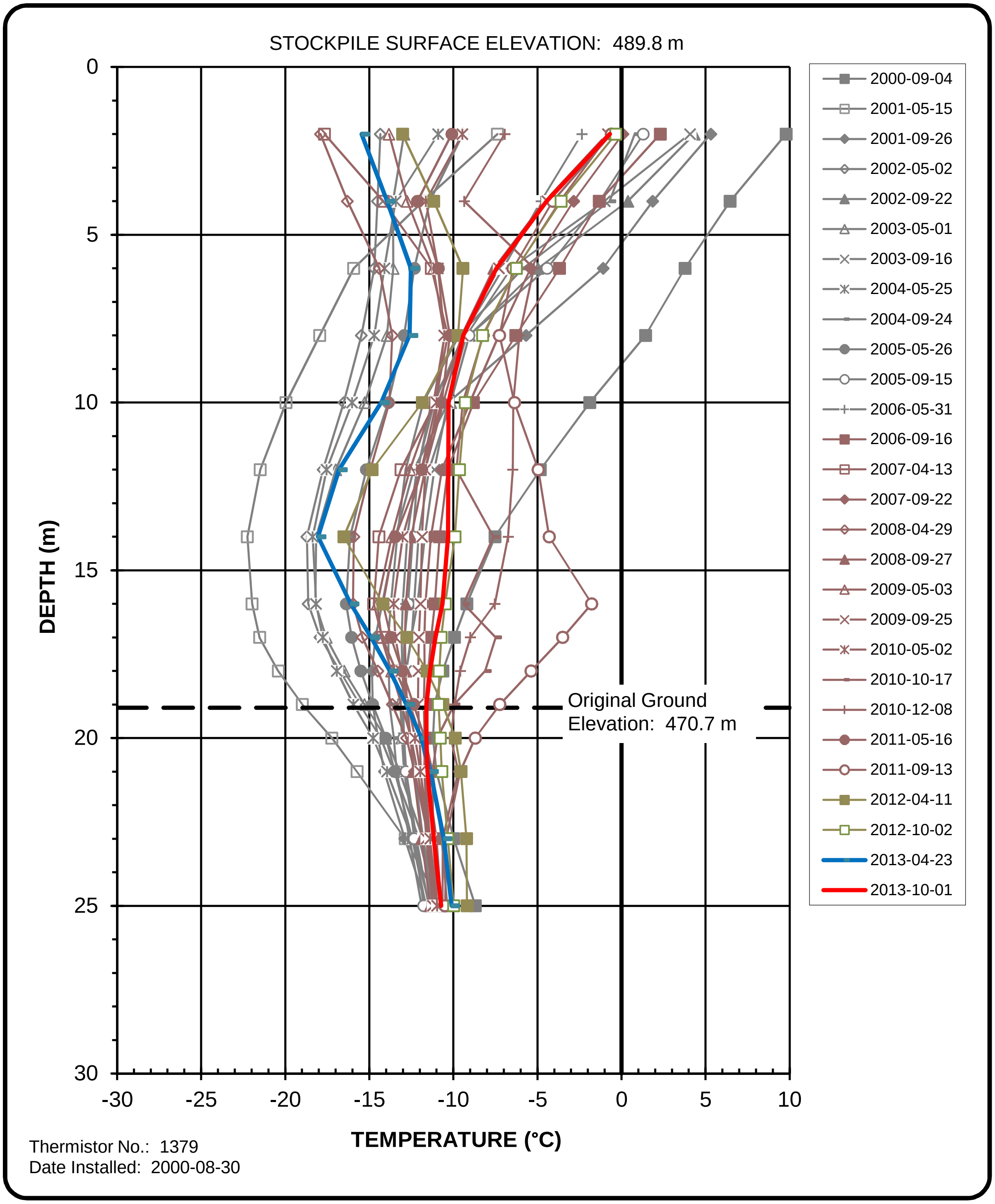


Figure 5
Ground Temperature Profile
Site 2 (15 m Bench)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

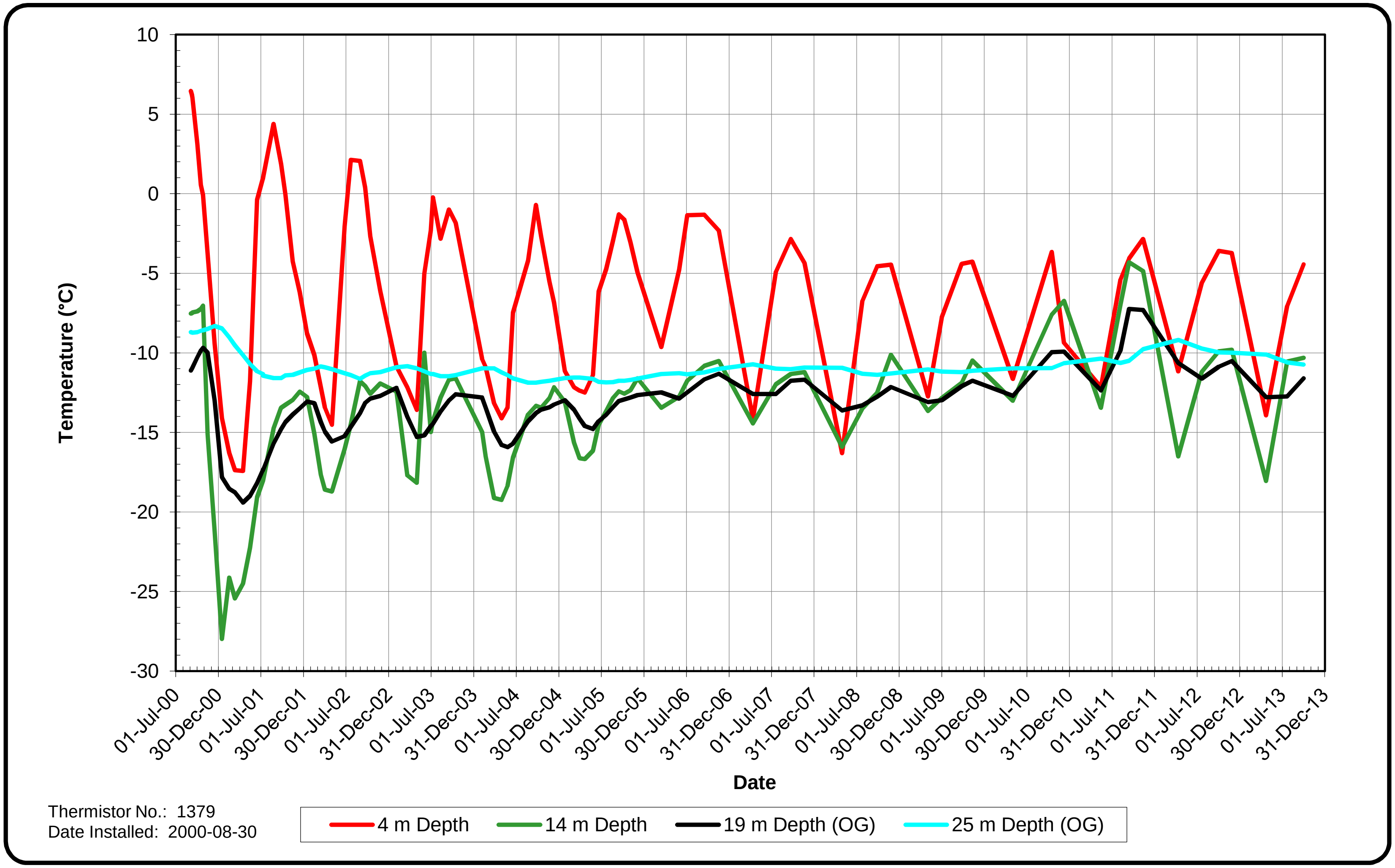


Figure 5a
Ground Temperature History
Site 2 (15 m Bench)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

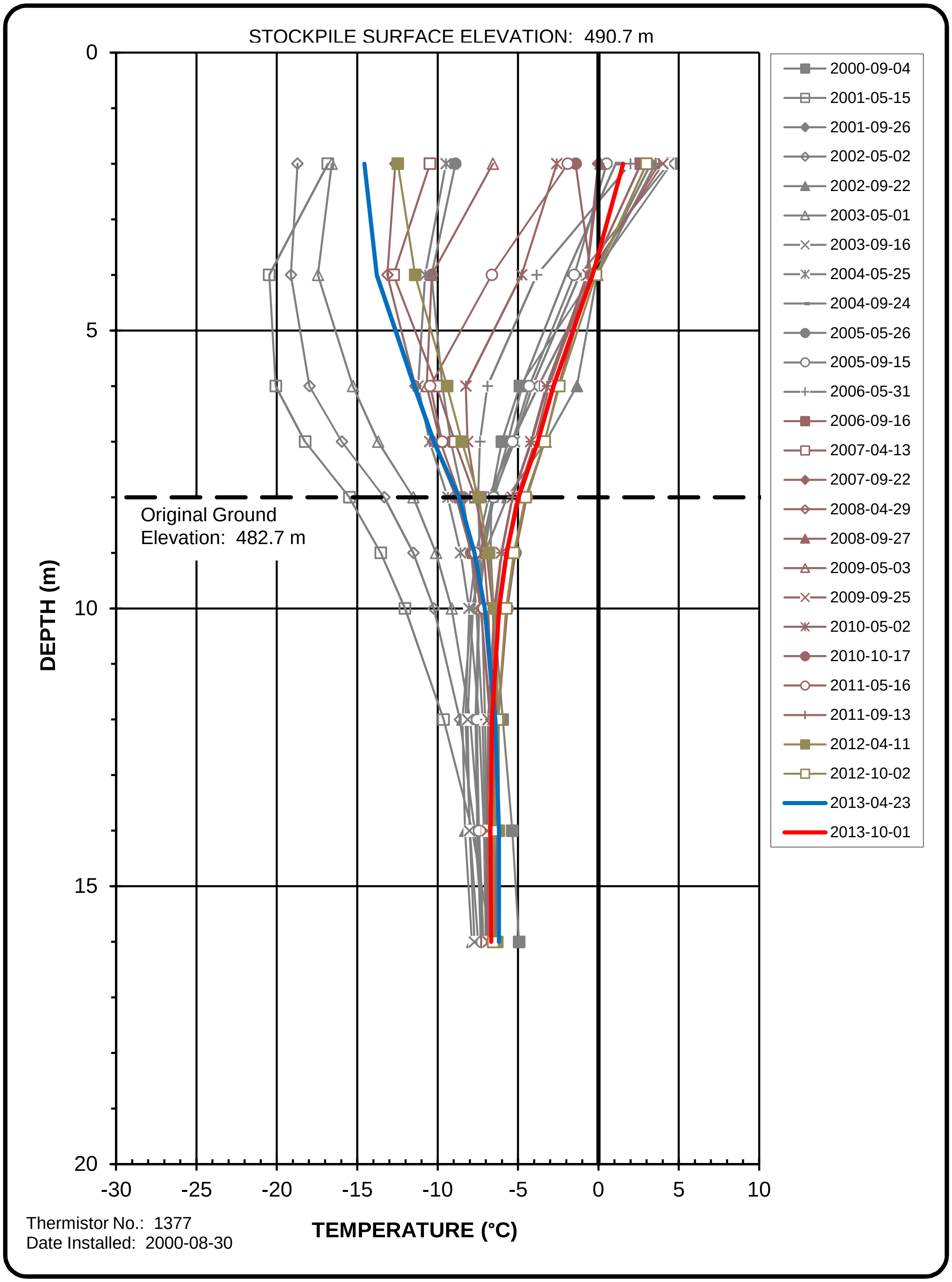


Figure 6
Ground Temperature Profile
Site 3 (15 m Bench)
Panda/Koala Waste Rock Storage Area

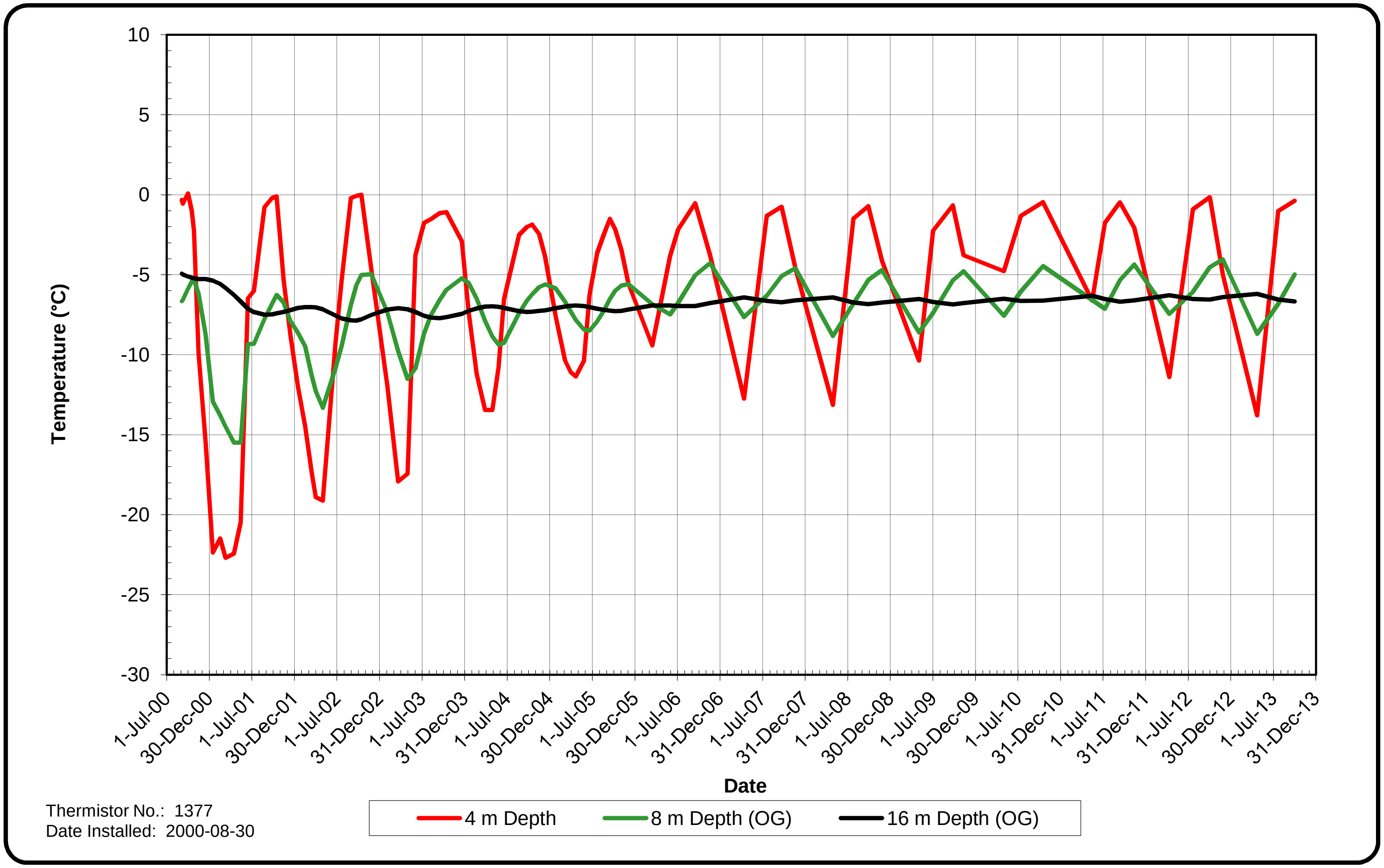
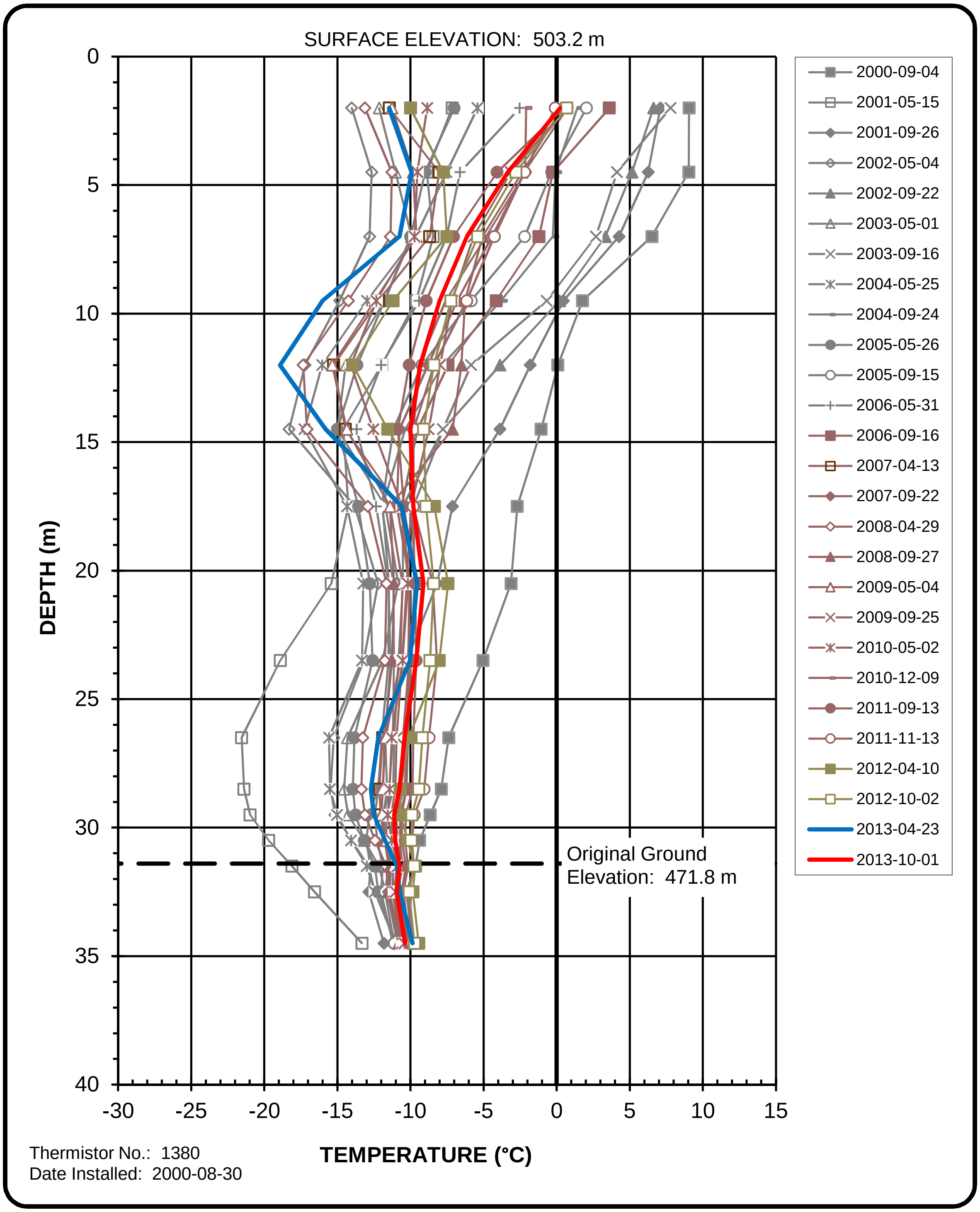


Figure 6a
Ground Temperature History
Site 3 (15 m Bench)
Panda/Koala Waste Rock Storage Area



NOTE: Surface covered with overburden September 2003

Figure 7
Ground Temperature Profile
Site 4 (30 m Bench)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

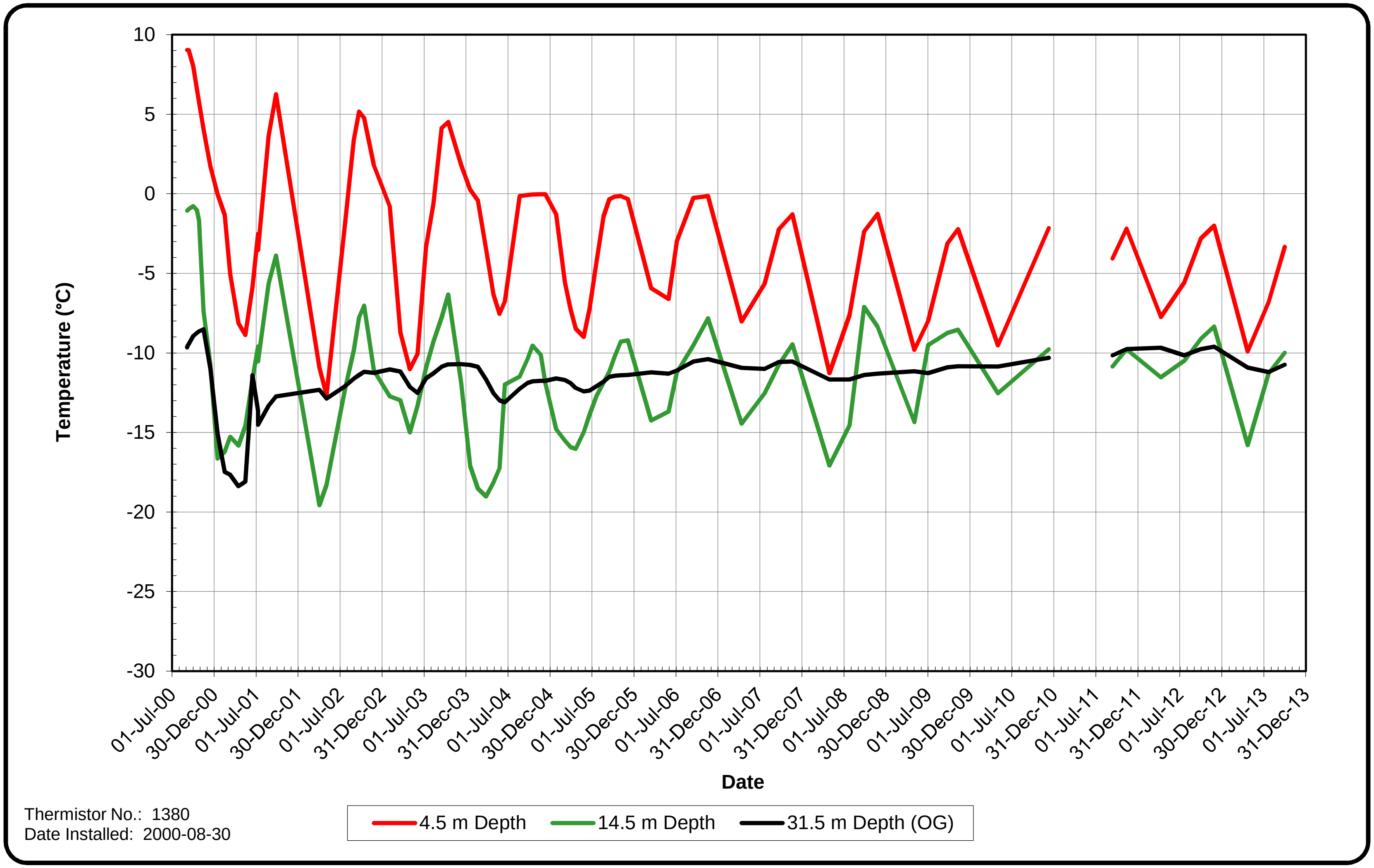
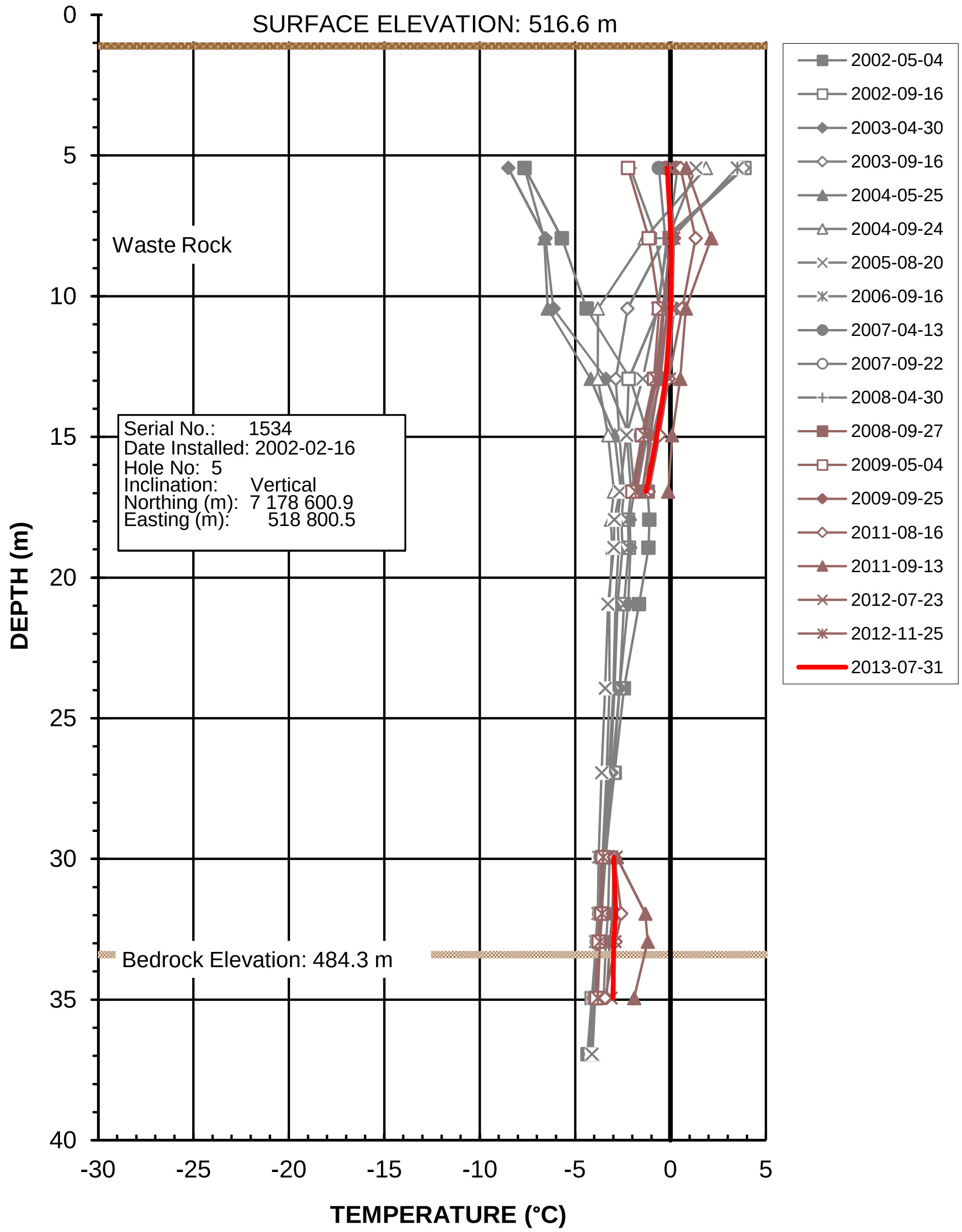
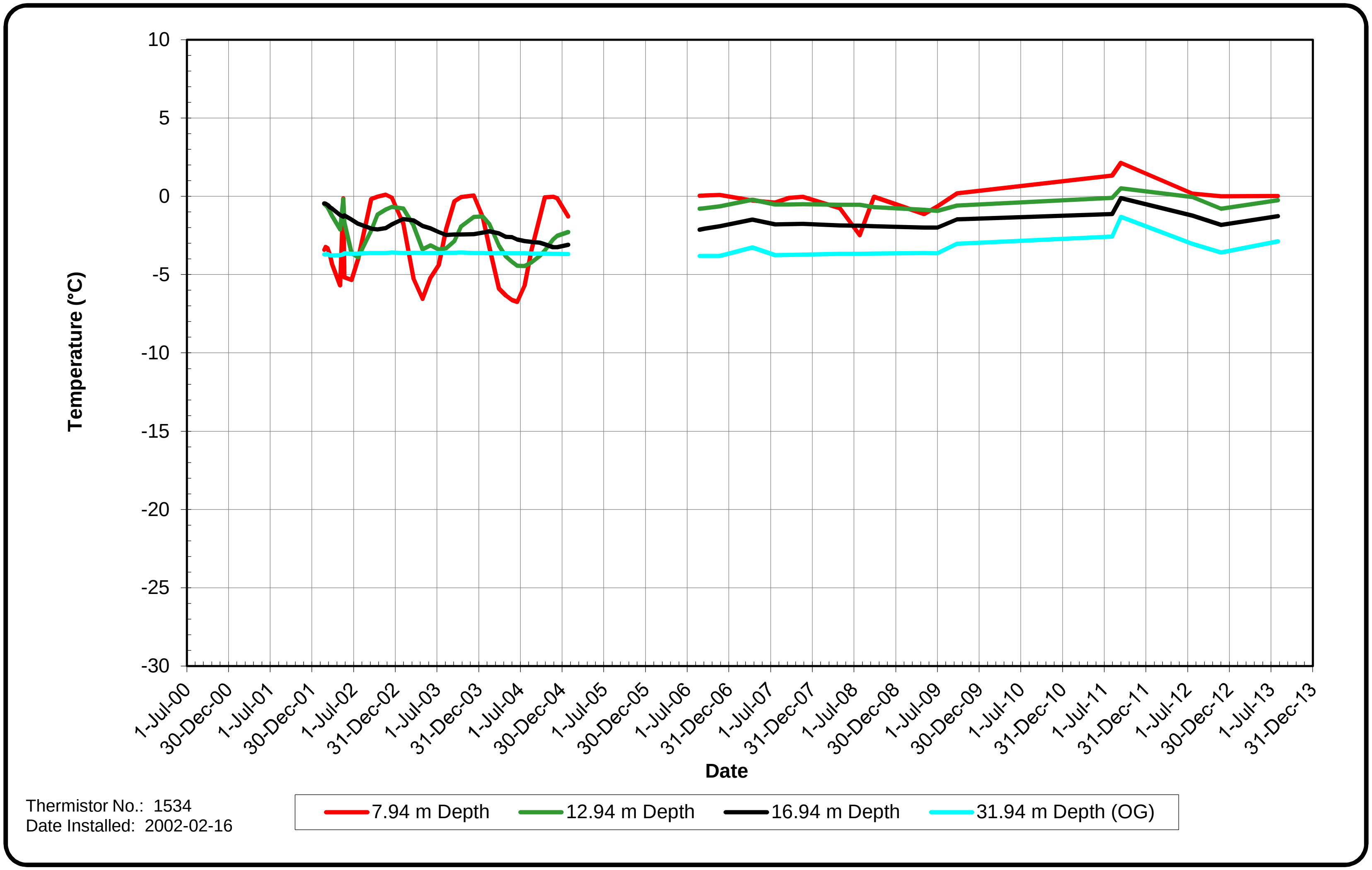


Figure 7a
Ground Temperature History
Site 4 (30 m Bench)
Panda/Koala Waste Rock Storage Area



Note: Stockpile surface elevation in the vicinity of cable raised to 516.6 m from 513.66 m in August 2006

Figure 8
Ground Temperature Profile
Site 5 (Centre of Top Bench)
Panda/Koala Waste Rock Storage Area



Note: Stockpile surface elevation in the vicinity of cable raised to 516.6 m from 513.66 m from August 2006

Figure 8a
Ground Temperature History
Site 5 (Centre of Top Bench)
Panda/Koala Waste Rock Storage Area

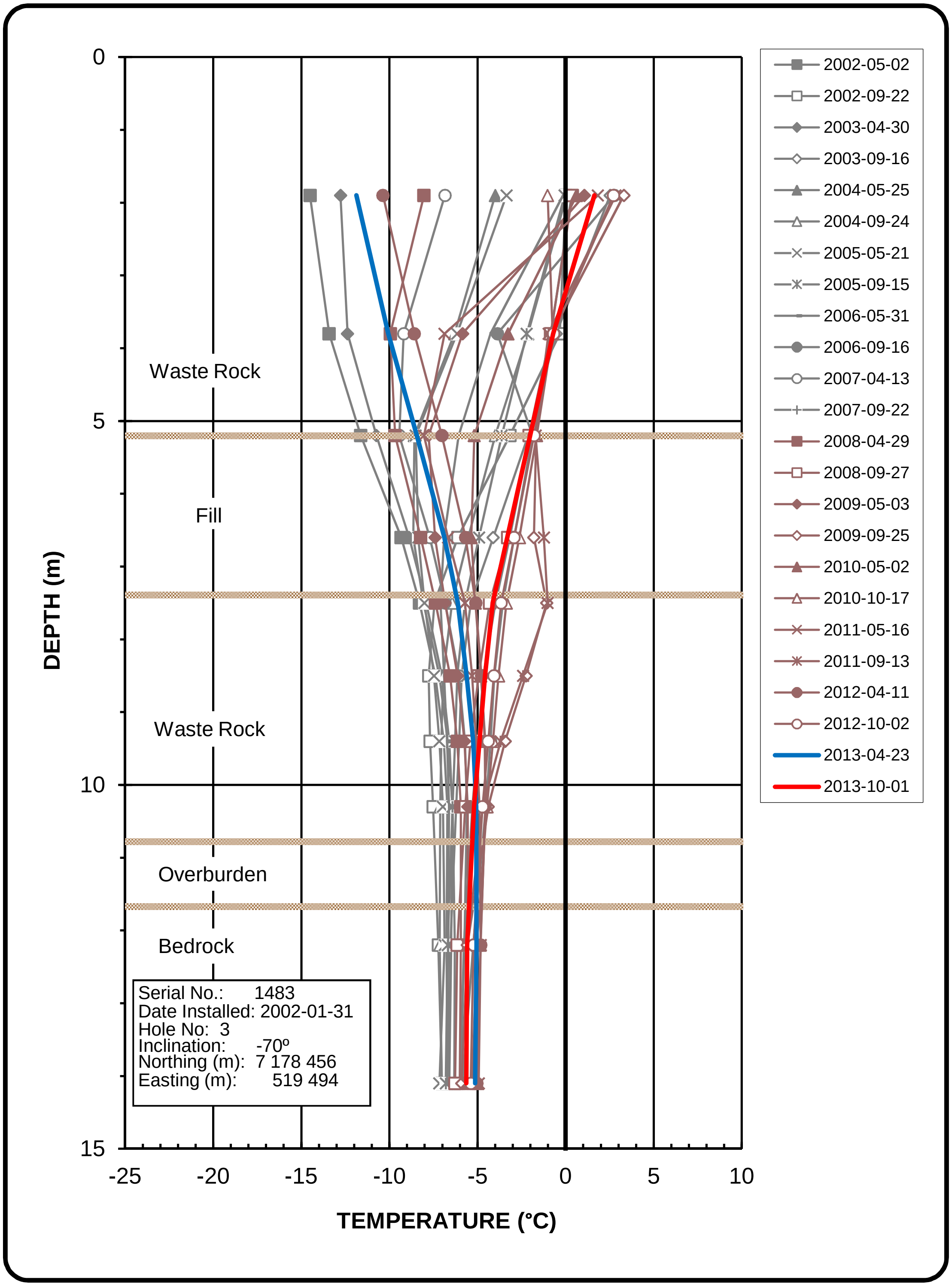


Figure 9
Ground Temperature Profile
Site 6 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

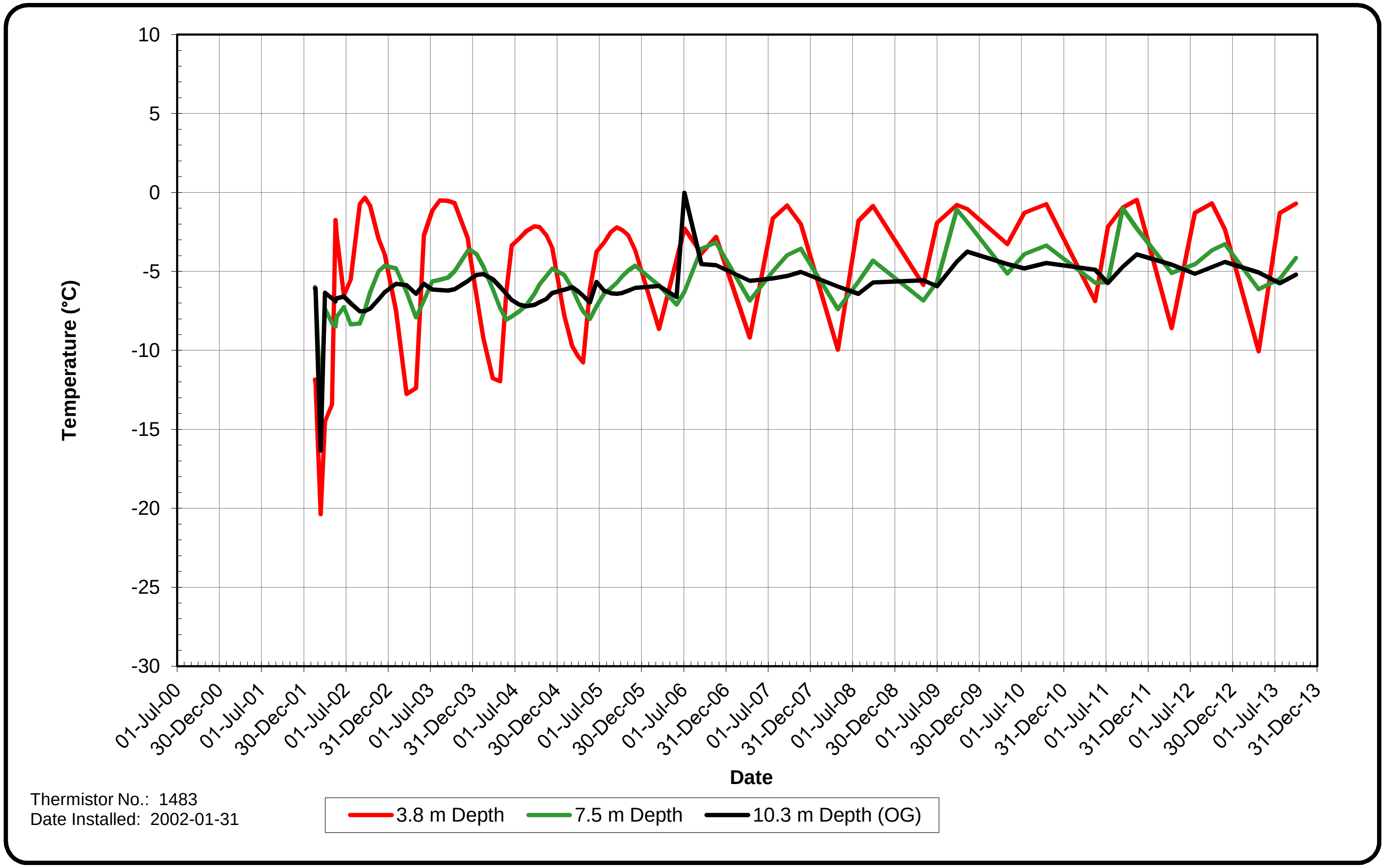


Figure 9a
Ground Temperature History
Site 6 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

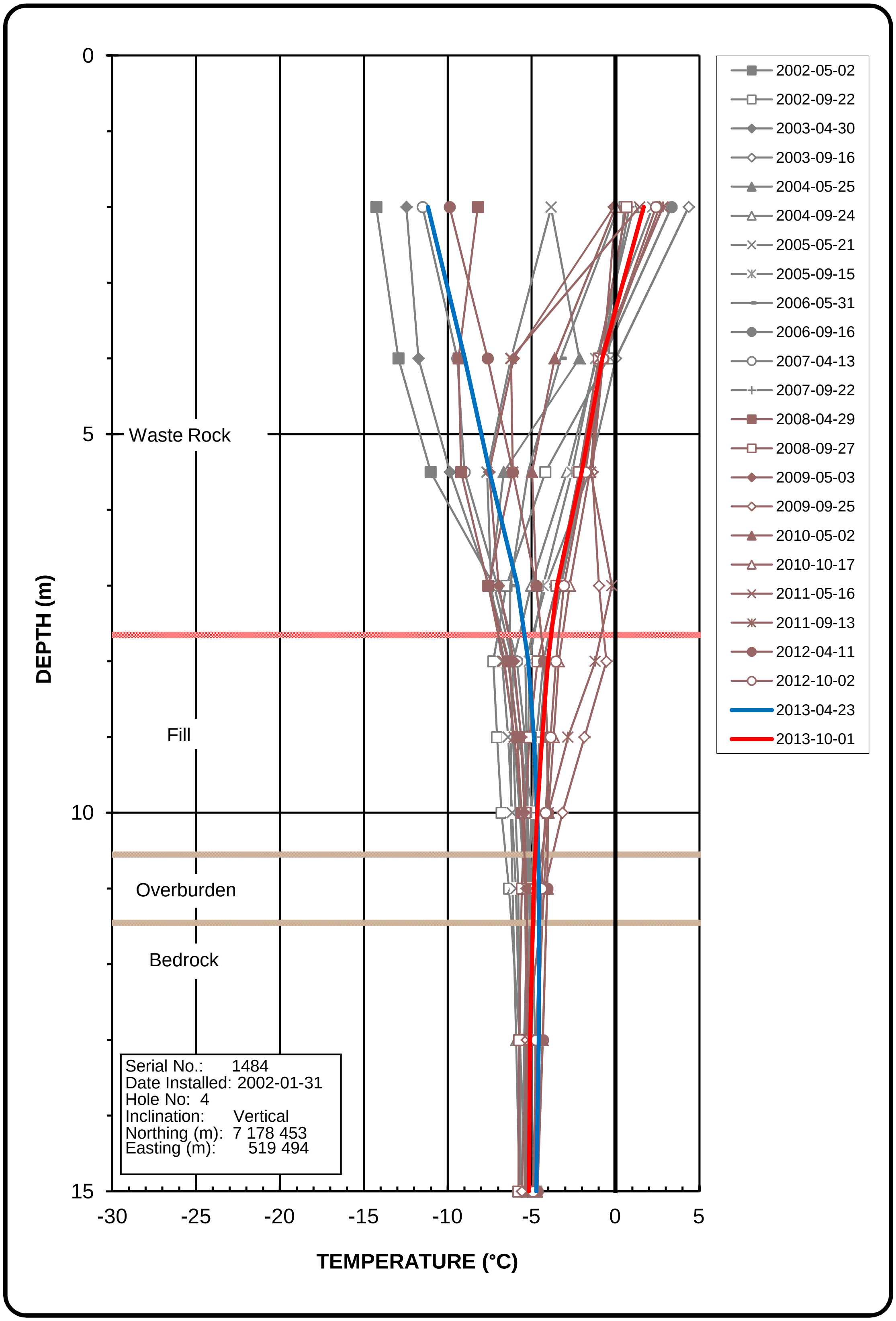


Figure 10
Ground Temperature Profile
Site 6 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

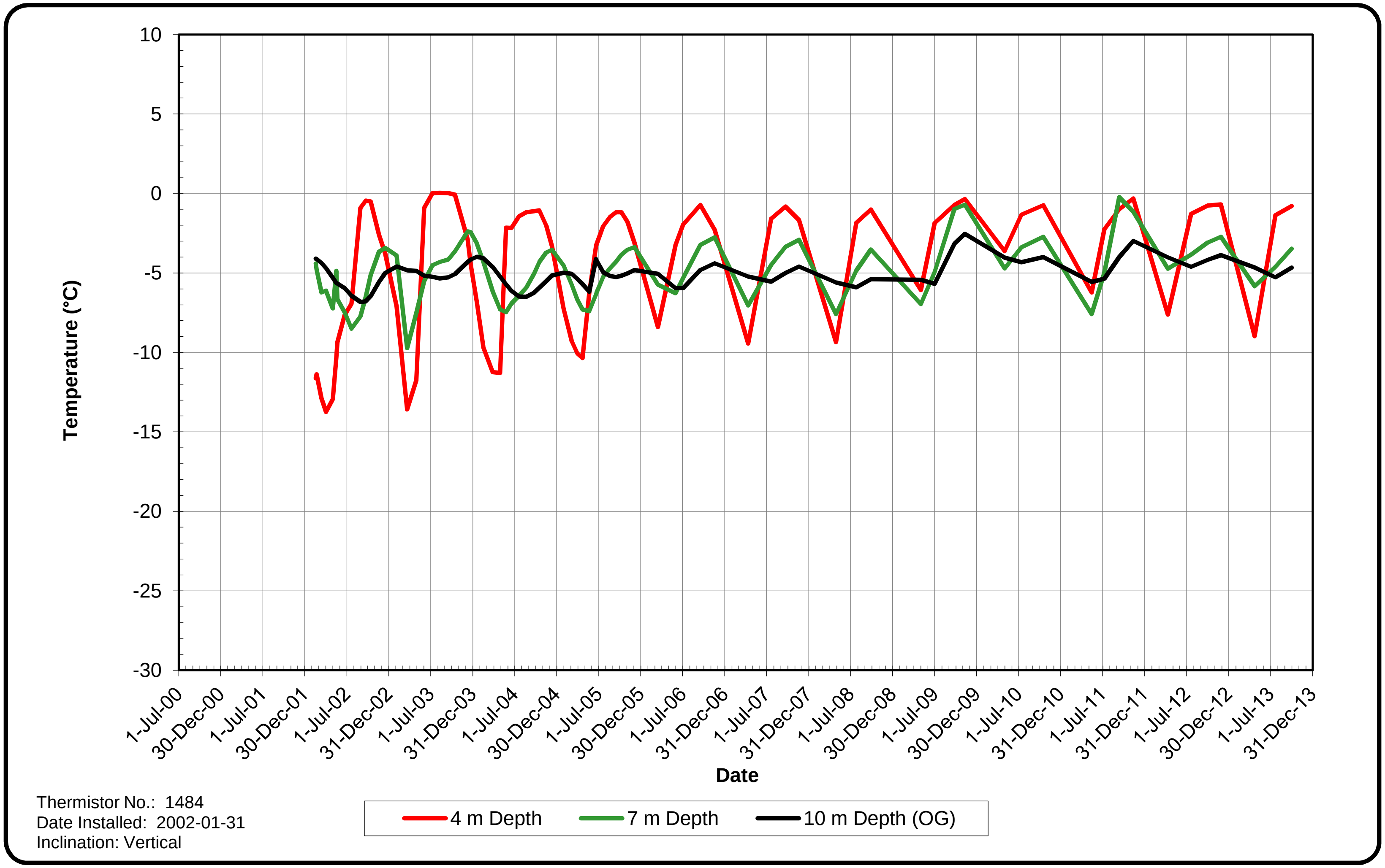


Figure 10a
Ground Temperature History
Site 6 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

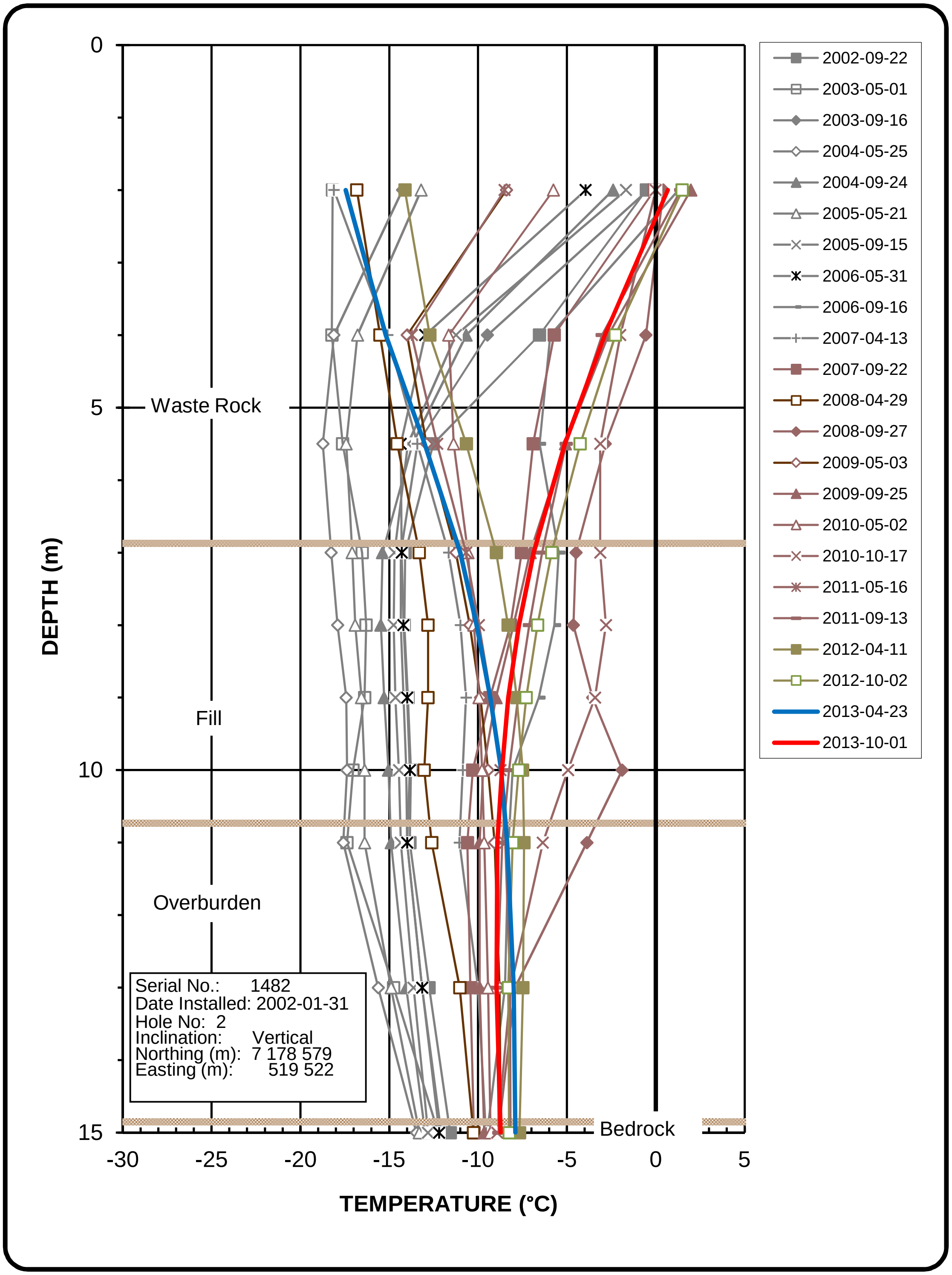


Figure 11
Ground Temperature Profile
Site 7 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

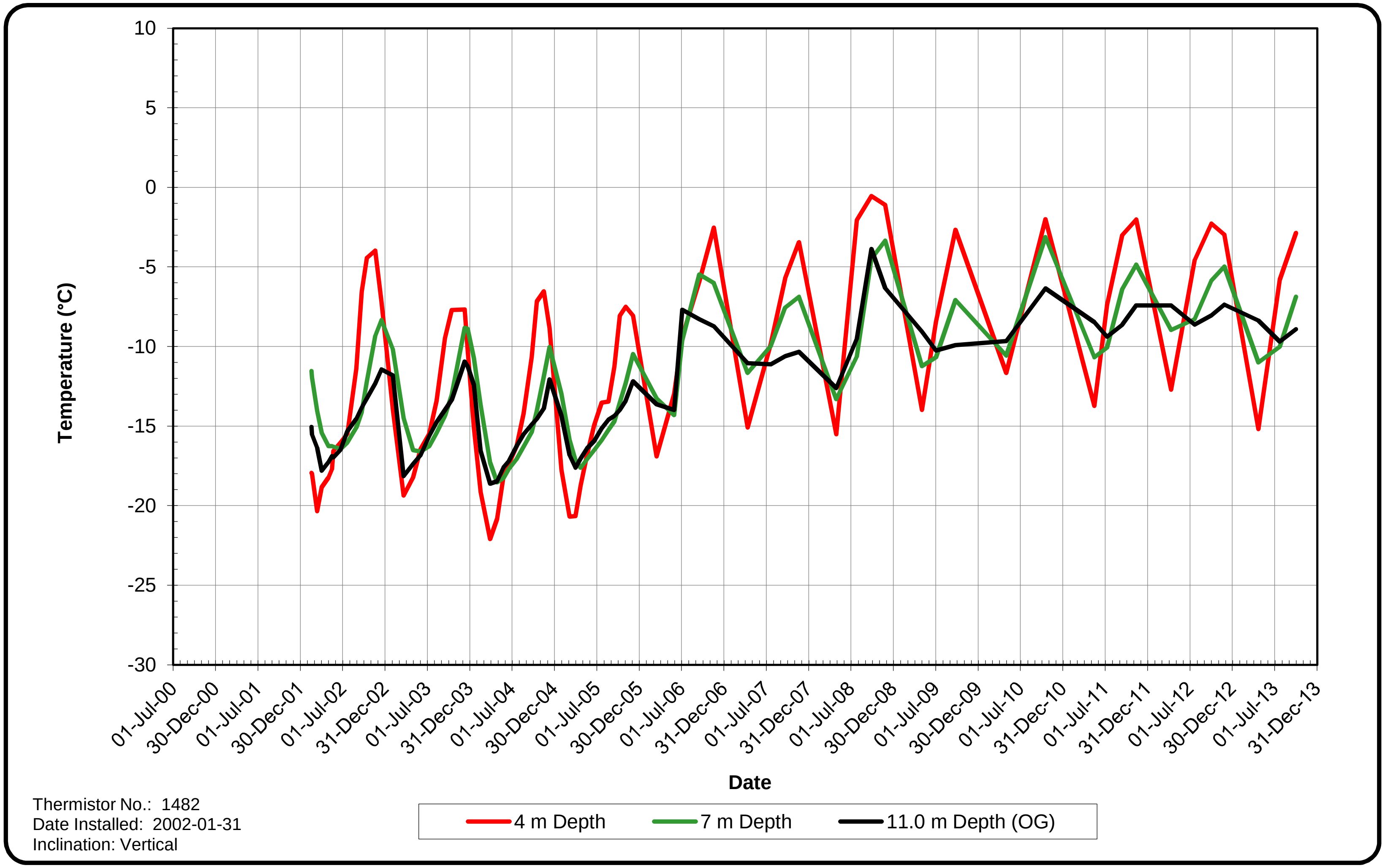


Figure 11a
Ground Temperature History
Site 7 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

TETRA TECH EBA

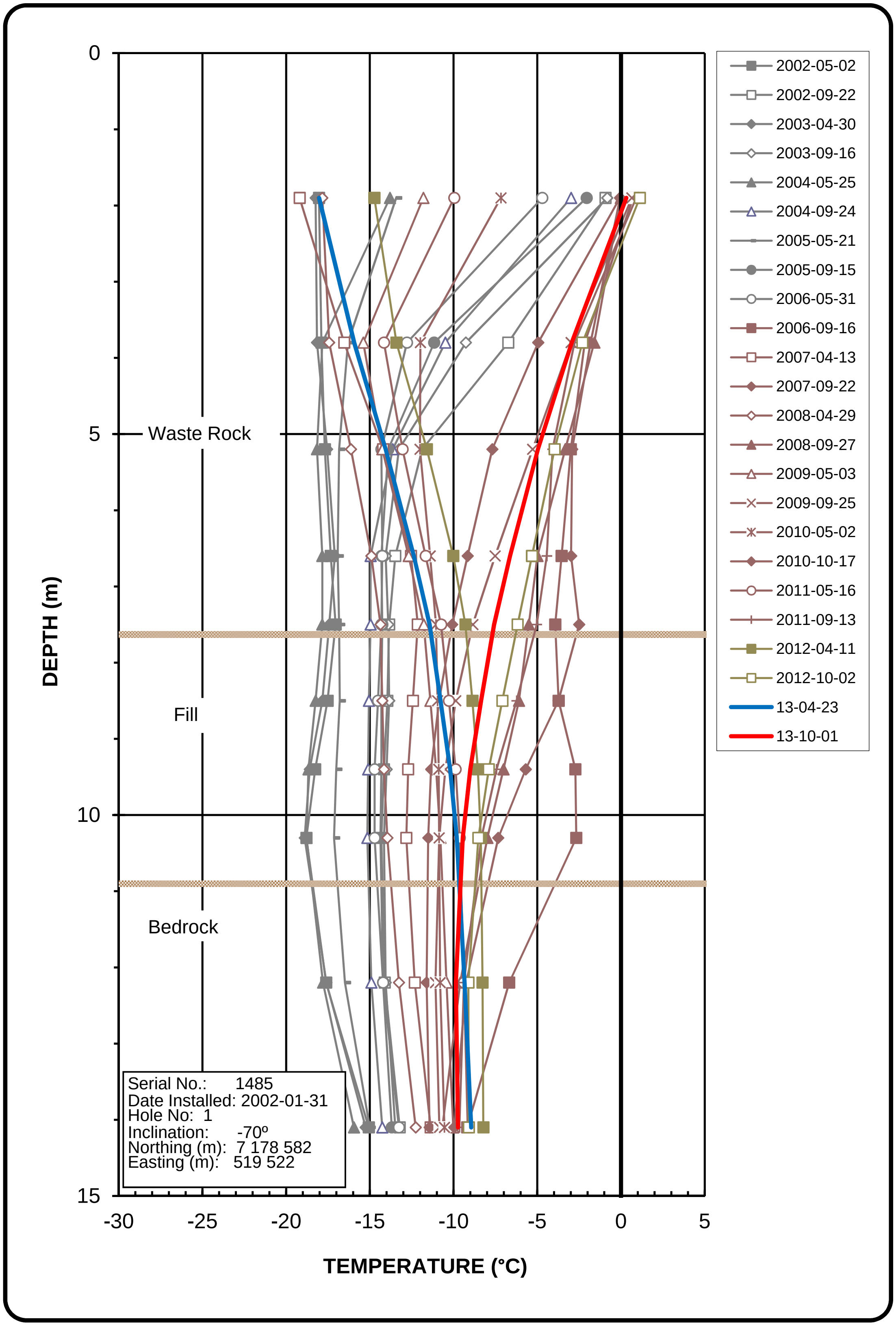


Figure 12
Ground Temperature Profile
Site 7 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

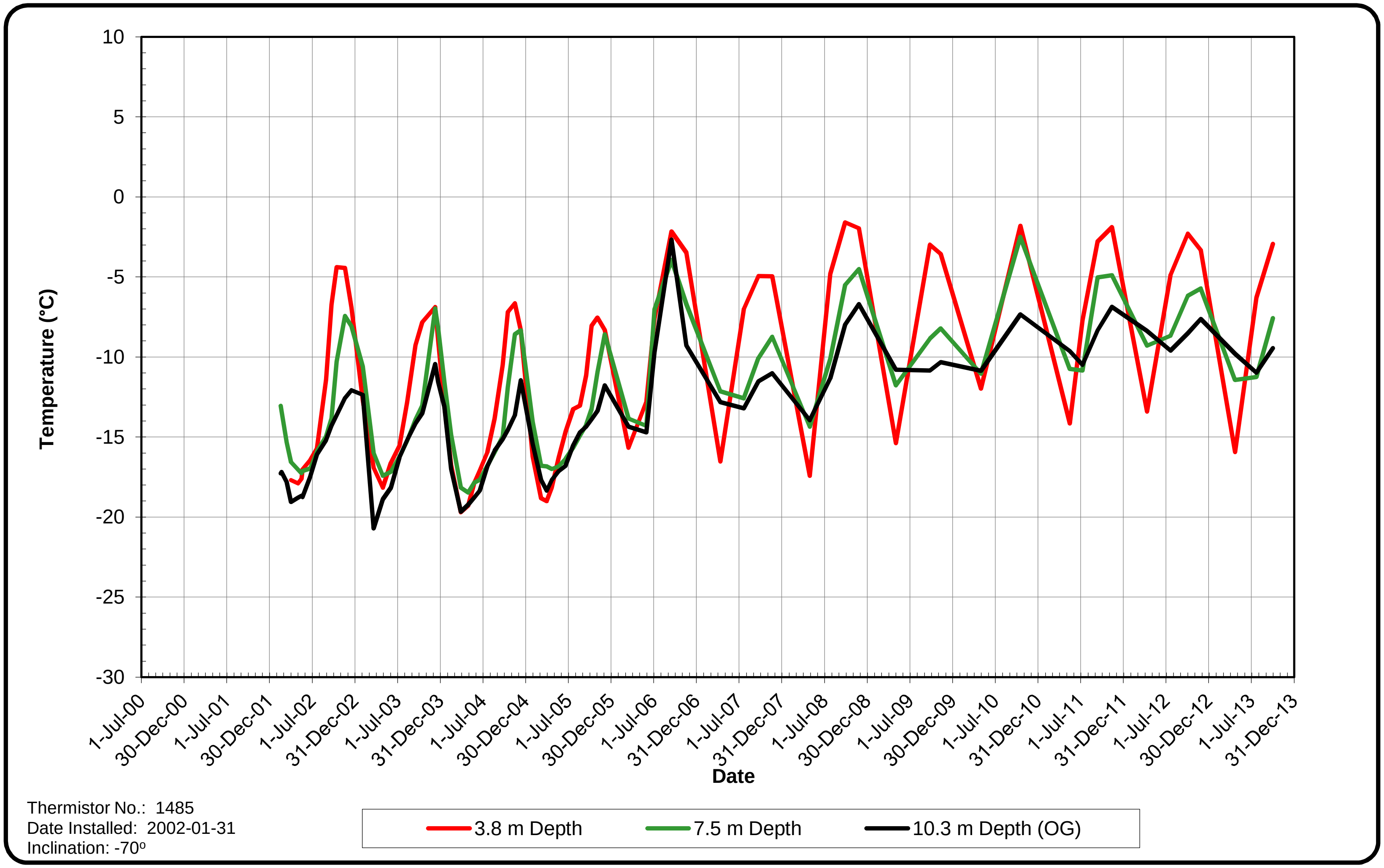


Figure 12a
Ground Temperature History
Site 7 (Adjacent to Toe of Storage Pile)
Panda/Koala Waste Rock Storage Area

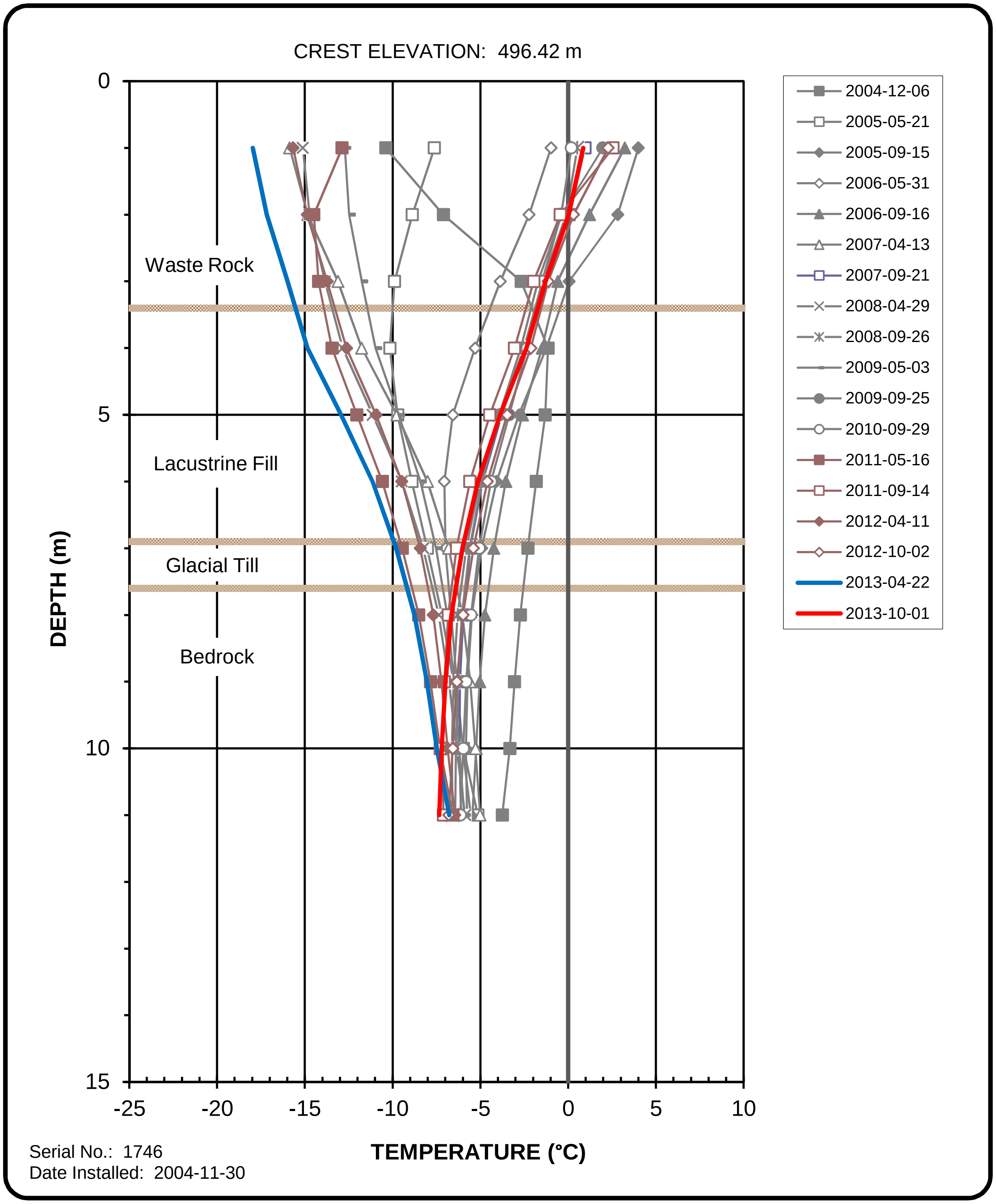


Figure 13
Ground Temperature Profile
Bearclaw Toe Berm

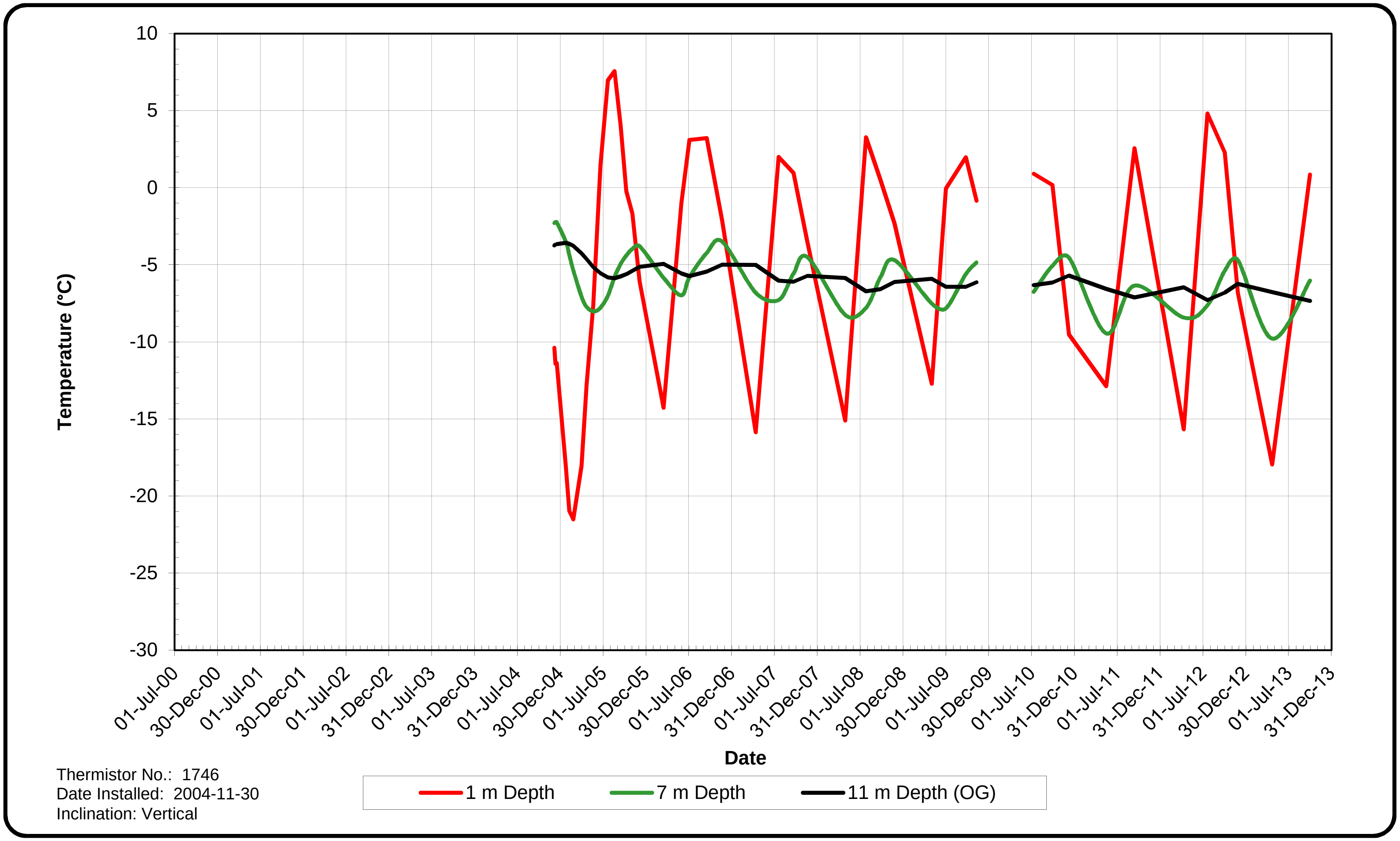


Figure 13a
Ground Temperature History
Site 7 (Adjacent to Toe of Storage Pile)
Bearclaw Toe Berm

TETRA TECH EBA

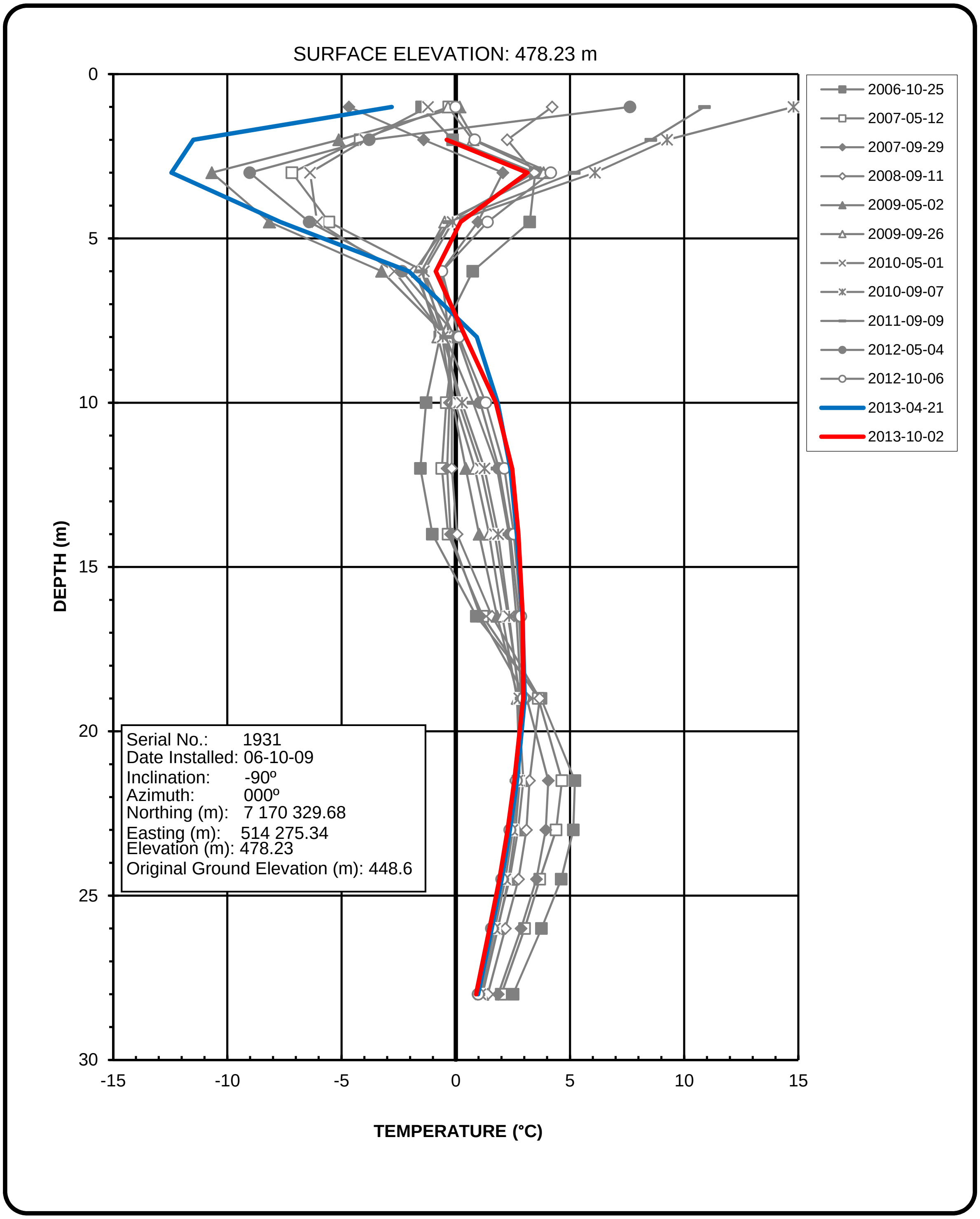


Figure 14

Ground Temperature Profile
Fox Low Grade Kimberlite Dump
Fox Waste Rock Storage Area

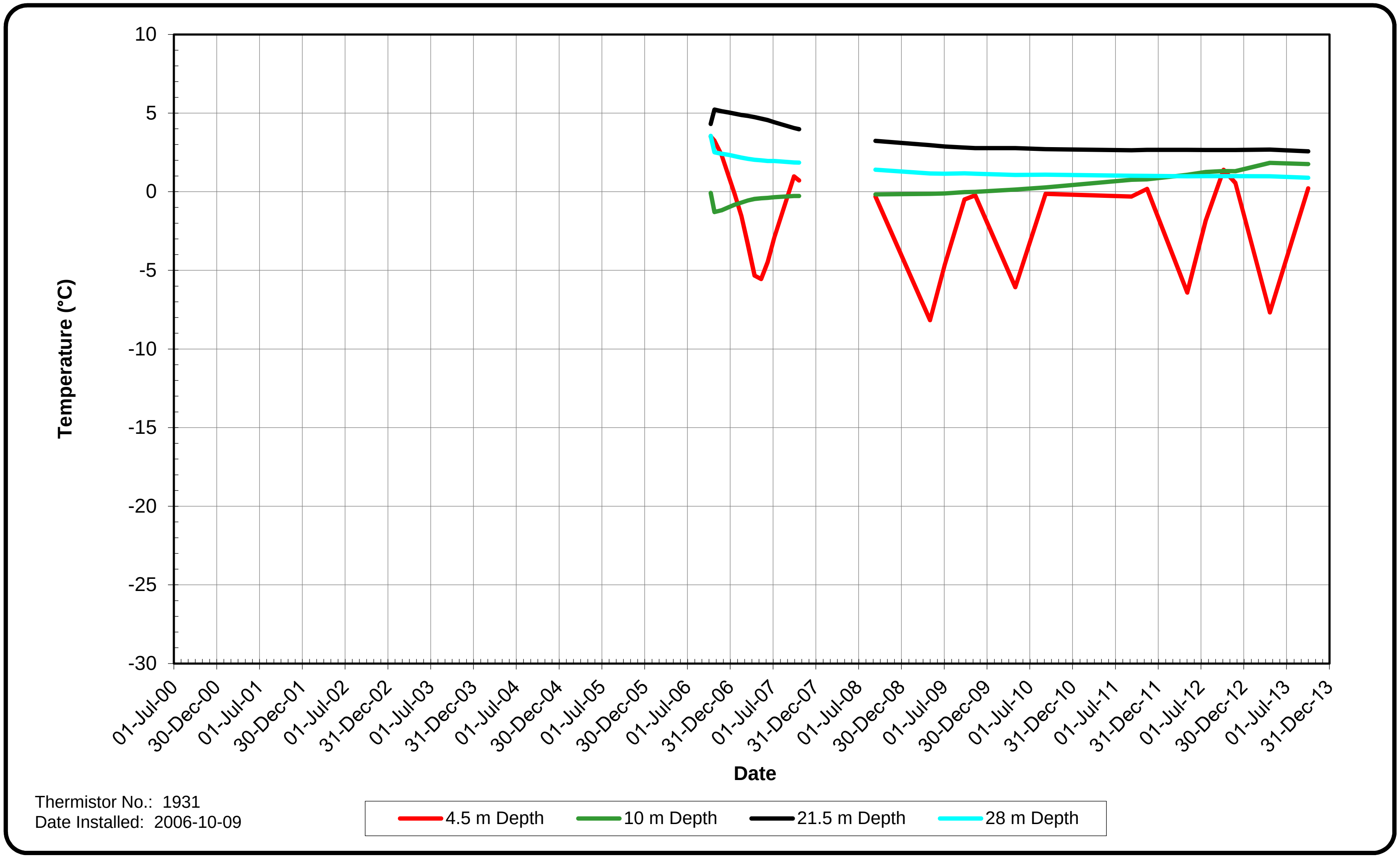


Figure 14a
Ground Temperature History
Fox Low Grade Kimberlite Dump
Fox Waste Rock Storage Area

TETRA TECH EBA

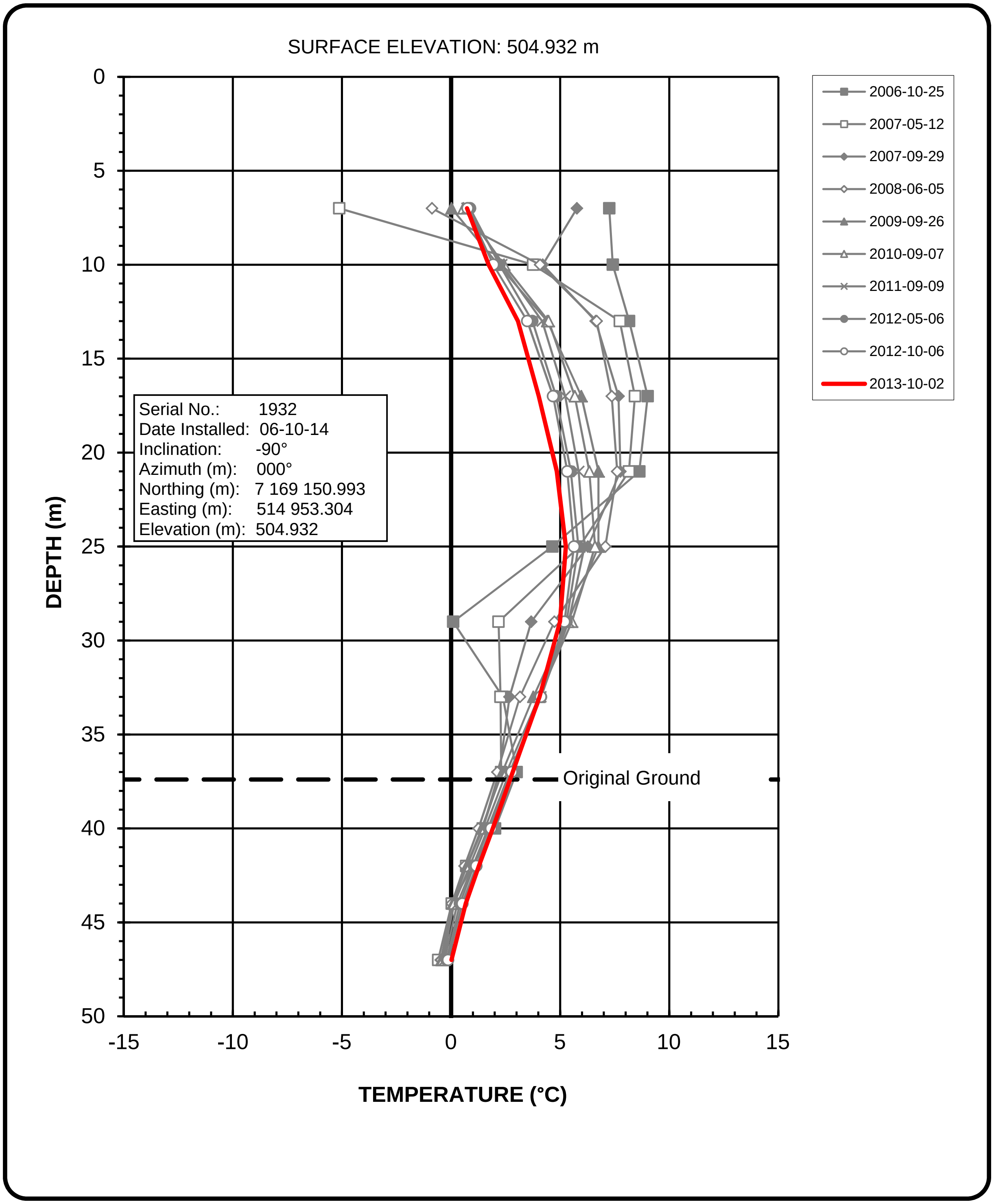


Figure 15
Ground Temperature Profile
Fox Waste Granite Dump
Fox Waste Rock Storage Area

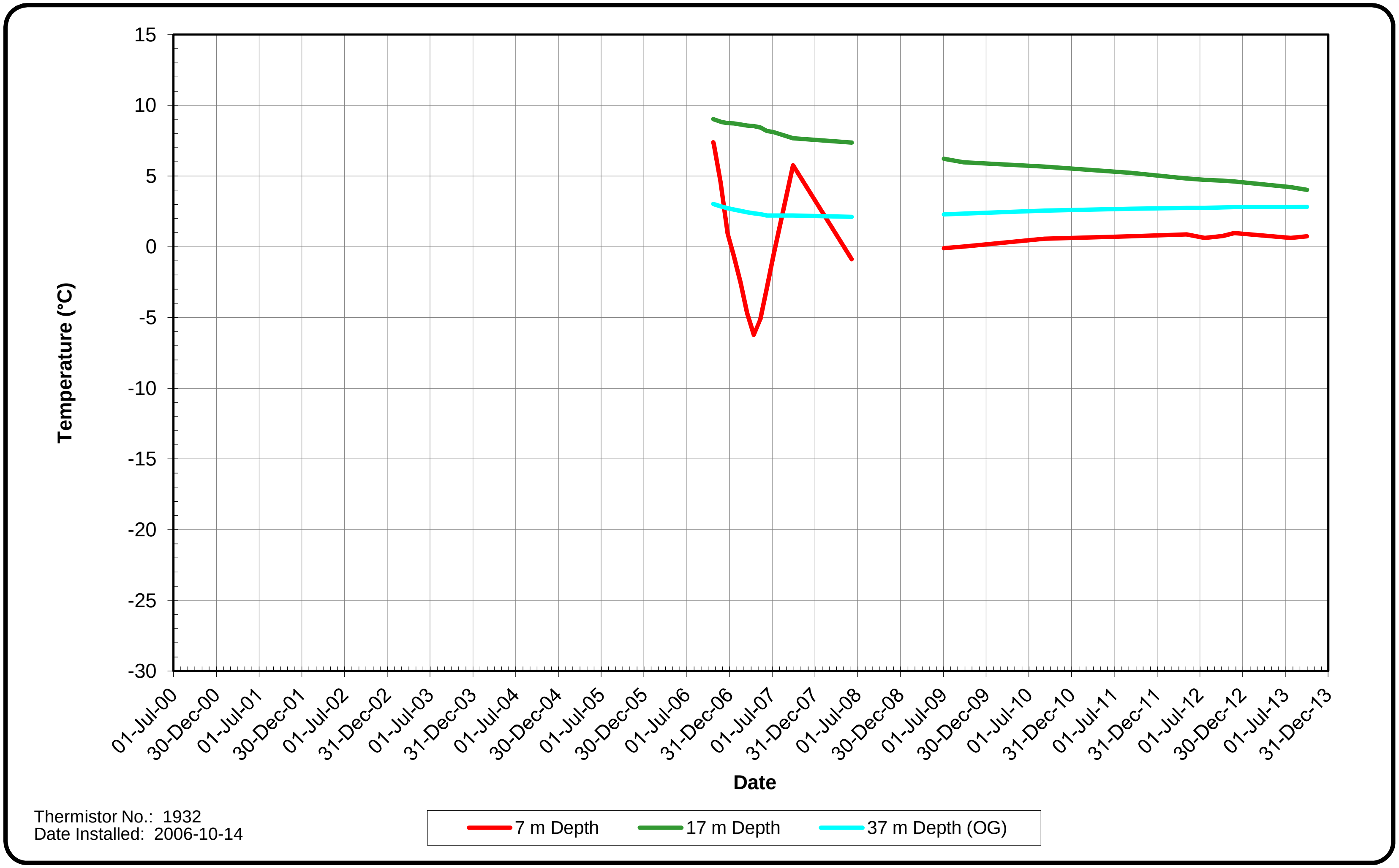


Figure 15a
Ground Temperature History
Waste Granite Dump
Fox Waste Rock Storage Area

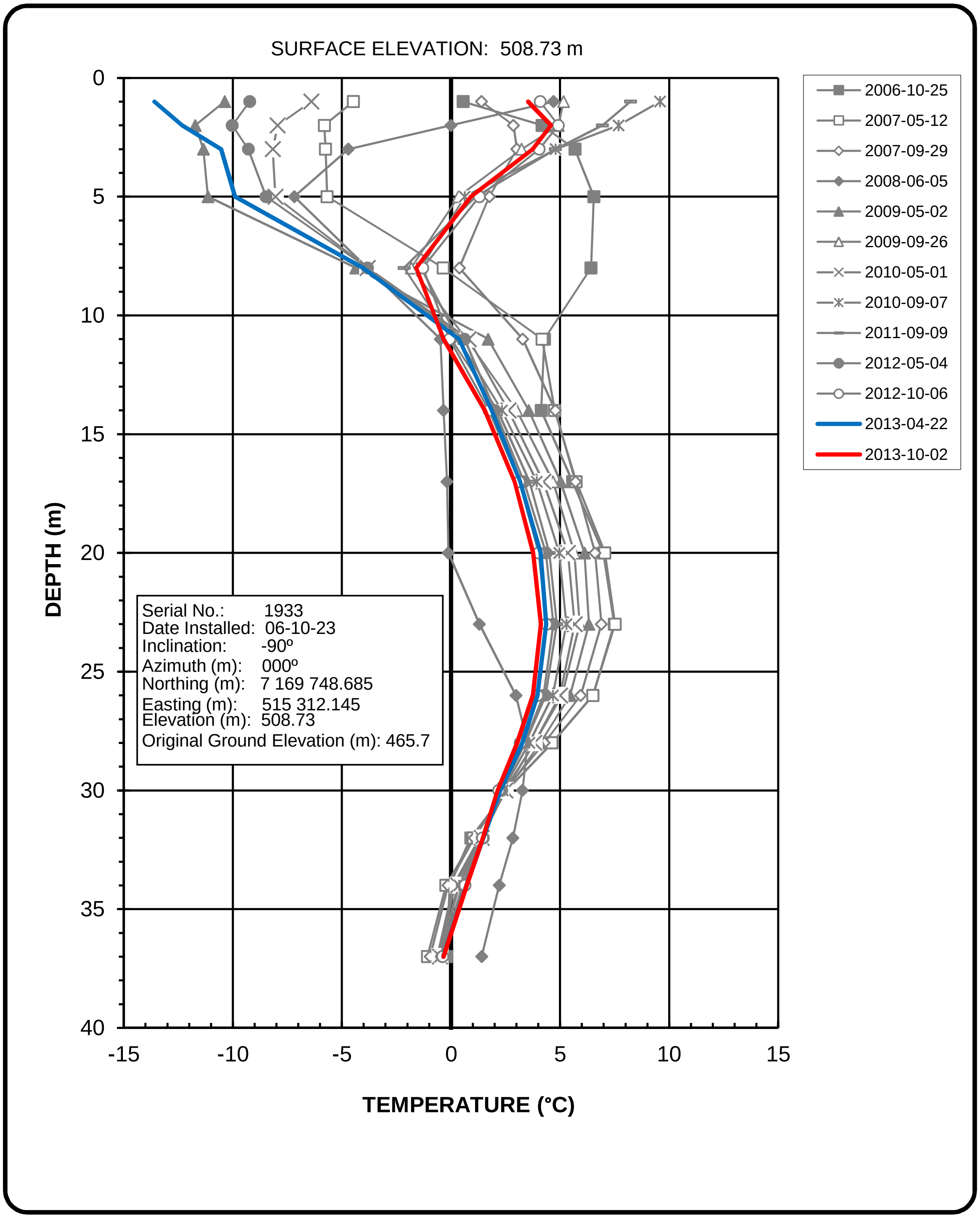


Figure 16
Ground Temperature Profile
Fox Waste Kimberlite Dump
Fox Waste Rock Storage Area

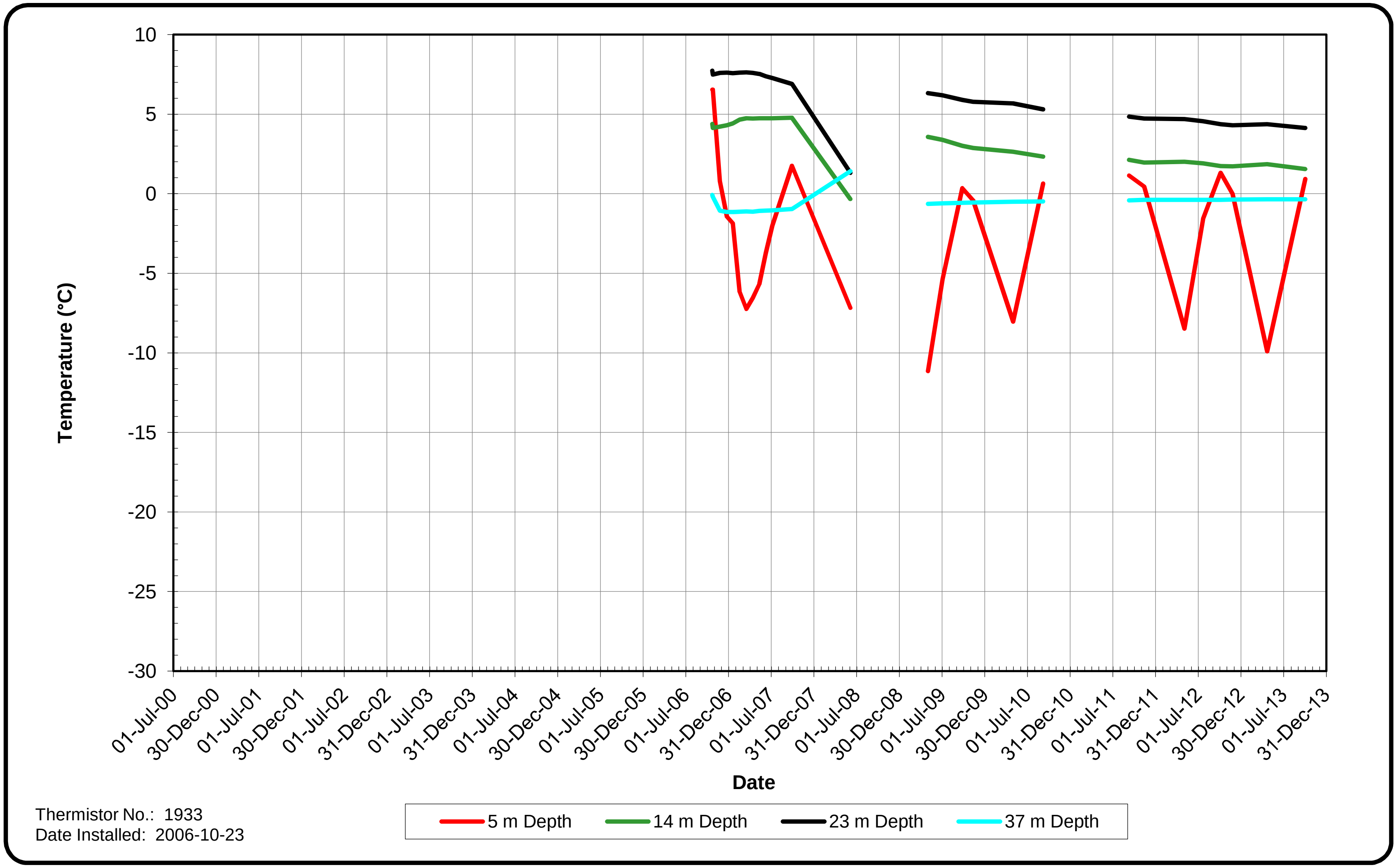


Figure 16a
Ground Temperature History
Fox Waste Kimberlite Dump
Fox Waste Rock Storage Area

TETRA TECH EBA

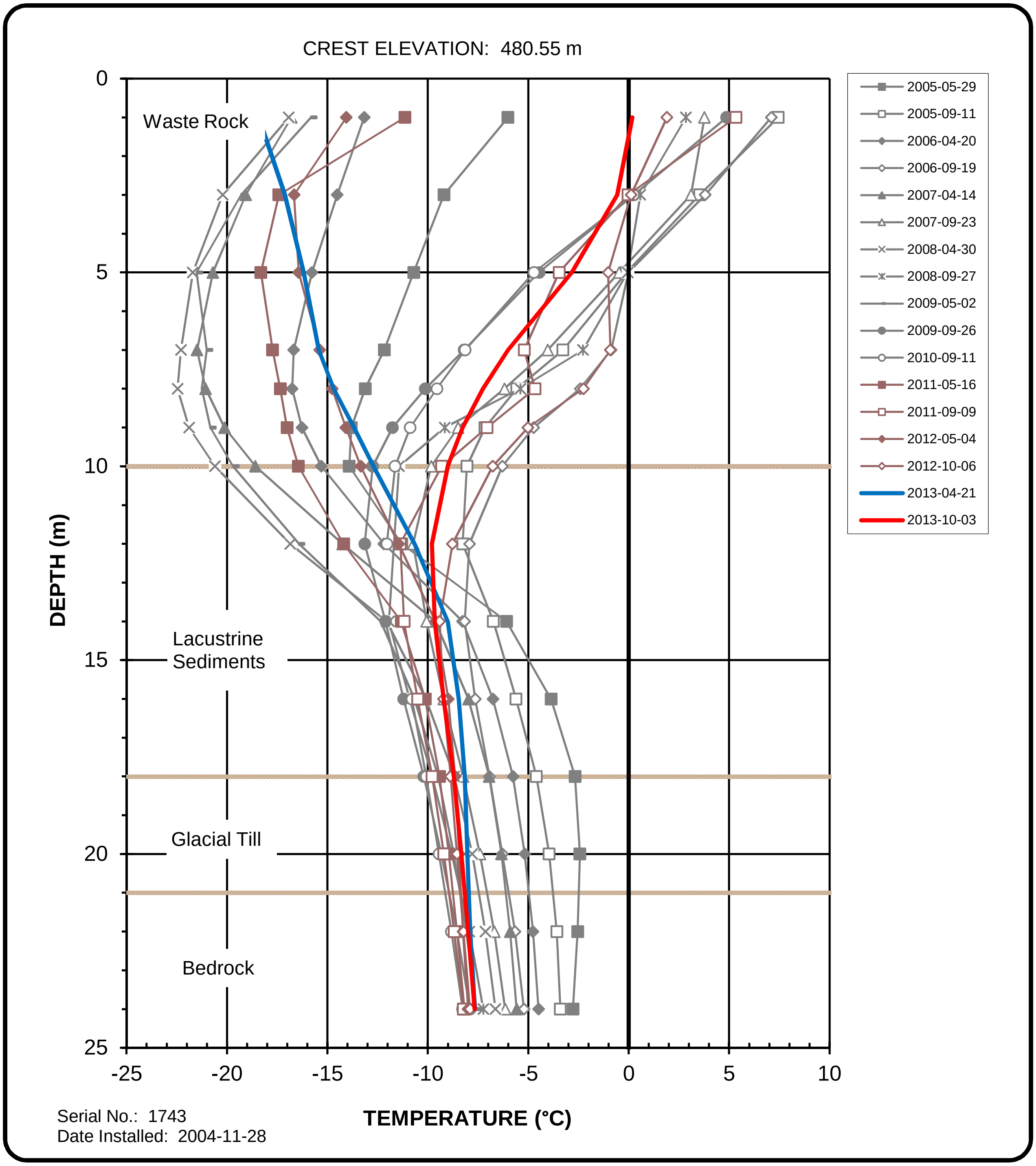


Figure 17
Ground Temperature Profile
Fox Toe Berm Southeast Valley

TETRA TECH EBA

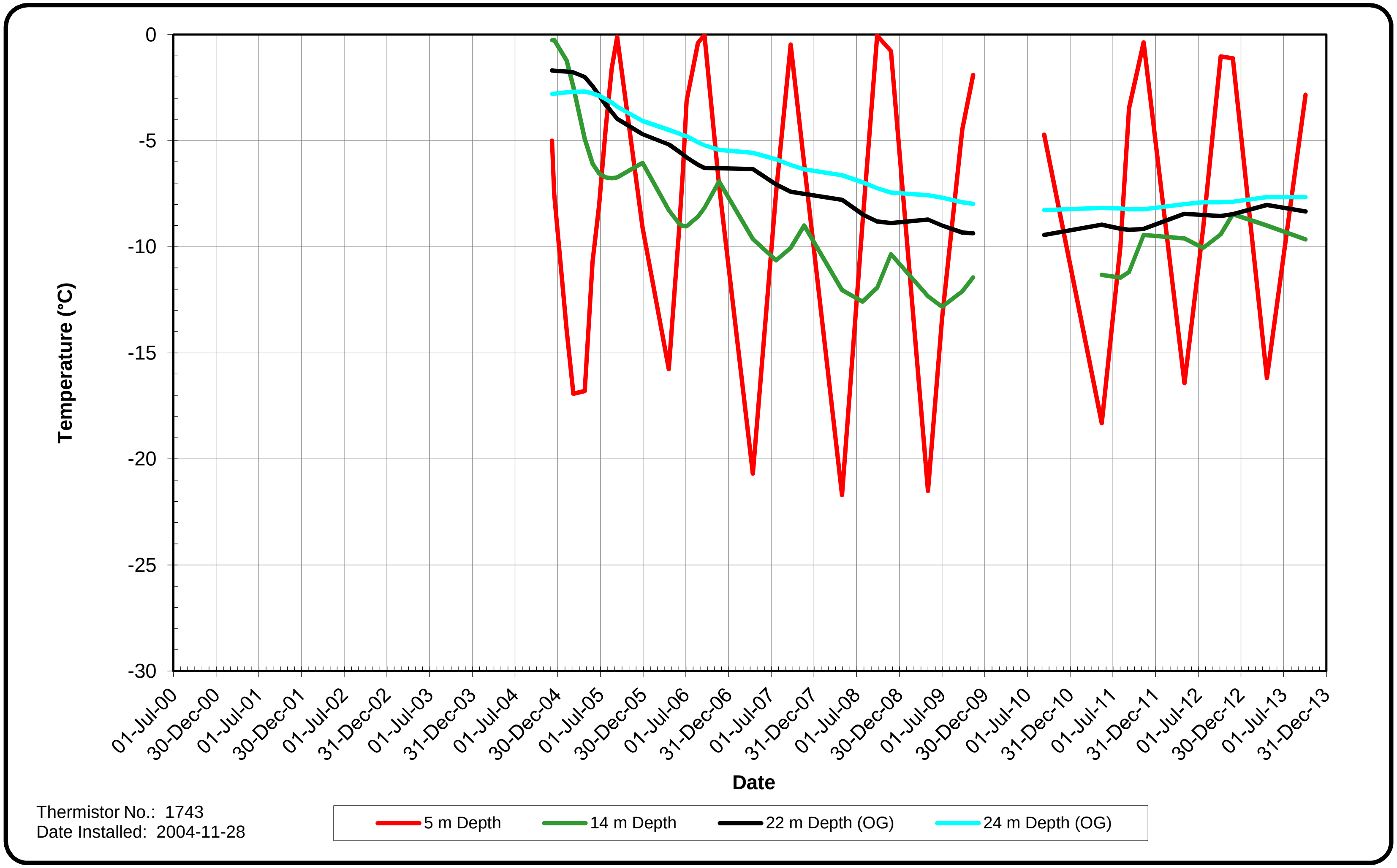


Figure 17a
Ground Temperature Profile
Fox Toe Berm Southeast Valley

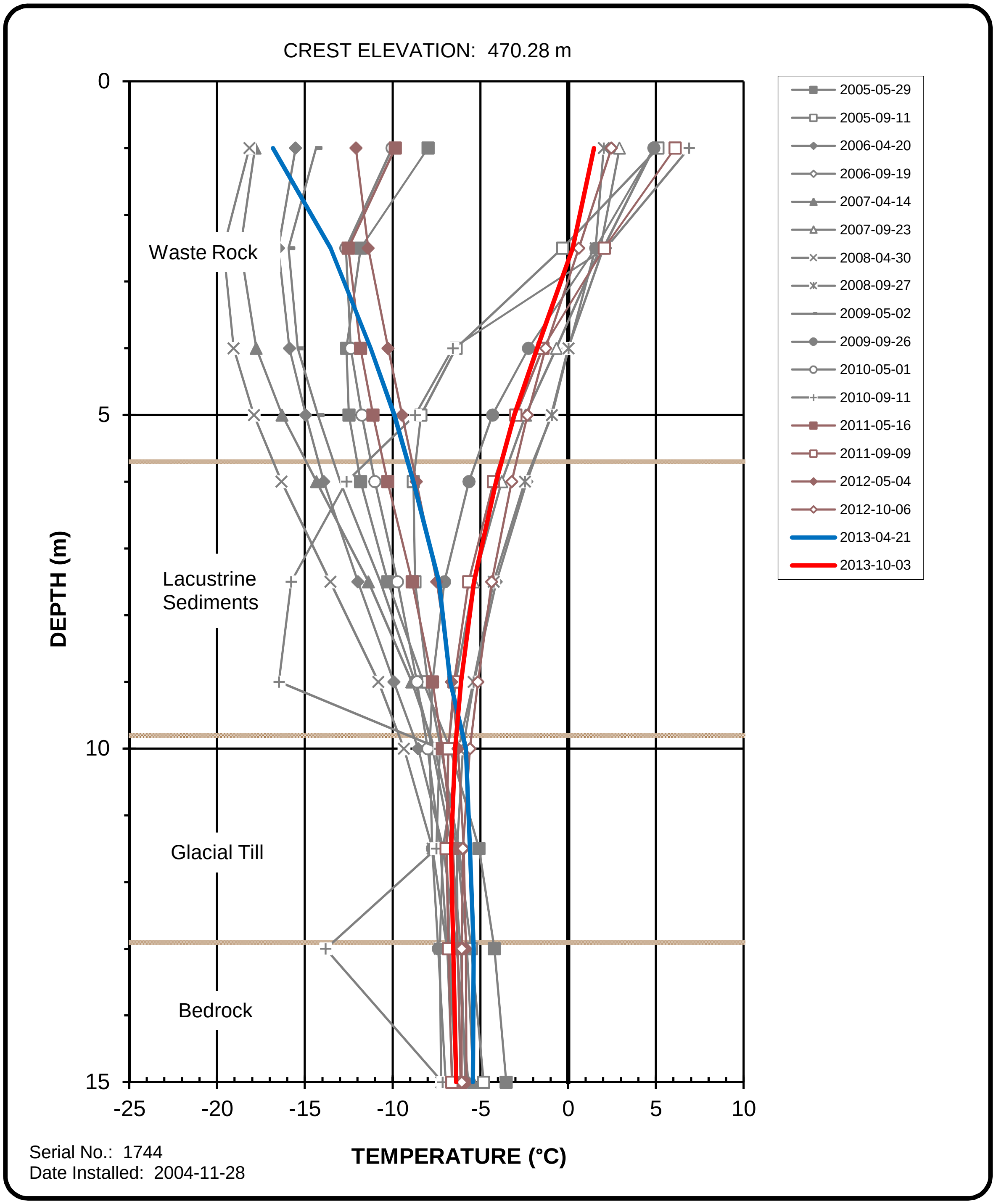


Figure 18
Ground Temperature Profile
Fox Toe Berm 3 Hump Lake Streams

TETRA TECH EBA

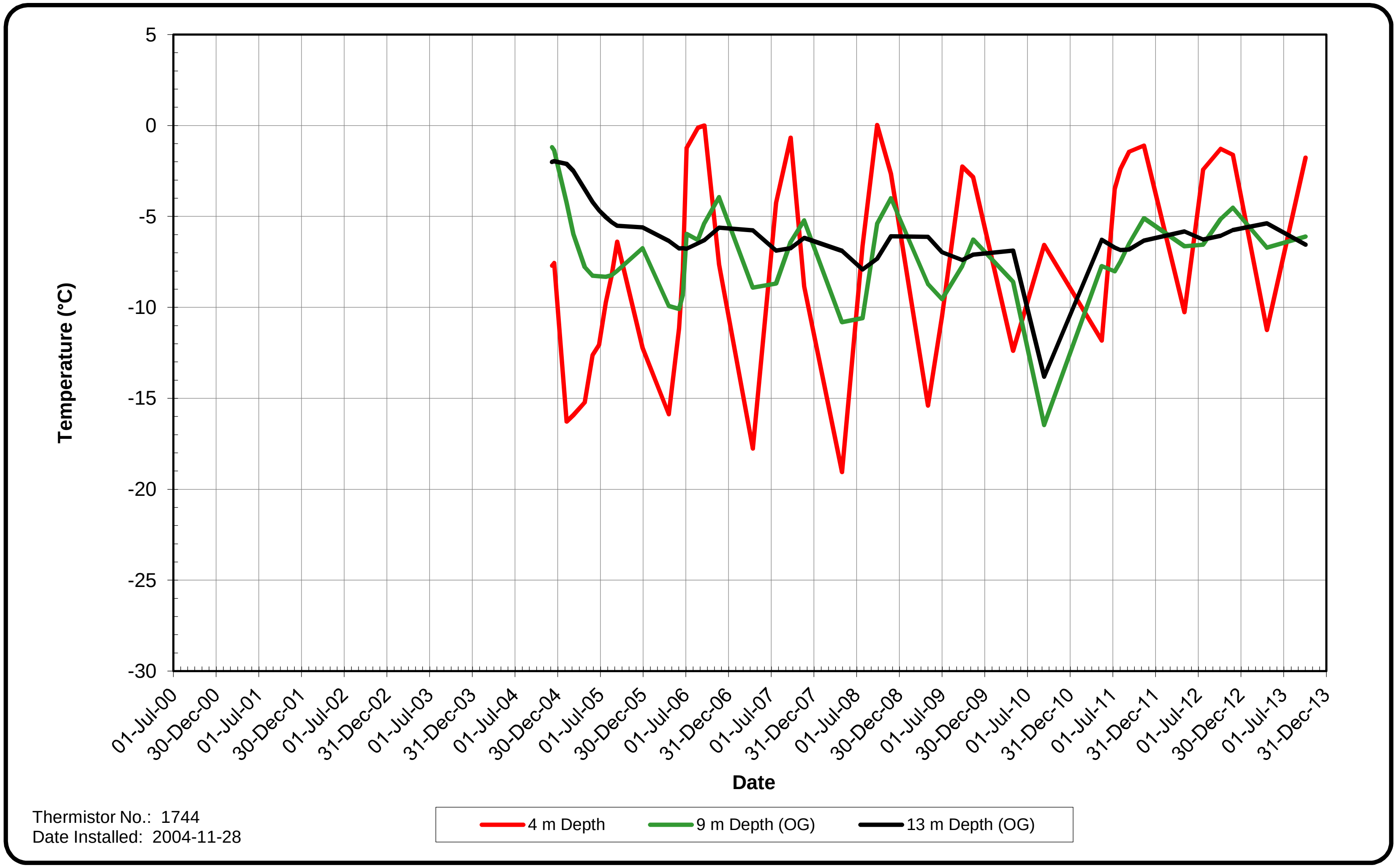


Figure 18a
Ground Temperature Profile
Fox Toe Berm Southeast Valley

TETRA TECH EBA

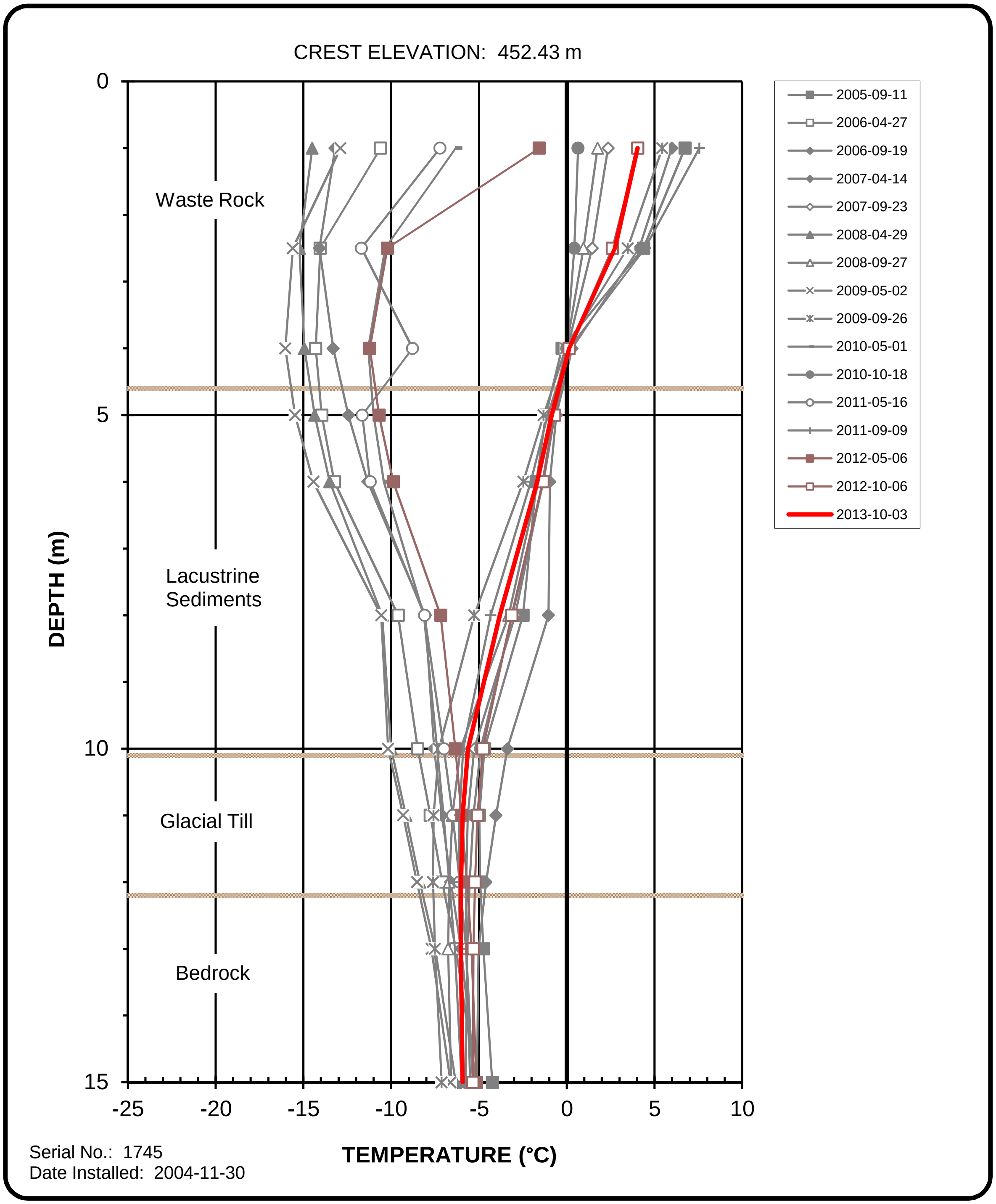


Figure 19
Ground Temperature Profile
Fox Toe Berm Fox Lake Tail

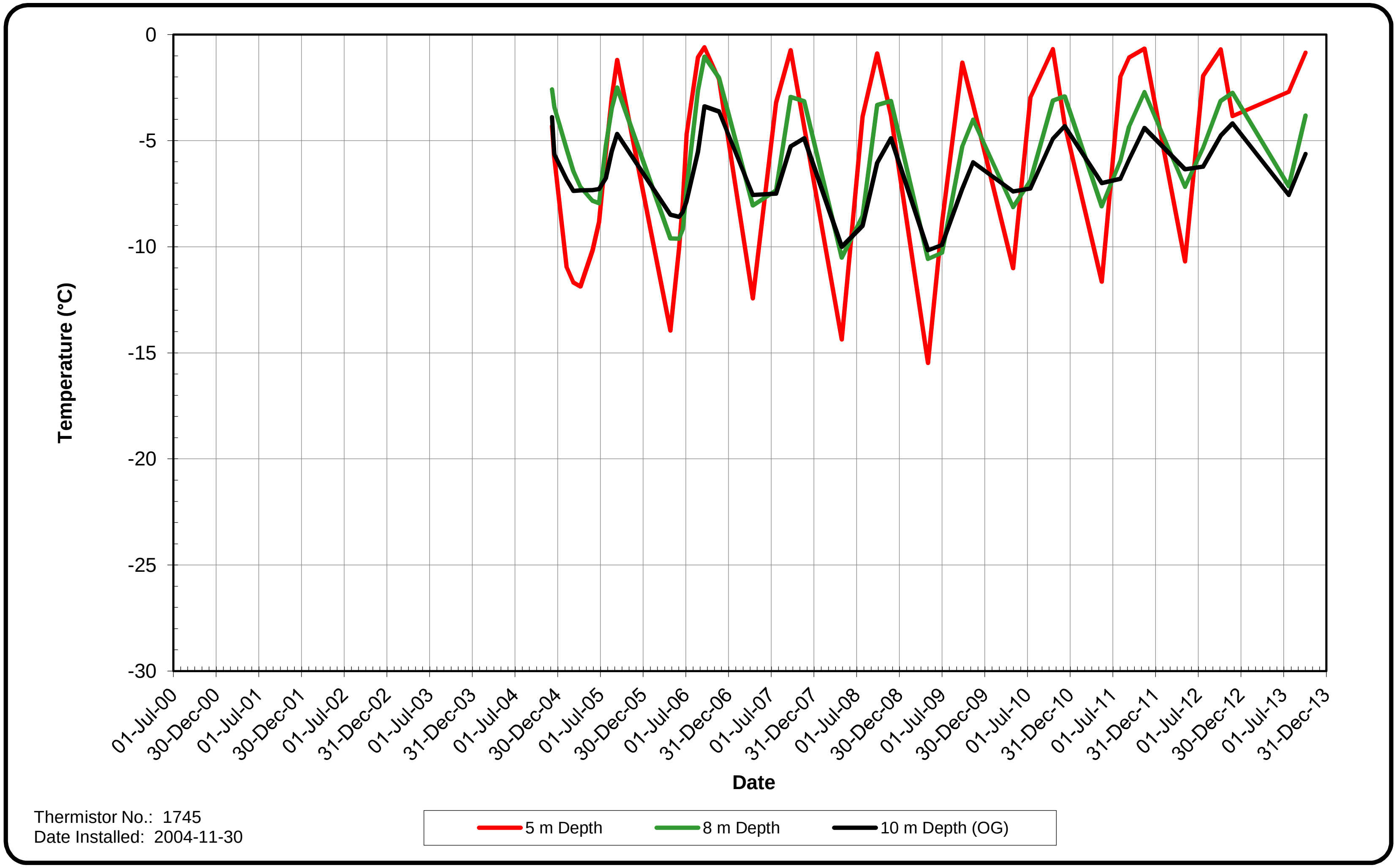
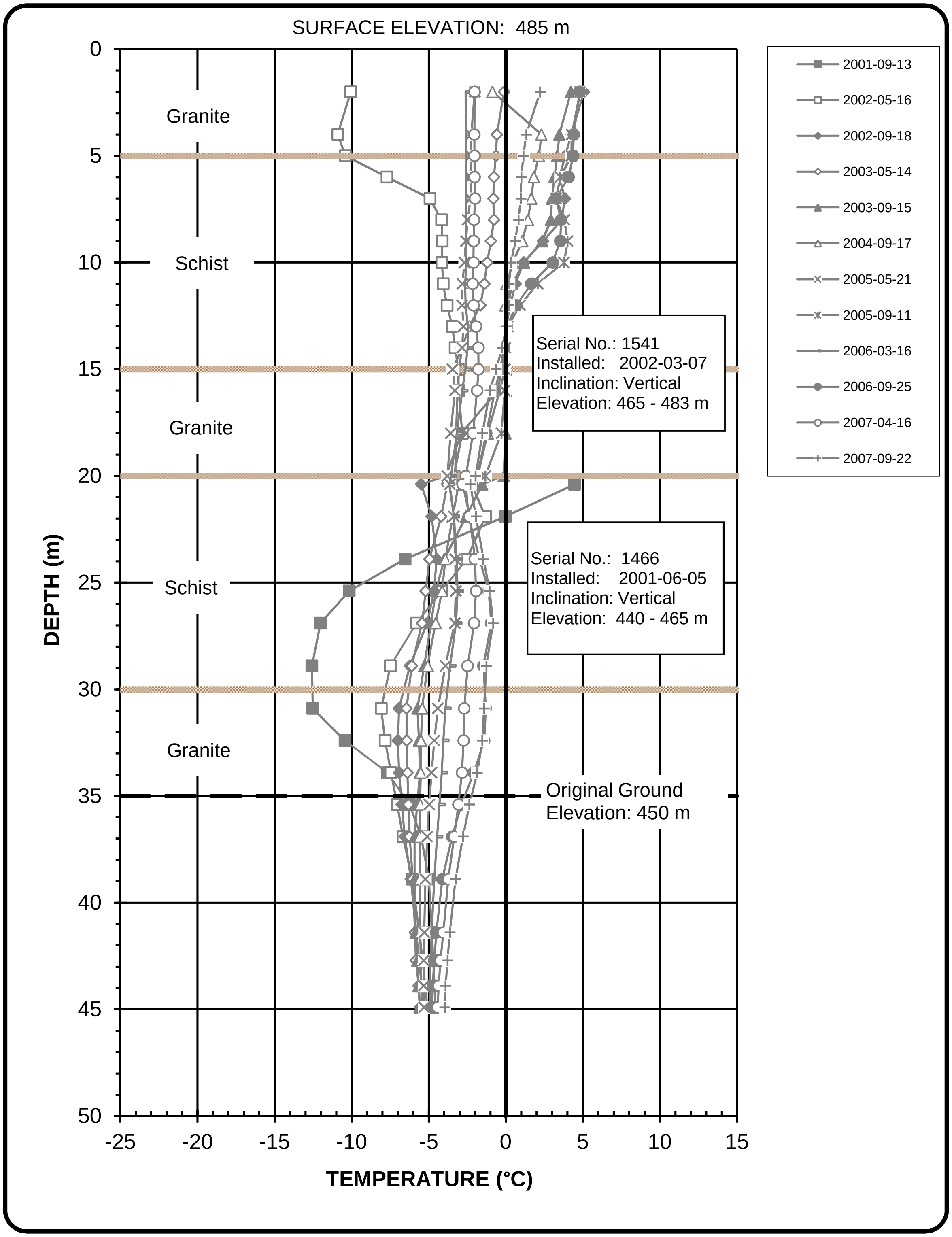
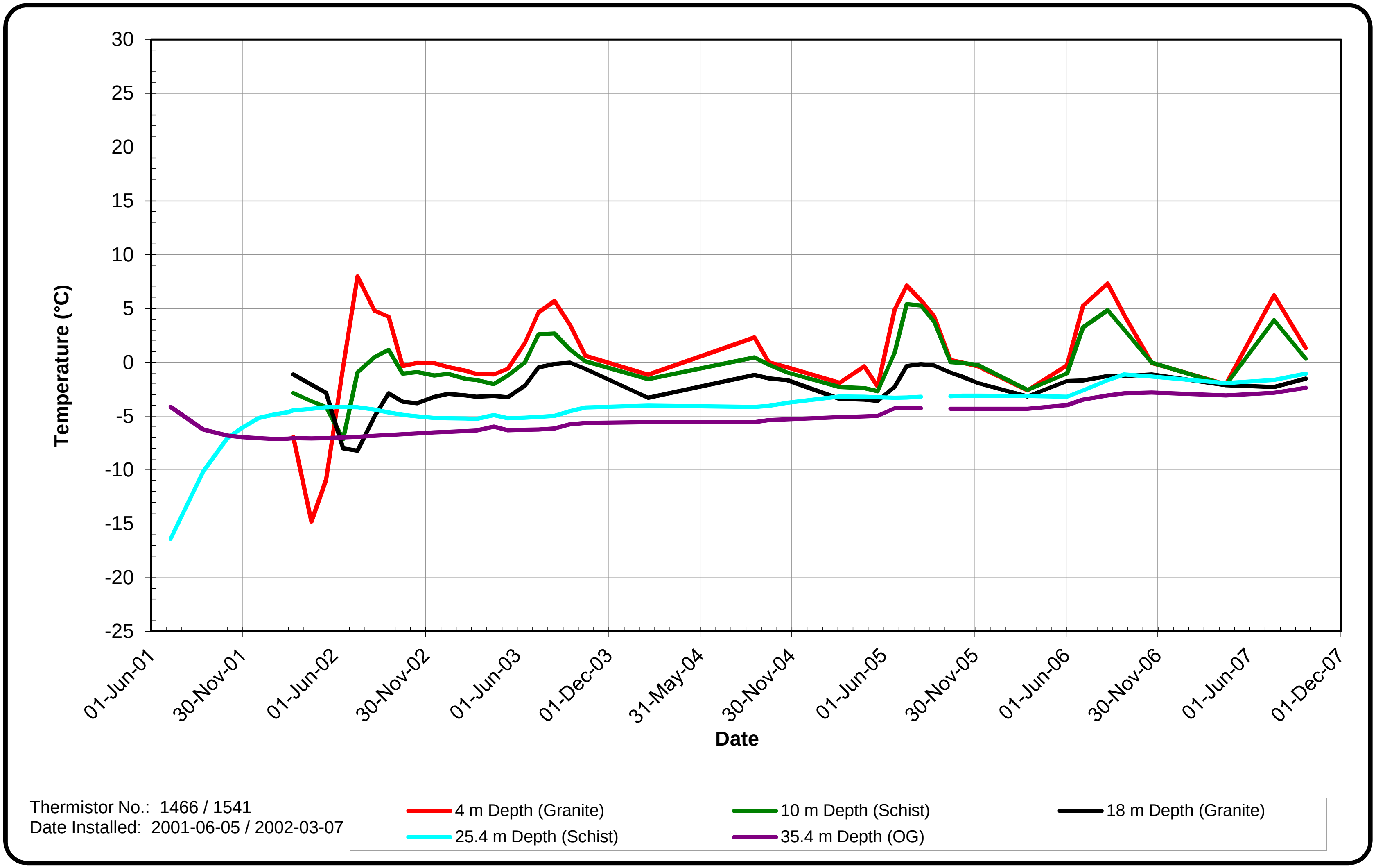


Figure 19a
Ground Temperature Profile
Fox Toe Berm Southeast Valley



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

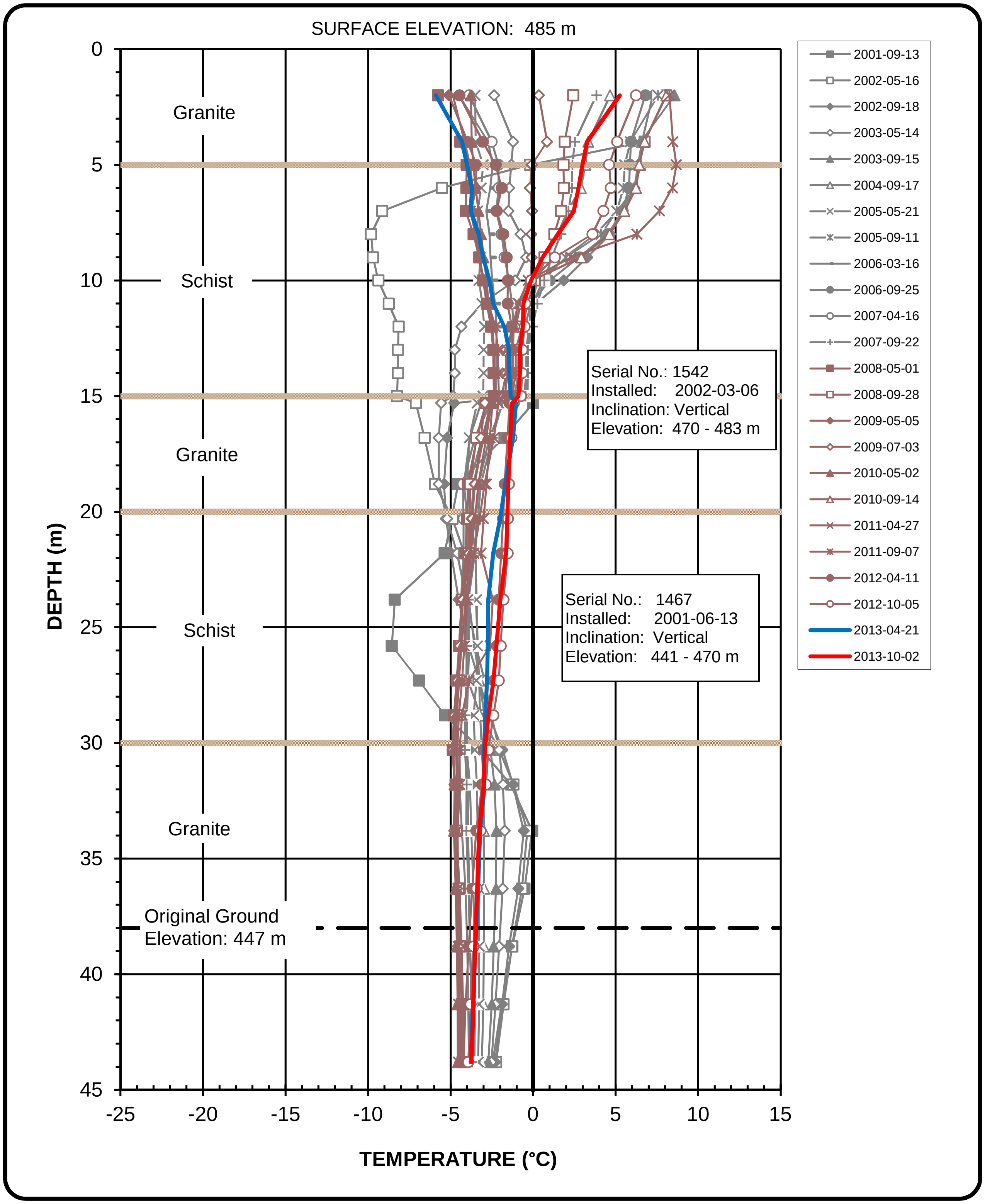
Figure 20
Ground Temperature Profile
WRP#1
Misery Waste Rock Storage Area



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

Figure 20a
Ground Temperature History
WRP#1
Misery Waste Rock Storage Area

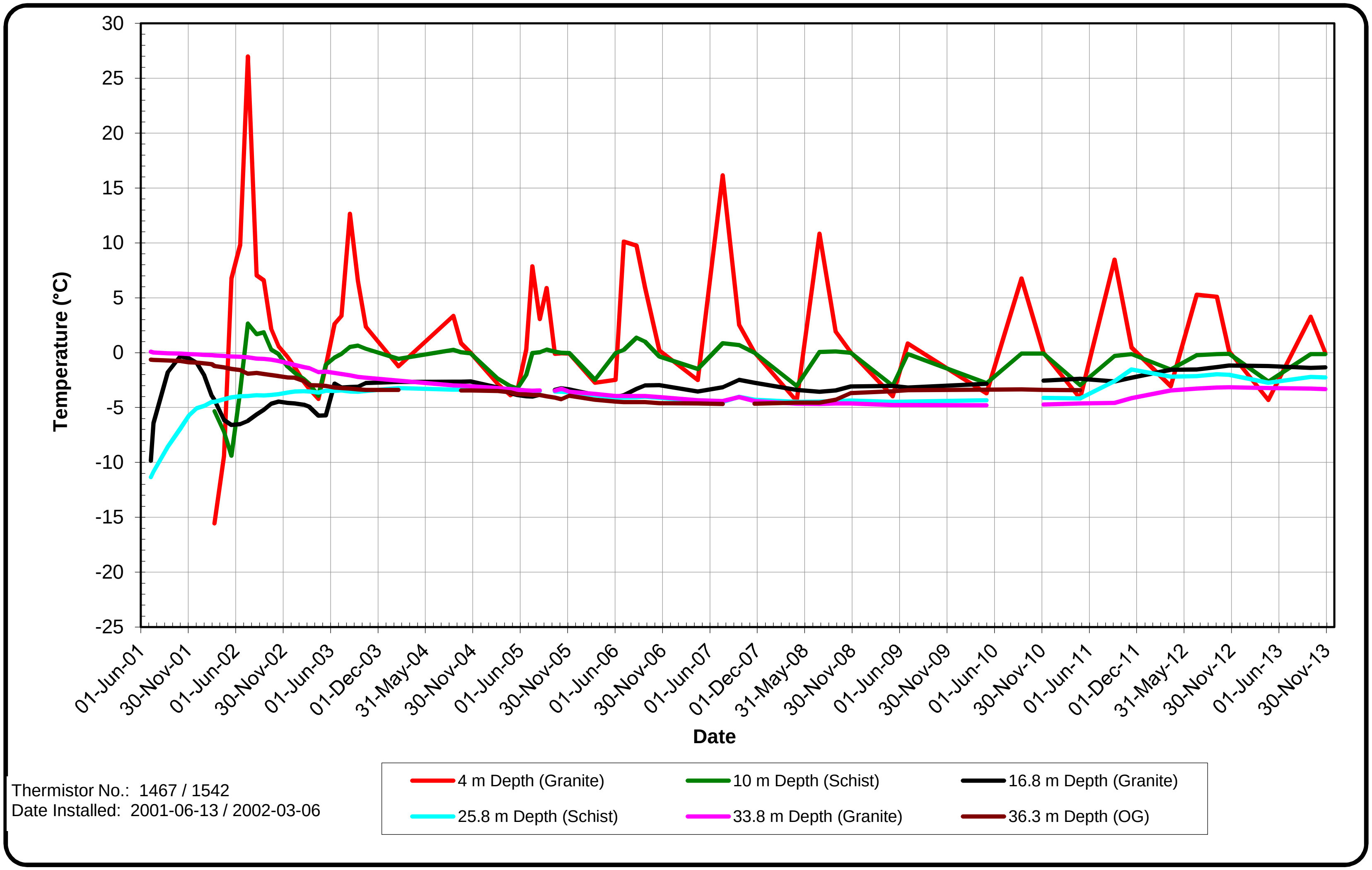
TETRA TECH EBA



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

Figure 21
Ground Temperature Profile
WRP#2
Misery Waste Rock Storage Area

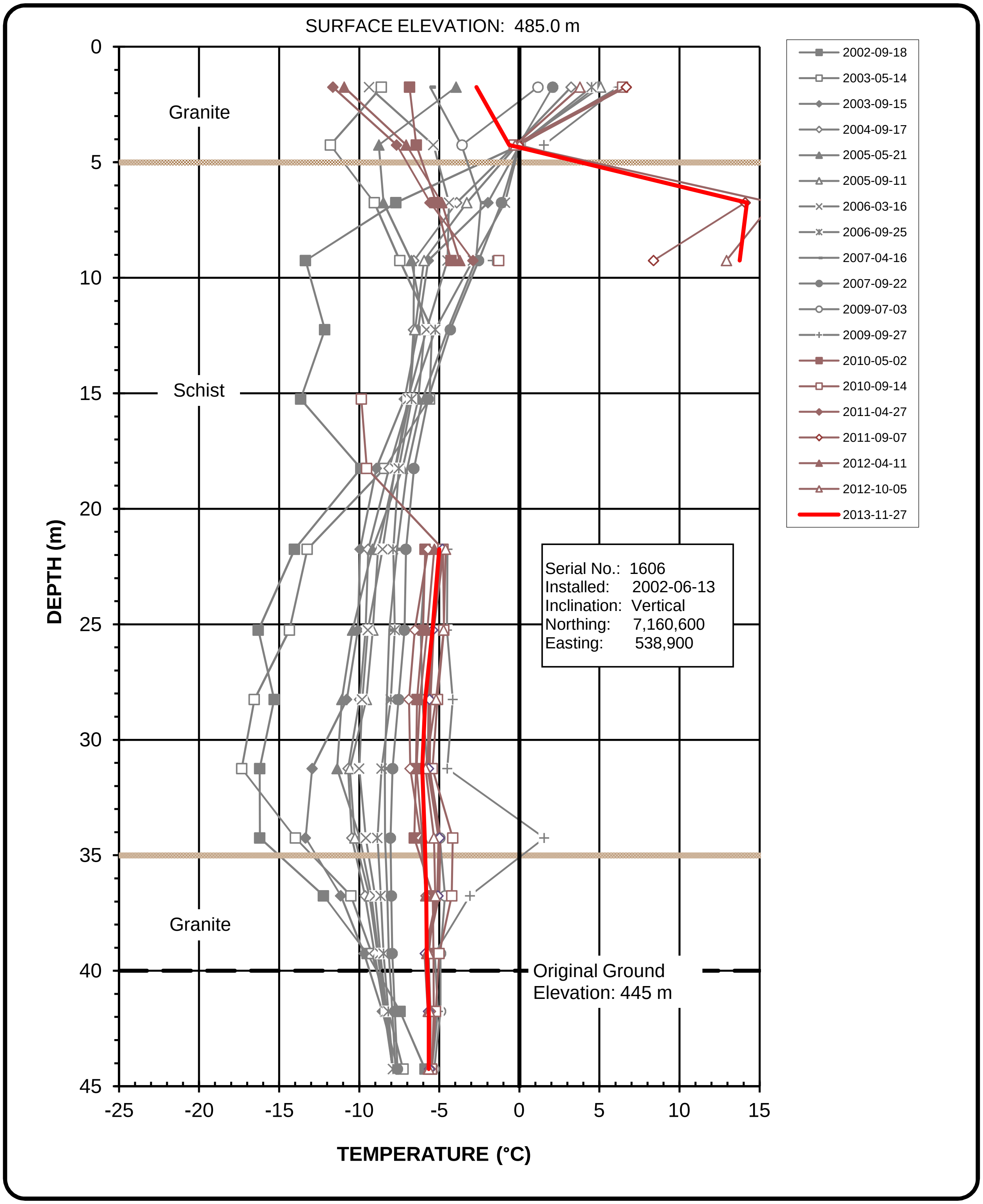
TETRA TECH EBA



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

Figure 21a
Ground Temperature History
WRP#2
Misery Waste Rock Storage Pile

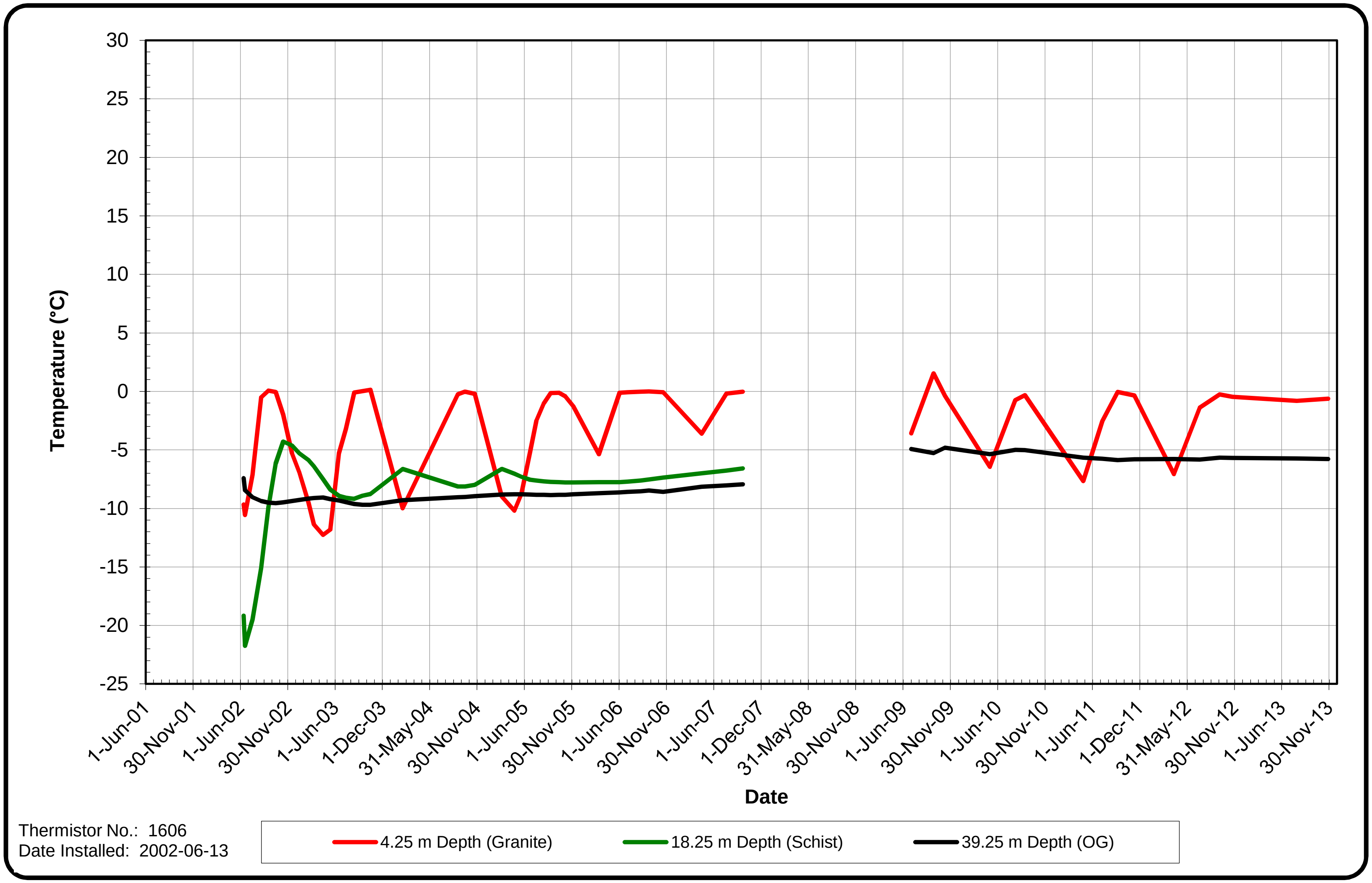
TETRA TECH EBA



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

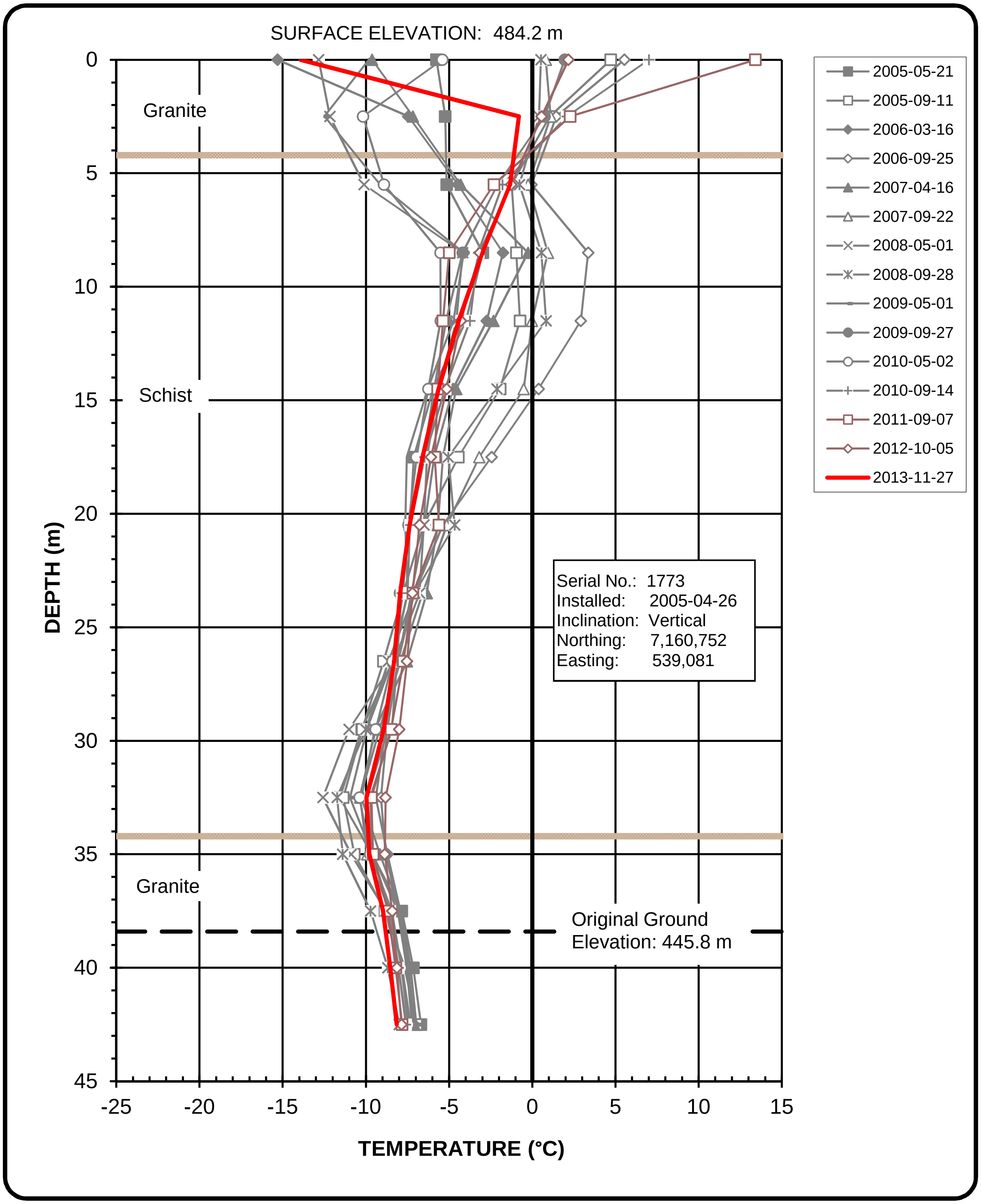
Figure 22
Ground Temperature Profile
WRP#3
Misery Waste Rock Storage Area

TETRA TECH EBA



Notes: Ground temperature instrumentation installed by BHP Billiton personnel. Stratigraphic details provided by BHP Billiton.

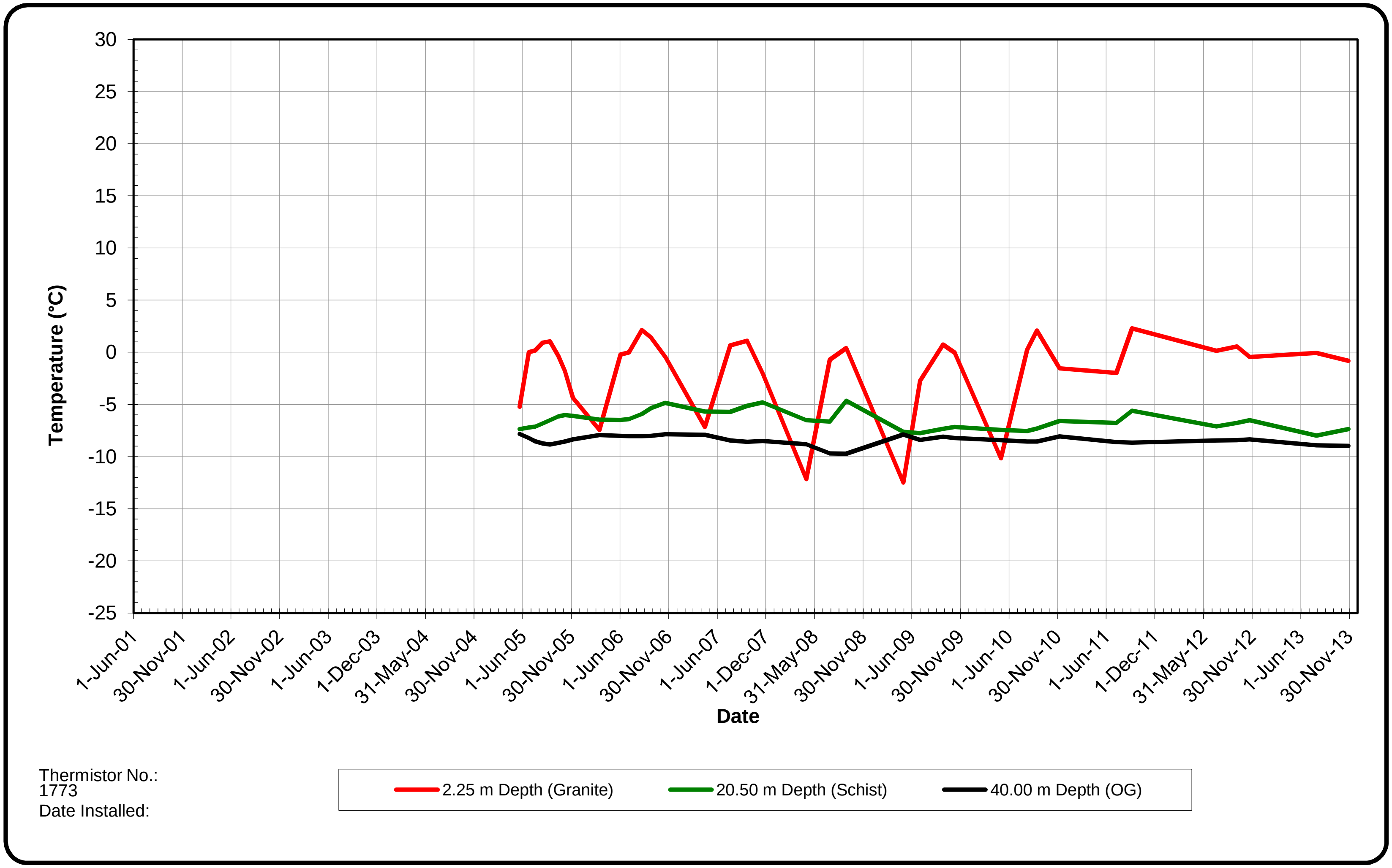
Figure 22a
Ground Temperature History
WRP#3
Misery Waste Rock Storage Area



Notes: Stratigraphic details provided by BHP Billiton.

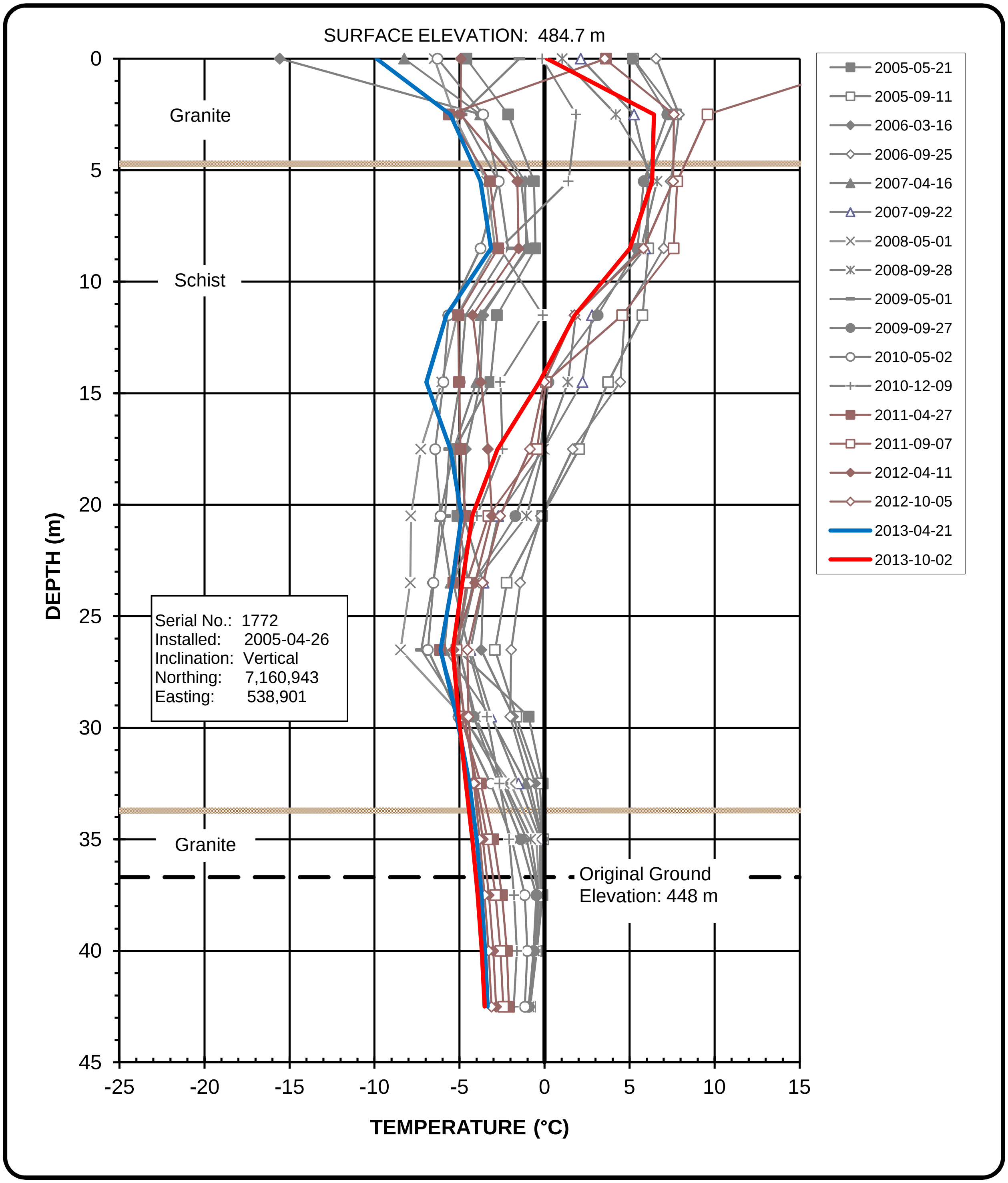
Figure 23
Ground Temperature Profile
WRP#4
Misery Waste Rock Storage Area

TETRA TECH EBA



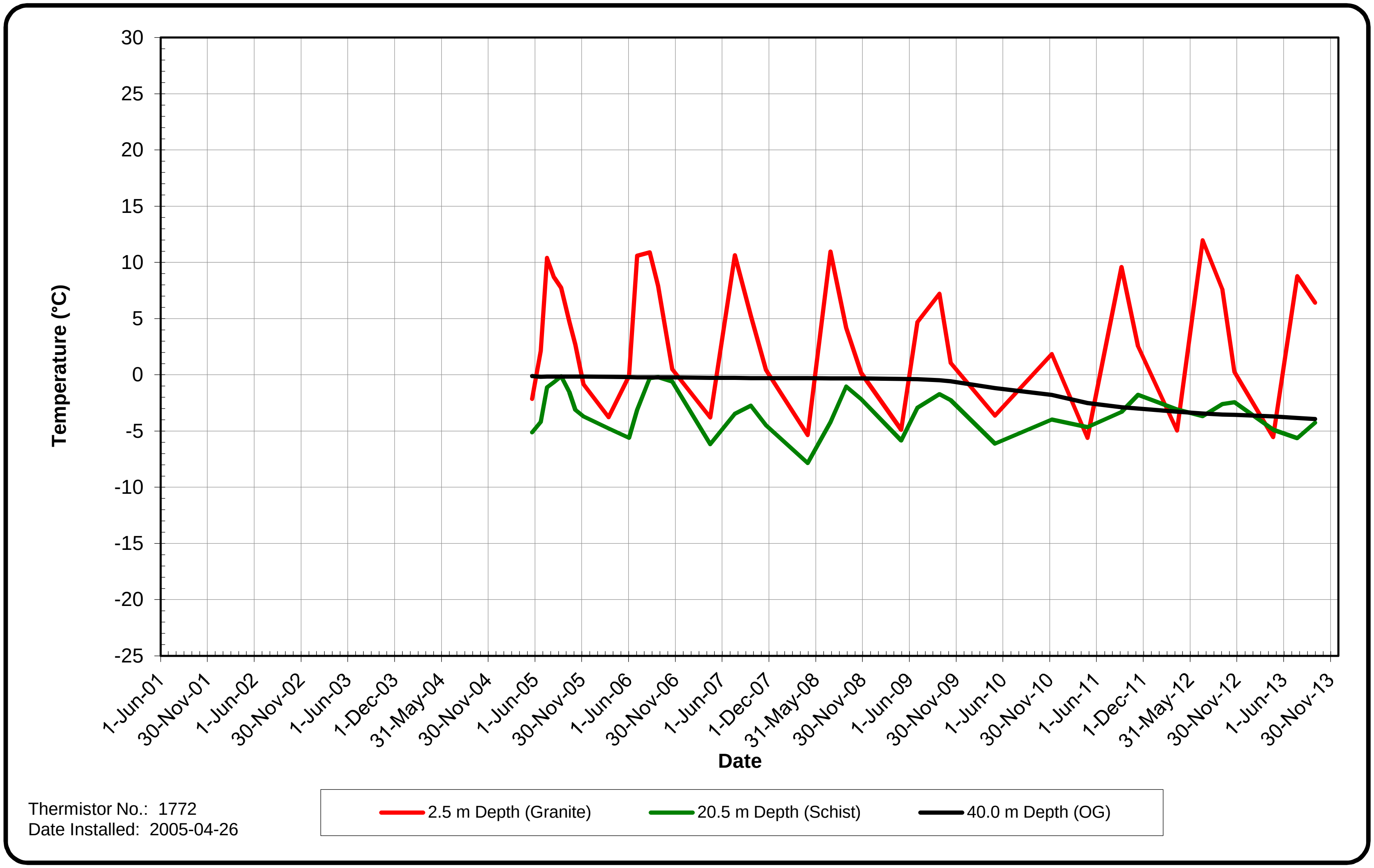
Notes: Stratigraphic details provided by BHP Billiton.

Figure 23a
Ground Temperature History
WRP#4
Misery Waste Rock Storage Area



Notes: Stratigraphic details provided by BHP Billiton.

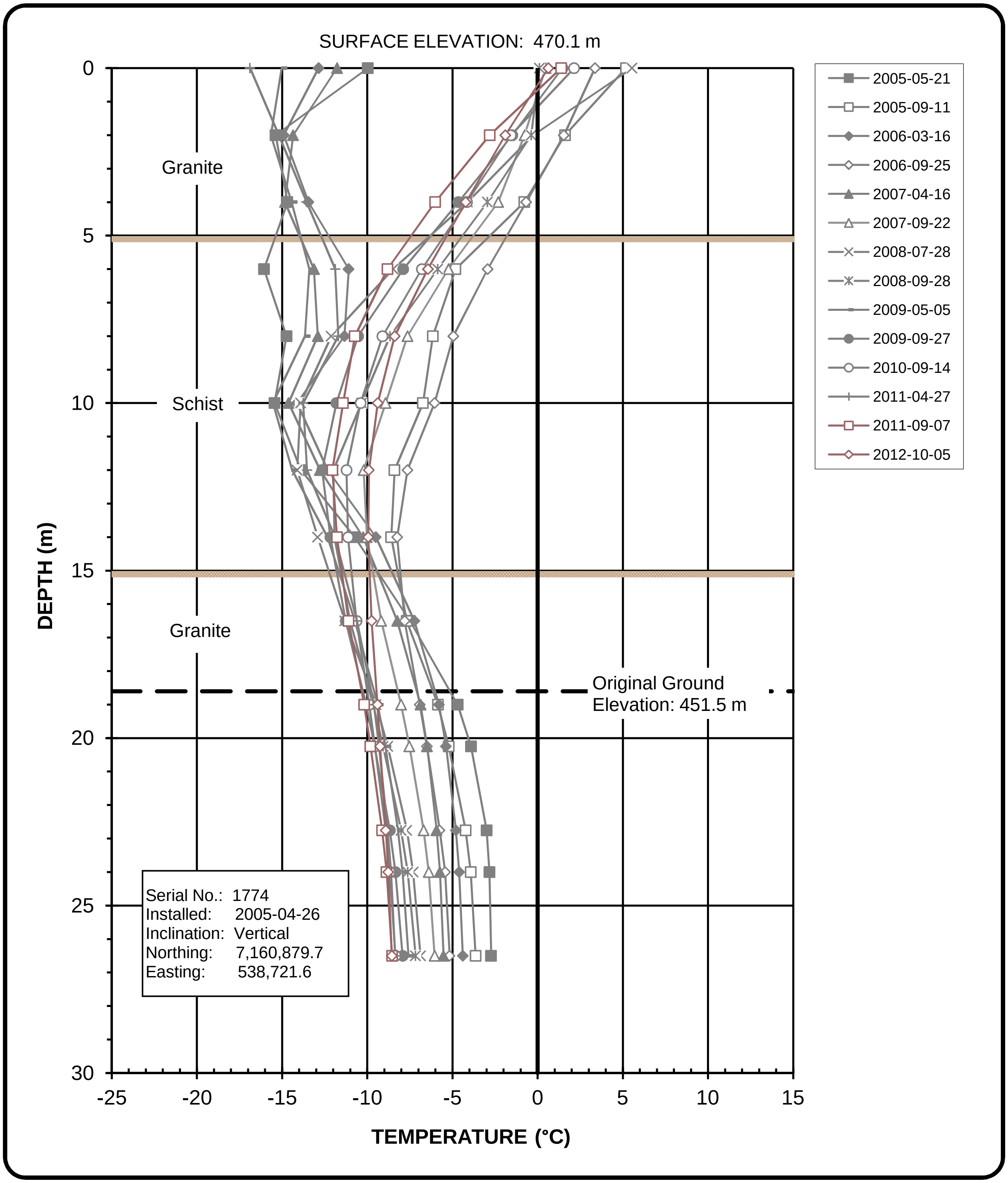
Figure 24
Ground Temperature Profile
WRP#5
Misery Waste Rock Storage Area



Notes: Stratigraphic details provided by BHP Billiton.

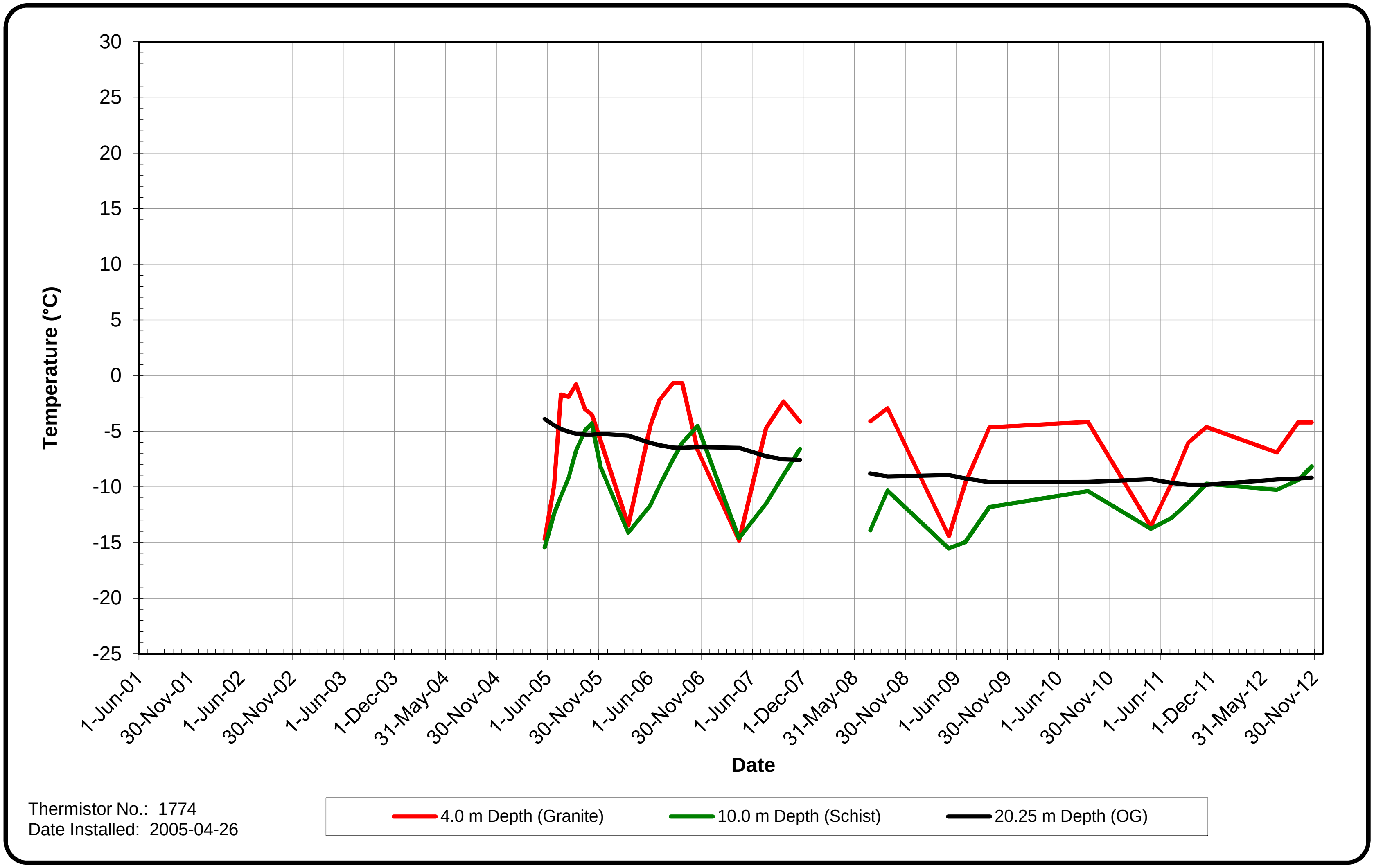
Figure 24a
Ground Temperature History
WRP#5
Misery Waste Rock Storage Area

TETRA TECH EBA



Notes: Stratigraphic details provided by BHP Billiton.

Figure 25
Ground Temperature Profile
WRP#6
Misery Waste Rock Storage Area



Notes: Stratigraphic details provided by BHP Billiton.

Figure 25a
Ground Temperature History
WRP#6
Misery Waste Rock Storage Area

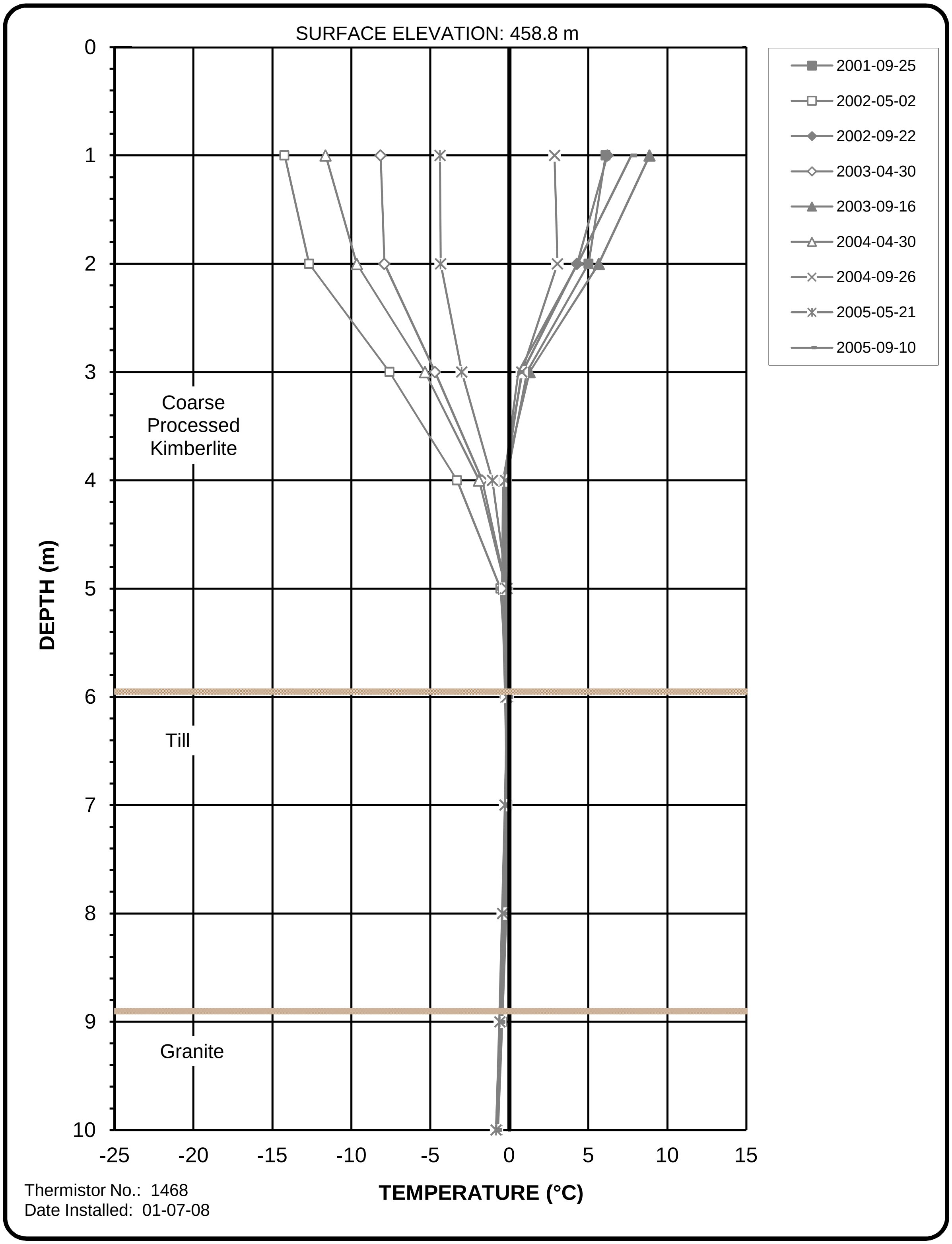


Figure 26
Ground Temperature Profile
Coarse Processed Kimberlite Storage Pile

TETRA TECH EBA

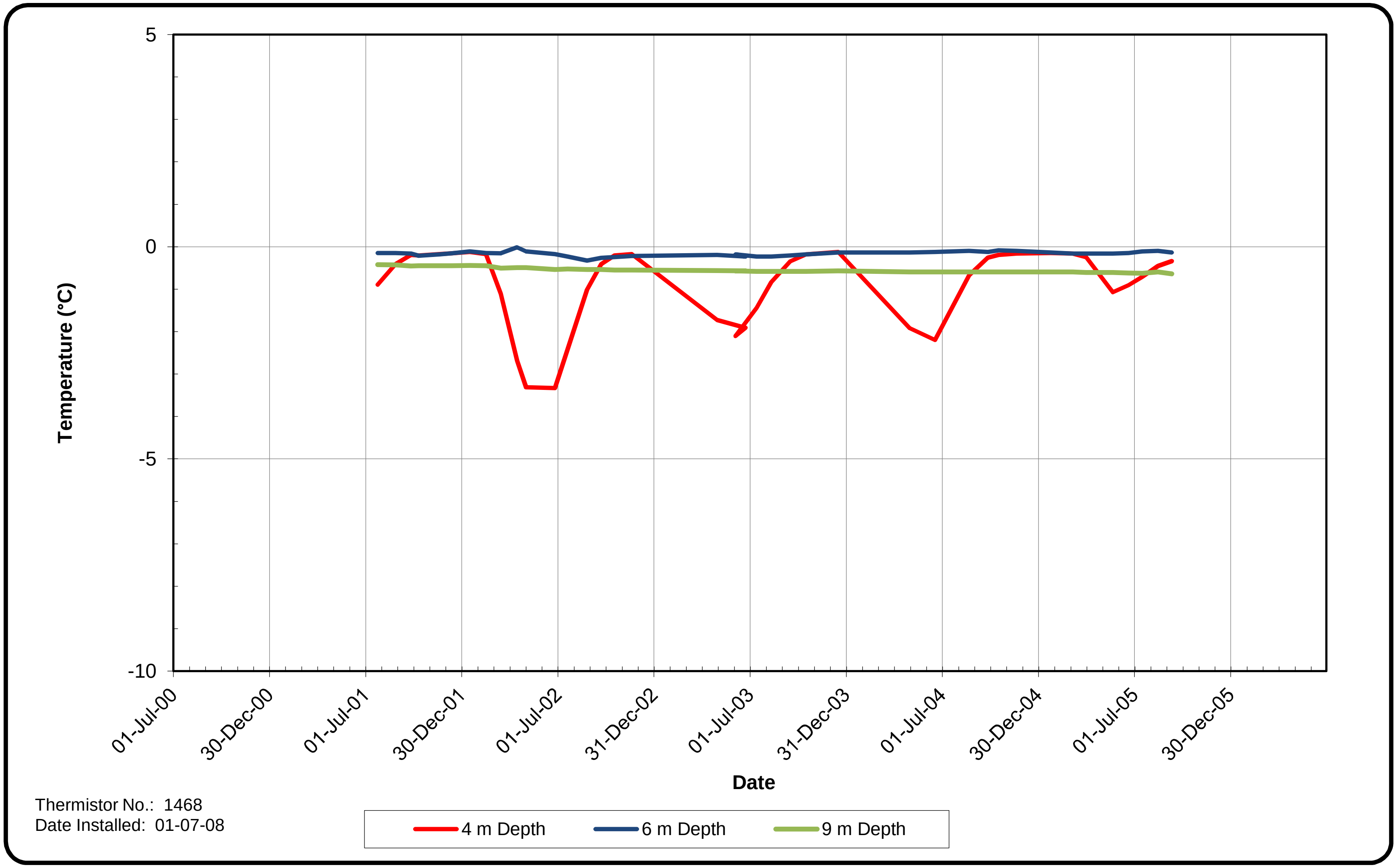


Figure 26a
Ground Temperature History
Coarse Processed Kimberlite Storage Area

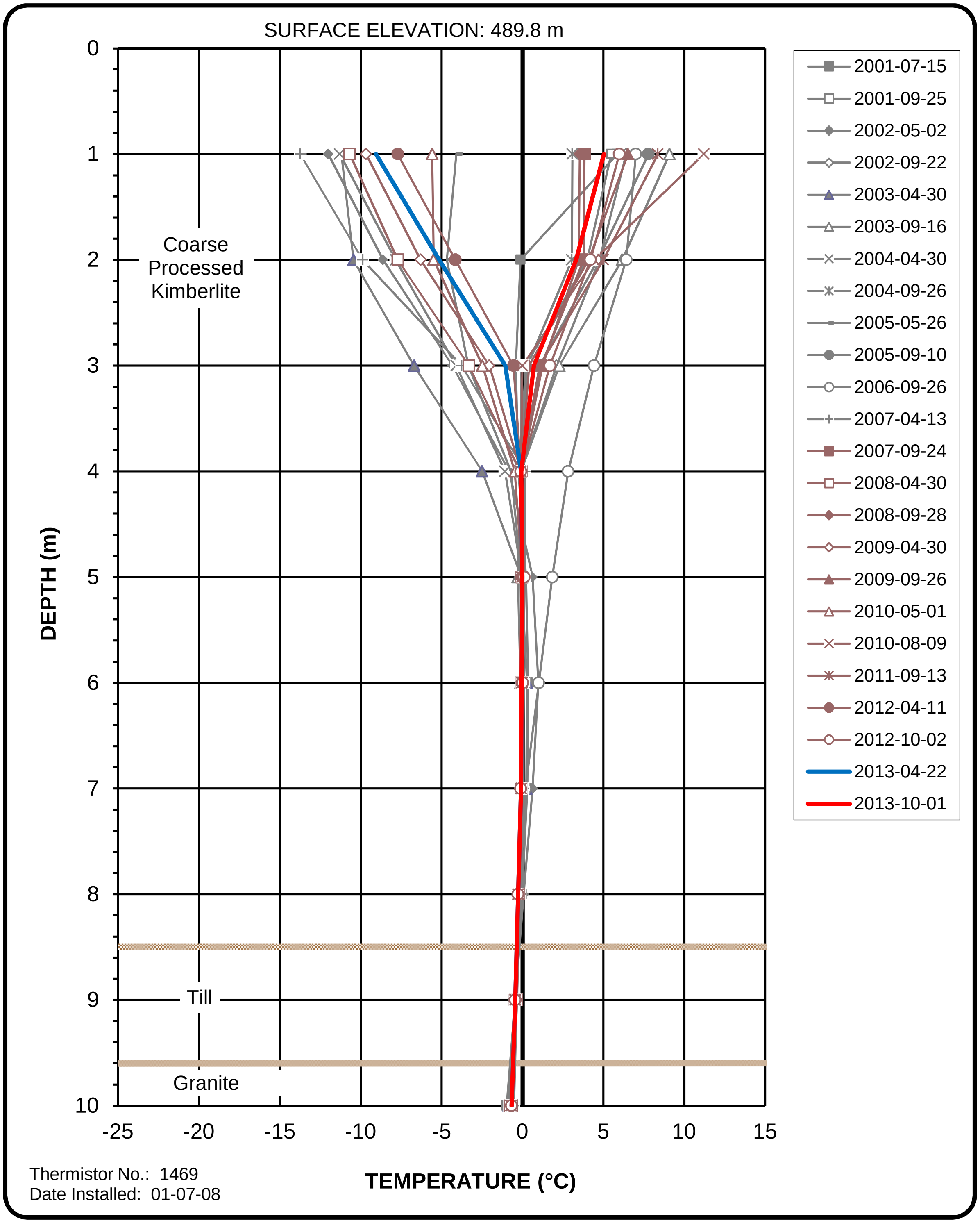


Figure 27
Ground Temperature Profile
Coarse Processed Kimberlite Storage Pile

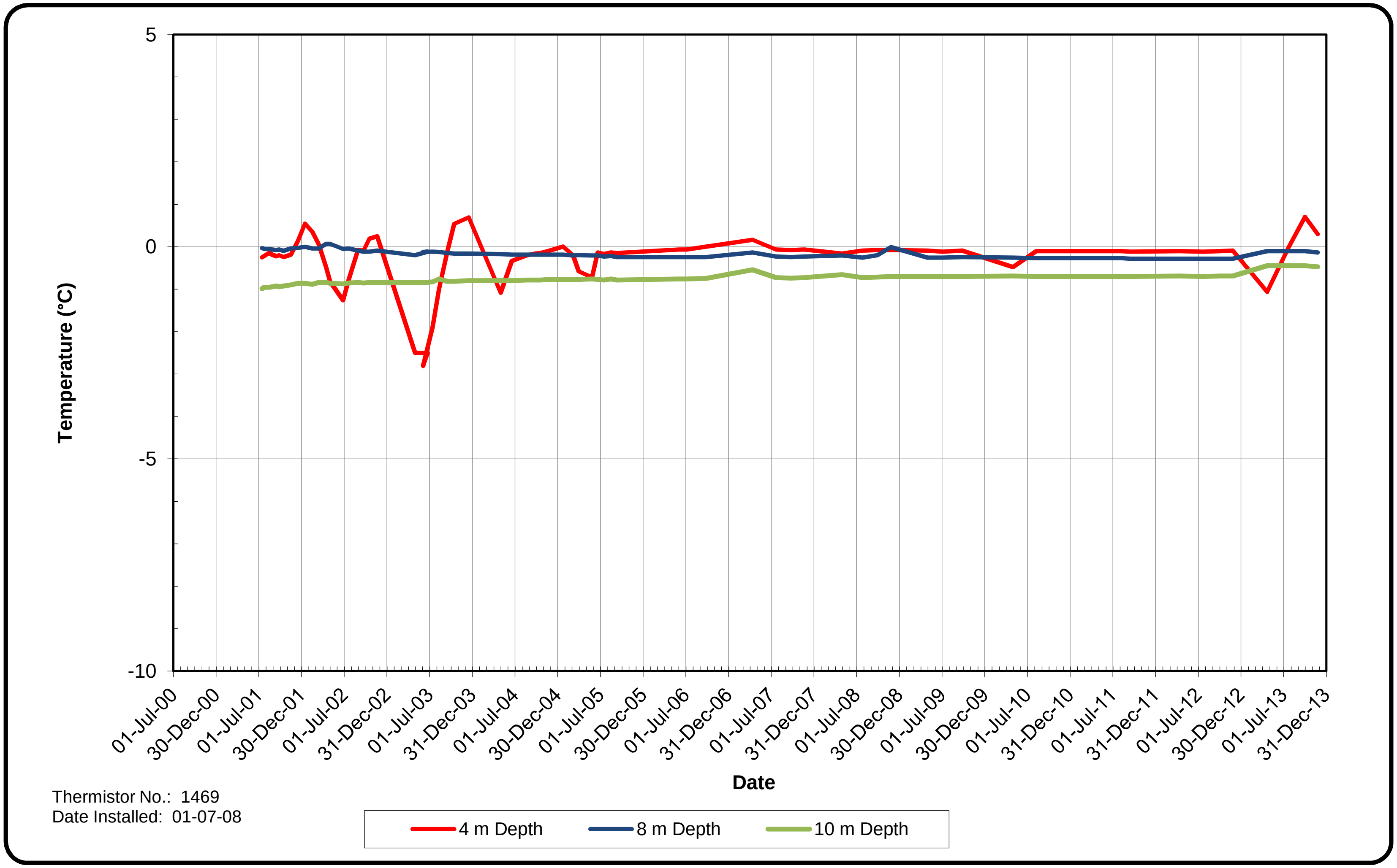


Figure 27a
Ground Temperature History
Coarse Processed Kimberlite Storage Area

TETRA TECH EBA

APPENDIX A
GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.